Critique of the 2015 Carter/Sarfati Paper Titled:

“Why the Universe does not Revolve Around the Earth: Refuting Absolute Geocentrism”

http://creation.com/refuting-absolute-geocentrism

by Robert Carter and Jonathan Sarfati

R. Sungenis: Before we begin, let me say that I have great respect for both Dr. Carter and Dr. Sarfati. Their painstaking work against Evolution is quite admirable. I also appreciate their devotion to the Bible as the inerrant word of God. I recently corresponded with Dr. Sarfati regarding Creationism in my association with the Kolber Center for the Study of Creation. At the same time, I must also say that, although Dr. Carter and Dr. Sarfati are experts in their respective fields of marine biology and chemistry, their grasp of the issues surrounding Geocentrism are not on the expert level. At many places in their paper I could only conclude that either Dr. Carter and Dr. Sarfati were ignorant of the details of the geocentric model or were misrepresenting it. In either case, it is my considered opinion that they are lacking the needed information they need to make an intelligent decision about this issue.

Introduction

Carter/Sarfati: Questions about how the universe works are not always easy to answer. For many centuries most people (scientists and philosophers included) thought the earth was at its center and that the planets, moon, sun, and stars revolved around us. This is called “geocentrism” or the “geocentric view of the universe”. It took years of painstaking work, spread out over multiple centuries, to show that this was false as an absolute claim.

R. Sungenis: Throughout their paper, Carter/Sarfati make a distinction between “geocentrism” and “absolute geocentrism.” This is necessary today because some scientists might be understood as “geocentrics” in the sense that they believe our solar system or our galaxy are in the center of the universe, as is the case with John Hartnett and Russell Humphries. Conversely, “absolute geocentrism” is the position that the Earth is the only body in the universe that does not move and is consequently the center of the universe. Absolute geocentrism has been the dominant view of astronomy/cosmology since the time of Aristotle.

It is the position of Carter/Sarfati that absolute geocentrism has been falsified. It is my contention that it has not only not been falsified, it never will be. As historian Lincoln Barnett has recognized in a book endorsed and Foreworded by Albert Einstein:

…we can’t feel our motion through space, nor has any physical experiment ever proved that the Earth actually is in motion.1

In his Foreword, Einstein writes:

Lincoln Barnett’s book represents a valuable contribution to popular scientific writing. The main ideas of the theory of relativity are extremely well presented. Moreover, the present state

1 Lincoln Barnett, The Universe and Dr. Einstein, 1948, 1960, p. 73.
of our knowledge in physics is aptly characterized. The author shows how the growth of our factual knowledge...has led to the present situation which is characterized...by an uncertainty concerning the choice of the basic theoretical concepts.

The “uncertainty of basic theoretical concepts” is inherent in the science of Relativity that Einstein espoused, which is the same science espoused by Carter/Sarfati. Relativity admits that it cannot know if the Earth is motionless or not, and thus the “uncertainty.” As Einstein himself admitted:

The struggle, so violent in the early days of science, between the views of Ptolemy and Copernicus would then be quite meaningless. Either coordinate system could be used with equal justification. The two sentences: “the sun is at rest and the Earth moves,” or “the sun moves and the Earth is at rest,” would simply mean two different conventions concerning two different coordinate systems.2

In addition to the relationship between the sun and the Earth, Einstein also admitted that he could not tell if the universe was revolving around the Earth or the Earth was rotating in a fixed universe. As he notes in both 1914 and 1950:

We need not necessarily trace the existence of these centrifugal forces back to an absolute movement of K' [Earth]; we can instead just as well trace them back to the rotational movement of the distant ponderable masses [stars] in relation to K' whereby we treat K' as ‘at rest.’…On the other hand, the following important argument speaks for the relativistic perspective. The centrifugal force that works on a body under given conditions is determined by precisely the same natural constants as the action of a gravitational field on the same body (i.e., its mass), in such a way that we have no means to differentiate a ‘centrifugal field’ from a gravitational field….This quite substantiates the view that we may regard the rotating system K' as at rest and the centrifugal field as a gravitational field….The kinematic equivalence of two coordinate systems, namely, is not restricted to the case in which the two systems, K [the universe] and K' [the Earth] are in uniform relative translational motion. The equivalence exists just as well from the kinematic standpoint when for example the two systems rotate relative to one another.3

The principle of equivalence was not limited to Einstein’s early use of Mach’s mechanics, but also much later. In a 1950 paper the same principle appears, only K and K' are now A and I:

Let A be a system uniformly accelerated with respect to an “inertial system.” Material points, not accelerated with respect to I, are accelerated with respect to A, the acceleration of all the points being equal in magnitude and direction. They behave as if a gravitational field exists with respect to A, for it is a characteristic property of the gravitational field that the acceleration is independent of the particular nature of the body. There is no reason to exclude the possibility of interpreting this behavior as the effect of a “true” gravitational field (principle of equivalence).4

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Other scientists who interpret Einstein’s theories conclude the same:

According to Einstein, the argument over whether the earth turns around or the heavens revolve around it, is seen to be no more than an argument over the choice of reference frames. There is no frame of reference from which an observer would not see the effects of the flattening of the poles. Thus in frame number 1 (the earth turns round while the sky is at rest), the centrifugal force is a consequence of the earth’s motion (uniform acceleration) relative to the heavens. This causes the flattening. In the latter frame, number 2 (the sky rotates and the earth stands still), the centrifugal force should be understood as being an effect of “the rotating heavens,” which is generating a gravitational field that causes the flattening of the poles. The two explanations are equivalent as there is equivalence between inertial and gravitational mass.\(^5\)

And Max Born (which Carter/Sarfati will also quote but misrepresent much later in their paper):

...Thus we may return to Ptolemy’s point of view of a ‘motionless Earth.’ This would mean that we use a system of reference rigidly fixed to the Earth in which all stars are performing a rotational motion with the same angular velocity around the Earth’s axis...one has to show that the transformed metric can be regarded as produced according to Einstein’s field equations, by distant rotating masses. This has been done by Thirring. He calculated a field due to a rotating, hollow, thick-walled sphere and proved that inside the cavity it behaved as though there were centrifugal and other inertial forces usually attributed to absolute space. Thus from Einstein’s point of view, Ptolemy and Copernicus are equally right. What point of view is chosen is a matter of expediency.\(^6\)

Carter/Sarfati: Today, we accept a “geokinetic” (moving-earth) view based on the work of Newton and Einstein. For the student of history and/or science, how we came to the modern view is an amazing exploration of how things work and a testimony to the amazing ability to reason that God uniquely put into people.

R. Sungenis: As we noted above about Einstein, the statement of Carter/Sarfati is false. But it is also false regarding Newton. Although Newton certainly sought to defend the geokinetic system, as noted in this quote from his 1684 Scholium:

\(^5\) “Einstein’s Ether: D. Rotational Motion of the Earth,” Galina Granek, Department of Philosophy, Haifa University, Mount Carmel, Haifa 31905, Israel, Apeiron, Vol. 8, No. 2, April 2001, p. 61

Thence indeed the Copernican system is proved a priori. For if a common center of gravity is computed for any position of the planets, it either lies in the body of the Sun or will always be very near it…

…in the end Newton realized, especially after consultation with Christiaan Huygens, that his laws of motion could be applied more expansively. In doing so, it would allow the solar system’s center of mass to be near the sun, but also allow the Earth to be the center of mass of a much larger system. As such, the sun, with its planets, would revolve around a fixed Earth as described in the Tychonian system.

Certainly, if one confines Newton’s mechanics to a solar system independent of the rest of the universe, then, of course, one will end up with an Earth revolving around the more massive sun, since there is no other force to counteract the gravity of the sun. But when one includes the rest of the universe, not only Mach and Einstein agree that the universe could be revolving around a fixed Earth, but so does Newton.

For the geocentric universe to be permitted, Newton stipulated that an additional force outside the solar system must work in tandem with the gravitational forces inside the solar system. Several modern physicists have acknowledged Newton’s alternative, one of them being the Nobel laureate, Steven Weinberg. Here is how Weinberg describes it in his 2015 book, To Explain the World:

If we were to adopt a frame of reference like Tycho’s in which the Earth is at rest, then the distant galaxies would seem to be executing circular turns once a year, and in general relativity this enormous motion would create forces akin to gravitation, which would act on the Sun and planets and give them the motions of the Tychonic theory. Newton seems to have had a hint of this. In an unpublished ‘Proposition 43’ that did not make it into the Principia, Newton acknowledges that Tycho’s theory could be true if some other force besides ordinary gravitation acted on the Sun and planets.7

Weinberg’s reference to “forces akin to gravitation” refers to inertial forces, such as centrifugal, Coriolis and Euler forces. Using Einstein’s General Relativity as the sanction, Weinberg indicates that, in the view of modern physics, a universe rotating around a fixed Earth will create inertial forces that mimic the force of gravity. Then, as the universe’s inertial forces meet the gravitational forces in our solar system, both will contribute to how the sun and planets will move with respect to each other. The forces will counteract each other and create a balance. We will show how this works later in this critique.

Weinberg also notes that the inclusion of forces outside the solar system that will allow Tychonian geocentrism are specified in Newton’s Proposition 43, which was originally planned to be added to page 510, the last page of The Principia. In Proposition 43 Newton says:

In order for the Earth to be at rest in the center of the system of the Sun, Planets, and Comets, there is required both universal gravity and another force in addition that acts on all bodies equally according to the quantity of matter in each of them and is equal and opposite to the accelerative gravity with which the Earth tends to the Sun…

For, such a force, acting on all bodies equally and along parallel lines, does not change their position among themselves, and permits bodies to move among themselves through the force of universal gravity in the same way as if it were not acting on them.

Since this force is equal and opposite to its gravity toward the Sun, the Earth can truly remain in equilibrium between these two forces and be at rest. And thus celestial bodies can move around the Earth at rest, as in the Tychonic system.

Whereas today some physicists wishing to advance geokineticism seek to confine Newton’s physics to the solar system and thereby exclude any external forces coming from the universe, this results in having to regard inertial forces as “fictitious”; mere effects that only appear when objects are accelerated.

Conversely, by expanding Newton’s mechanics to the rest of the universe – which, in Newton’s case, means that his Absolute Space will now rotate around a fixed Earth – the inertial forces created by the rotation are real forces that are caused by the mass in the universe. In other words, they are forces that actually cause things to accelerate, rather than being merely effects of acceleration.

In this way, the universe’s inertial forces contribute to the movement of everything from the revolutions of the celestial bodies to the directions of hurricanes on Earth and the turning of the Foucault Pendulum. Inertial forces will likewise pull the planets around the sun, and pull the sun and moon around the Earth.

As noted in Newton’s Proposition 43, all of these movements are permitted by Newton’s physics and confirmed by modern physics. In fact, having real inertial forces is better for Newtonian physics, since without them Newton never possessed a physical explanation for what causes the planets to continue to accelerate around the sun without eventually being pulled into the sun.

In addition to Newton’s Proposition 43 allowing a geocentric universe, his mechanics also show that the Earth will have no inclination to rotate. When the gravitational and inertial forces are balanced around a center of mass, they cannot generate a torque, and thus the Earth will remain absolutely motionless. This state of rest is calculated in the below equation. As noted by one science reference:

If the reference point R is chosen so that it is the center of mass, then the resultant torque (T) is zero. Because the resultant torque is zero the body will move as though it is a particle with its mass concentrated at the center of mass. By selecting the center of gravity as the reference point for a rigid body, the gravity forces will not cause the body to rotate, which means the weight of the body can be considered to be concentrated at the center of mass.

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8 Latin: Ut Terra quiescat in centro Systematis Solis Planetarum & Cometarum, requiritur et gravitas universalis, et alia insuper vis quae agit in omnia coropora aequaliter pro quantitate materiae in ipsis et aequalis est gravitati acceleratrici qua Terra tendit in Solem, eique contraria est, tendendo secundum lineas parallelas in plagam eandem cum linea quae ducitur a centro Solis ad centrum Terrae...Nam talis vis in corpora omnia aequaliter & secundum lineas parallelas agendo situm eorum inter se non mutat sed sinit corpora eodem modo per vim gravitatis universalis inter se moveri, ac si non ageret in cadem. Terra vero, cum haec vis gravitati ejus in Solem aequalis sit & contraria, in aequilibrio inter has duas vires manere potest et quiescere. Et sic corpora caelestia circa Terram quiescentem moveri possunt ut in Systemate Tychonico.
Carter/Sarfati: We live in a created universe, meaning its existence did not come about through naturalistic processes alone. We also live in a well-ordered universe; meaning it behaves according to a set of rules. This is consistent with it being created by an ultimate Lawgiver, who is not fickle and acts in a consistent manner, according to His very nature (c.f. 1 Corinthians 14:33, James 1:17). Therefore, we can explore the way things work and expect rational results from our experiments.

However, it is far more difficult to take these experiments and use them to explain the origin of everything. When a person tries to predict backwards to infinity, this type of science breaks down. Philosophically, there are paradoxes waiting around every corner. For example, we are either in a steady-state universe that defies the 2nd Law of Thermodynamics, or we are in a universe that has a beginning but without a cause. Scientifically, we see how appeals to big bang physics have lead to much speculation, including inflation theory, dark matter, dark energy, the fine tuning of numerous constants in order to get the models pointing in the right direction, etc. Therefore, even after we have learned all this about the mechanics of the universe, once we begin trying to explain how it all began we get into the realm of faith. True, there are still puzzles to be explained in the “young-earth” position, but since evolutionists explain away their puzzles with ‘it’s science’s job to solve these puzzles’, the same allowances should be made for creationist scientists.

R. Sungenis: Agreed.

Carter/Sarfati: The question about whether or not earth is at the center is not as easy to answer as the “flat earth” question. Not only are these two ideas not the same, but no significant evidence exists for flat earth beliefs among scientists going back to the Greeks. Indeed, a Greek scientist named Eratosthenes of Cyrene (276–194 BC) calculated the circumference of the earth (to an amazing degree of accuracy). Within the circles of Christian scholarship, no notable theologian seems to have believed in a flat earth, not only because of it so obviously is not, but also because the Bible does not claim it is. Notable theologians throughout the Christian era believed the earth is spherical. Even in the midst of the falsely-named “Dark Ages”, the leading Anglo-Saxon scholar and monk ‘the Venerable’ Bede (AD 673–735), one of most widely-read scholars for the next 1000 years, wrote that the earth: … in its width it is like a circle, and not circular like a shield but rather like a ball, and it extends from its centre with perfect roundness on all sides.1

R. Sungenis: Agreed.
Carter/Sarfati: The relationship between the spherical earth and the universe, however, was a notorious nut to crack, with many famous scientists weighing in on the difficulty. The main problem is that we are here on earth and, to us, it appears that everything revolves around our planet. We don’t feel like we are sailing through the heavens. We don’t feel like we are moving at all. Is it possible to sort out fact from fiction in this subject? Actually, yes. The answer is both elegant and satisfying, but we must do a little digging to answer the riddle.

Biblical phenomenological language

Well-meaning Christian geocentrists basically say, “The Bible says the sun rises and sets and that the earth doesn’t move; that settles it.” However, does the Bible really say that absolute geocentrism is true?

The use of language complicates this subject. Even today, in both writing and in common speech, people often use “phenomenological language”. Indeed, it would be almost impossible to have many conversations if we did not talk about things like “sunrise” (go ahead, try to describe a sunrise or sunset without sounding like you are stationary and the sun is moving, and compare with our attempt below). Thus, even when consulting biblical passages, we must be wary of the use of language.

R. Sungenis: Of course. But even the geocentrist admits that a “sunrise” in the Bible is phenomenal language, since the sun doesn’t actually rise, rather; it revolves with the rest of the universe around the Earth, and thus only appears to “rise” when the viewer sees the Earth’s horizon in the background.

But when the specific question of ‘what causes the sun to appear to rise and set?’ must be answered, there are passages in Scripture that are not phenomenal, and which tell us that it is the sun’s movement around the Earth that causes the “sunrise” and “sunset,” not the Earth rotating on an axis. When posed with this issue, the great Chrysostom wrote:

The heaven, for instance, hath remained immoveable, according as the prophet says, ‘He placed the heaven as a vault, and stretched it out as a tent over the earth.’ But, on the other hand, the sun with the rest of the stars, runs on his course through every day. And again, the earth is fixed, but the waters are continually in motion; and not the waters only, but the clouds, and the frequent and successive showers, which return at their proper season.9

Carter/Sarfati: This was recognized in the Middle Ages by scientist-clergy such as the priest Jean Buridan (c. 1300–c. 1360), the bishop Nicole Oresme (c. 1320–1382),2,3 and Cardinal Nicolas of Cusa (1401–1464).4

R. Sungenis: Jean Buridan had once entertained the possibility of a heliocentric system based on its reciprocity with the geocentric, but opted to reject it in favor of Aristotle. The two others were heliocentrists, following the Pythagorean school of the Greeks, but it was all theory. They had no scientific proof to their claims. As such, they were forced to take the position that heliocentrism was allowed by Scripture since Scripture spoke in phenomenal language. But, as noted above, Scripture’s phenomenal language gives no license to heliocentrism. It is only one way Scripture speaks of the cosmos, but not the only way.

9 Homilies to Antioch, Homily XII, PG 49, 128
Carter/Sarfati: If you think these men are perhaps insignificant, Buridan’s formulation anticipated the principle of describing motion with respect to reference frames, which paved the way for Galileo, Newton, and Einstein.

R. Sungenis: Buridan, et al. were the first one to discover relative motion. Relative motion was known by the Greeks, and it is a common observation in all cultures. The real question is: when and how does one apply relative motion to the celestial bodies?

Carter/Sarfati: His idea of impetus anticipated Galileo’s concept of inertia and Newton’s First Law of Motion. Historian of science, James Hannam, comments: “Like many medieval Christians, Buridan expected God to have arranged things in an elegant way, always allowing that he could do as he pleased. However, although there was also a presumption towards elegance, you still had to check the empirical facts to see if God really operated this way.”

R. Sungenis: Again, these ideas were known and circulated among the Greeks. But even though those from Galileo forward refined the language, no one, including Newton, gave a cause for inertia. Newton didn’t even know what caused gravity. All he could do was give us equations to tell how much inertia affected movement and how fast gravity pulls something to the ground. As noted above, even Newton admitted in the end that his laws of motion, if applied to the universe and not merely the sun and earth, would support a geocentric system.

Carter/Sarfati: Living almost exactly 100 years after Buridan, Nicolas Cusa wrote eloquently on the subject:

It has already become evident to us that the earth is indeed moved, even though we do not perceive this to be the case. For we apprehend motion only through a certain comparison with something fixed. For example, if someone did not know that a body of water was flowing and did not see the shore while he was on a ship in the middle of the water, how would he recognize that the ship was being moved? And because of the fact that it would always seem to each person (whether he were on the earth, the sun, or another star) that he was at the “immovable” center, so to speak, and that all other things were moved: assuredly, it would always be the case that if he were on the sun, he would fix a set of poles in relation to himself; if on the earth, another set; on the moon, another; on Mars, another; and so on. Hence, the world-machine will have its center everywhere and its circumference nowhere, so to speak; for God, who is everywhere and nowhere, is its circumference and center.

R. Sungenis: Although Cusa is correct in his theoretical understanding of movement, his thesis would be true only if he could prove that there was no object in the universe that wasn’t moving. Rather, he merely asserts that “It has already become evident to us that the earth is indeed moved.” But he has no proof for the Earth’s movement. Rather, he assumes it must be the case because he can advance a theoretical argument that any place in the universe could be a “center.” Asserting the corollary does not prove the antithesis incorrect.

Carter/Sarfati: It is clear here that he believed the earth moved through space, and he clearly understood the principle of frames of reference (discussed in more detail below). Buridan and Cusa predate the
Copernican Revolution, meaning later scientists did not come up with their ideas on their own. 8 Centuries of scholarship had been working in this direction.

**R. Sungenis:** As noted, Buridan turned back to geocentrism, and the Greek Pythagoreans predated everyone in regards to the thesis of heliocentrism. Copernicus admitted that his heliocentrism came from the Greeks. The Indian astronomers as well were discussing the merits of both systems in the first millennium, long before Cusa.

**Carter/Sarfati:** When we consider the biblical ‘proof texts’, most are taken out of context by those few people who want to argue for absolute geocentrism (the view that the earth is fixed and does not rotate while everything in the universe rotates about us once every day).

**R. Sungenis:** It is here that Carter/Sarfati have defined what they mean by “absolute geocentrism,” that the Earth is fixed and does not rotate or revolve.

**Carter/Sarfati:** This taking out of context is done both by biblioskeptics and, unfortunately, modern geocentrists who take their views as gospel.

**R. Sungenis:** We shall see exactly who is taking things “out of context.” The “context” issue has become the rag doll that both sides use to accuse the other of misapplying the Bible. The best that can be done is examine each verse on a case-by-case basis. A more insidious problem with these debates is that the heliocentrists begin from a position that heliocentrism (or acentrism) has been “proven” by modern science, which presupposition is stated quite clearly by Carter/Sarfati in their opening words of this paper, namely, “This is called ‘geocentrism’ or the ‘geocentric view of the universe’. It took years of painstaking work, spread out over multiple centuries, to show that this was false as an absolute claim.” Once one starts out with such an “absolute” presupposition, he leaves no room for a biblical passage to teach “absolute geocentrism.”

**Carter/Sarfati:** There are multiple verses that have a generic reference to “sunrise”, including Genesis 19:23, Exodus 22:3, Judges 5:31, Judges 9:33, Job 9:7, Psalm 104:22, Ecclesiastes 1:5, Nahum 3:17, Matthew 5:45, Mark 16:2, and James 1:11. There are also a number of verses that use “sunrise” in relation to the direction “east”, which makes perfect sense, including Numbers 2:3, Numbers 3:38, Numbers 34:15, Joshua 1:15, Joshua 12:1, Joshua 13:5, Joshua 19:12, and Joshua 19:13. Indeed, the normal Greek word for ‘east’, ἀνατολή (anatolē, e.g. Matthew 2:1), has the primary meaning of ‘rising’, usually of the sun. In other places, “sunrise” is used in a prophetic or poetic sense, including Luke 1:78 (also anatolē), which comes in the middle of the prophesy of Zechariah, father of John the Baptist, and is comparing Christ to the sunrise “that shall visit us from on high”. This is similar to the prophesy of Malachi 4:2 that claims “the sun of righteousness shall rise with healing in its wings.” Additional references can be found in Psalm 50:1 (“The Mighty One, God the Lord, speaks and summons the earth from the rising of the sun to its setting.”), Malachi 1:11 (“From the rising of the sun to its setting my name will be great among the nations…”), and Psalm 113:3 (“From the rising of the sun to its setting, the name of the Lord is to be praised!”). There are also multiple verses that have a reference to “sunset”, including Genesis 28:11, Deuteronomy 16:6, Deuteronomy 23:11, Deuteronomy 24:13, Deuteronomy 24:15, Joshua 8:29, Joshua 10:27, 1 Kings 22:36, 2 Chronicles 18:34, Psalm 50:1, Psalm 104:19, Psalm 113:3, Ecclesiastes 1:5, Daniel 6:14, Malachi 1:11, and Luke 4:40.
None of these verses is a challenge to geokinetic theory and none actually support geocentrism for all are acceptable uses of phenomenological language and, as mentioned earlier, we use similar phrases every day with no intention of misleading anyone into thinking we are geocentrics. Modern geokinetic astronomers teach using a planetarium, which treats the earth as the center of an infinite celestial sphere, and is full of phenomenological ‘geocentric’ terms such zenith, nadir, celestial poles and equator. Language conventions like this are necessary for simple communication.

R. Sungenis: The problem with Carter/Sarfati’s above explanation is that it is a half-truth. Their explanation is true insofar as we recognize that Scripture uses phenomenal language (that is, descriptions of nature from the viewpoint of the observer), but Carter/Sarfati cannot use this fact as a proof or even evidence that Scripture never teaches “absolute geocentrism.” Carter/Sarfati have, thus far, presented no proof that the Earth is moving around the sun or rotating on an axis, hence it is presumptuous for them to start the debate and dogmatically state that Scripture does not teach geocentrism and thus conclude that its “phenomenal” language must be interpreted to mean that the Earth is spinning and the Sun is not moving around the Earth.

Carter/Sarfati: There are other passages, however, that require a more careful exegesis. After the Israelites crossed the Jordan into Canaan, they defeated the cities of Jericho and Ai (Joshua 1–8). Soon after that the residents of Gibeon tricked Israel to entering into a covenant with them (Joshua 9). Gibeon was to the west of Ai and an obvious next target for the invading army. The other peoples in the area were angry and went to war against the Gibeonites. Israel came to their aid and a great battle was fought (Joshua 10). In the midst of this battle, the Bible says:

> At that time Joshua spoke to the Lord in the day when the Lord gave the Amorites over to the sons of Israel, and he said in the sight of Israel, “Sun, stand still at Gibeon, and moon, in the Valley of Aijalon.” And the sun stood still, and the moon stopped, until the nation took vengeance on their enemies. Is this not written in the Book of Jashar? The sun stopped in the midst of heaven and did not hurry to set for about a whole day. There has been no day like it before or since, when the Lord heeded the voice of a man, for the Lord fought for Israel.

This very famous passage describes Joshua’s Long Day, and is often used to support geocentric views, but what is it saying, really? Obviously, the statements are being given in a local frame of reference. Why? Because the sun standing over Gibeon would not appear to be overhead anywhere except in the geographic vicinity of Gibeon.

R. Sungenis: It doesn’t make any difference whether “the statements are being given in a local frame of reference.” Likewise, it makes no difference that the sun is left standing over Gibeon. Gibeon is where Joshua needed the sun to be so that it stayed at the maximum point at which its light would be shed on Earth, which is noon time. Although that actual point would be, say, at a lower height for the sun at 10:00 am for a point west of Gibeon, it doesn’t matter. Joshua wants the sun at 12:00 noon for his locale because that gives him the best chance of defeating the five armies. Moreover, Carter/Sarfati’s argument misses the point. The point is that the sun stopped at Gibeon and didn’t move for a whole day. What difference does it make if Joshua described the cessation of the sun’s movement from a local frame or a universal frame?
Carter/Sarfati: The valley of Aijalon is to the west of Gibeon. Therefore, the moon would not appear to be to the west of Gibeon to someone standing in Aijalon; it would be out over the Mediterranean.9

R. Sungenis: But Joshua wasn’t standing in Aijalon. He was standing in Gibeon and thus describes the position of the celestial bodies from that vantage point. As such, the moon, which will be about 30 degrees above the horizon when it is stopped, is described as being “above the valley of Aijalon” because that is how it appeared to Joshua who is viewing it from Gibeon. Obviously the moon wasn’t literally above Aijalon or even above the Mediterranean Sea, since the moon is 250,000 miles away. Joshua is merely saying that if one dropped a plumb line from where he saw the moon when it was stopped in the local sky, it would have dropped on the valley of Aijalon, whereas if he dropped a plumb line from the sun when it was stopped, it would have dropped on Gibeon (which means that there was about 60 degrees between the sun and the moon on that particular day). Additionally, the reason Joshua speaks of the moon over the valley of Aijalon is because the moon is still above the horizon when it is told to stop. If Joshua had waited a few more hours, the moon would have sunk below the horizon and appear to have gone into the Mediterranean Sea and thus would not be “above” Aijalon.

Carter/Sarfati: Many claim this passage teaches that God stopped the moving sun and moon. Yet there is nothing here to say that he did not temporarily slow down a rotating earth (as well as the hydrosphere and atmosphere). This would produce the same effect.

R. Sungenis: This is the fallacy of “begging the question,” or “using as proof the very thing one is trying to prove.” Carter/Sarfati haven’t yet proved that Scripture’s insistence that the sun moves and the Earth does not move is scientifically incorrect, and thus it is quite presumptuous to suggest that God could have slowed down the Earth. They are using one unproven scientific proposition to discredit another.

But, more importantly, if God had stopped or slowed the Earth from rotating, this action would not have stopped the moon from moving, since the moon moves independently of the Earth and the sun. In other words, if Joshua had stopped or slowed the Earth from rotating, the moon would have continued on at its normal speed and end up going below the horizon in a few hours. Hence, since the account says that BOTH the sun and the moon stood still for a whole day (24 hours), then having the Earth stop or slow its rotating cannot be applied to Joshua 10.

Notice, however, that Carter/Sarfati don’t claim the Earth totally stopped rotating but only that God “temporarily slowed down a rotating earth.” Why do they do so? Apparently they think that if they allow the sun and moon to move just a little bit (due to the relative motion against a slightly rotating Earth), this will suffice for Joshua’s command that they stay still in the sky. But even if the Earth rotates slowly, the sun and moon will not remain in the sky for an extra day (besides the fact that Carter/Sarfati are twisting the words of Scripture from “stop” to “slowing down”).

Another possibility is that Carter/Sarfati speak of a “slow rotation” of the Earth because they are aware of the extreme inertial forces that would be created upon the Earth if it were to suddenly and completely come to a stop. The oceans would literally spill over onto a major portion of the Earth’s land surface.

In any case, claiming that either the Earth slowed down or stopped rotating does not fit the geometrical or time constraints imposed by Joshua 10. From a purely astronomical perspective, to keep both the sun and the moon in the sky for a whole day means that the sun and moon had to be stopped, not the Earth.
From a biblical perspective, the burden of proof is on Carter/Sarfati, since the Bible is very clear in Joshua 10 that it was the sun and moon that stopped moving, not the Earth that stopped or slowed spinning. Since there is nothing in the Bible that says the Earth moves or that the sun does not revolve around the Earth, Carter/Sarfati have an impossible task to accomplish. The only thing that could possibly save them is indisputable scientific evidence that the Earth goes around the sun. Do they have it? The rest of this critique will show that they don’t.

Carter/Sarfati: Or He could have stopped the movement of everything in the universe. Same result. That something universal really happened in history is shown by legends of a long night in people groups on the other side of the globe.

R. Sungenis: Yes, something really happened. Joshua remarks in verse 14 that nothing like it has ever happened before. But what I can’t help noticing is that Carter/Sarfati will allow at least two God-performed miracles to occur in order to allow the day to be twice as long in Joshua 10 (e.g., stopping or slowing the Earth from rotating or stopping the everything in the universe from moving), but they won’t allow the actual stopping of the sun and moon that Joshua specifies. Why?

The reason is that, from the get-go, Carter/Sarfati have dismissed the possibility that the sun revolves around the Earth. In their view, God can perform miracles such as stopping the Earth from rotating or stopping everything in the universe from moving, but He can’t perform the miracle of having a sun revolve around the Earth or stopping it from revolving around the Earth. The double standard is quite evident.

Carter/Sarfati: Note that the mention of the moon is a mark of authenticity. The Amorites were sun worshippers, so it makes sense for God to show His power over the false god.

R. Sungenis: It is clear that Carter/Sarfati are ‘reading into the passage’ and have missed the obvious effect that including the moon in the narrative will have upon their analysis. Whereas Carter/Sarfati want to limit the moon’s significance to some historical authenticator, they miss the fact that the moon would continue to move if the Earth had stopped rotating, and thus they nullify their thesis.

Carter/Sarfati: But if His means really was slowing down the earth, as we suggest, then this would also affect the relative motion of the moon, which otherwise need not have been mentioned.

R. Sungenis: Notice how Carter/Sarfati are again referring to a “slowing” of the Earth’s rotation instead of stopping the rotation. Somehow they think that having the Earth rotate just a little bit will take care of the problem. The best they can do is posit that a slowed Earth will “affect the relative motion of the moon,” but they don’t tell us what that means. Are they trying to tell us that if the Earth rotated a little bit it would keep the moon in the sky for a whole day? If so, that can be easily falsified, as noted above. In the end, it doesn’t matter whether Carter/Sarfati opt for a slow rotating or a stopped Earth. Neither will give enough time for the moon to stay in the sky for a whole day, since the moon will continue to move regardless what the Earth or sun is doing.

Carter/Sarfati: And let us not forget the reversing of the course of the sun in the time of Hezekiah (2 Kings 20:5–11, Isaiah 38:1–7), an event that was noticed, or at least enquired about, by astronomers outside of Jerusalem (2 Chronicles 32:24–31). These deviations from the scientific norm are what allow us to identify miracles when they occur.
R. Sungenis: So if Carter/Sarfati accept celestial miracles in the above biblical passages, why can’t they accept the miracle of God stopping a moving sun and a moving moon? The reason is that they have already discounted such a miracle since they think science has proven that the sun does not revolve around the Earth. Hence, the first thing Carter/Sarfati should have done is given us proof from modern science that the Earth moves.

Carter/Sarfati: In a geocentric universe, everything is one giant miracle with no simple explanation (see below). Certainly, a geocentrist would not expect the sun to stop or to move backward, but why not? There is no rational explanation for the way the universe operates, so why could something out of the ordinary not happen?

R. Sungenis: It is apparent here that Carter/Sarfati have never thoroughly studied the scientific basis for the geocentric system, otherwise they would never make such sweeping generalizations of geocentrists (e.g., “everything is one giant miracle”). It is difficult to discuss science with someone who doesn’t even know or appreciate the scientific basis of his opponent’s position.

Carter/Sarfati: Psalm 96:10 is another critical verse for us to understand. It says:

Say among the nations, “The Lord reigns! Yes, the world is established; it shall never be moved; he will judge the peoples with equity.” Similar statements that “the earth shall not be moved” appear in Psalm 93:1 and Psalm 104:5. Do these verses not say that the earth does not move? No, they do not, for one very simple reason: the Hebrew word מֶט (mot) means “to totter, shake, or slip”11 and is often translated such in other places. The opposite of “shake” can be “unmoving”, as in these verses, but it can also be accurately translated “unshaken”.

R. Sungenis: To be a little more precise, the Hebrew מֹט (mot) appears 39 times in the Old Testament, 20 in the Psalms. The Qal form appears 13 times, 23 times in the Niphal, and one each in the Hiphil and Hithpael. It can refer to things as simple as slipping with the foot (Dt 32:35; Ps 17:5; 38:16-17) or to moving the earth (Ps 82:5; Is 24:19). Môt, in the physical sense, refers to the transition from a state of rest to a state of movement; in the figurative sense, from a state of stability to a state of instability. Of all the words in Hebrew referring to movement (e.g., מֶט, מ֢ה, מְדָה, מְזַלָּה, מְשַקֶּל, מָצַל, מַעֲשֶׂה, מִשְׁמַרְשָׁר, et al) מֹט (mot) is used when any, even the slightest movement, is in view. Hence, it can refer to a shaking or vibration as well as a change of location.

Carter/Sarfati: Using the same word, Psalm 55:22 and Psalm 112:6 say the righteous will never be moved. Same word, similar context, but obviously this does not mean people are fixed in place! Yet, if the righteous can move, so can the earth.

R. Sungenis: Carter/Sarfati’s interpretation is self-serving. They consistently mix and match the literal and figurative when it is to their advantage, and here is no exception. Here they do so by telling us that Ps 55:22 and Ps 112:6 say the righteous will never be moved, but they don’t tell us that this is referring to the righteous in a spiritual sense, that is, the righteous will not be moved from their state of grace if they cling to the Lord. The reason Carter/Sarfati don’t tell us this fact is because they are about to compare it to a literal physical fact that righteous people don’t stay in one location. They do so in order to make the convenient conclusion that “if the righteous can move, so can the earth.” What they should have done is tell us that there are two literal meanings to “the righteous cannot be moved,” that is, (a) it is literally true
that the righteous cannot be moved from grace if they cling to God, or (b) it could be literally true that the righteous are stuck to one physical location. And then they should have told us that (a) is correct and (b) is incorrect. If they did, then they would not have made the specious contrast between the non-movement of the righteous and the movement of the Earth.

Carter/Sarfati: Following on that theme, Psalm 121 is titled, “The Righteous shall never be moved.” Verse 3 says God will never let your foot be moved, yet a few verses later talks about “coming in” and “going out”, meaning the feet must be moving and the earlier use of “shall not be moved” must be a metaphor or poetic expression for “firm” or “unshaken”.

R. Sungenis: Now that they think they have established a foundation, Carter/Sarfati want to make the claim that as Psalm 121 uses MOHT in a figurative sense, then this automatically means that when MOHT is applied to the Earth it must also be used in a figurative sense. This is a fallacy in logic. The figurative use of MOHT in one passage does not mean that it cannot be used literally in other passages.

Carter/Sarfati: Also, Psalm 16:8 says, “I shall not be moved,” and most biblioskeptics and geocentrists would not think that the Psalmist was in a strait jacket!

R. Sungenis: Correct. But the only ones who have put themselves in a strait jacket are Carter/Sarfati, since they are trying to make the stilted argument that the figurative use of MOHT in Ps 16:8 means that MOHT must always be used in a figurative sense.

Carter/Sarfati: Finally, Psalm 125:1 says those who trust in the Lord are like Mt. Zion, which cannot be moved and abides forever. This is perhaps a better place to use “cannot be moved”, for we are talking about a mountain, but even that will be burned up in the future (according to most views on eschatology), so the poetic expression is clear.

R. Sungenis: There is no “better” or worse place to use MOHT. It is used of the righteous to give the literal truth that they cannot be moved from their spiritual relationship with God if they cling to Him, and likewise MOHT is used to show that a mountain does not move. Both of these facts should have been recognized by Carter/Sarfati when they compared MOHT to passages in which it is used in reference to a non-moving Earth. They would have concluded that the Earth also cannot be moved. Instead, Carter/Sarfati try to say that MOHT is used figuratively in the Psalms and thus we must use it figuratively when it is used of the Earth not-moving, which is fallacious reasoning.

Carter/Sarfati: One other problem is the use of the word “firmament” in Genesis 1 in the King James version. That word comes straight out of the geocentric views of Ptolemy (AD 90–168) and his predecessors, albeit by a long route. Around 250 BC, Jewish scholars in Alexandria, Egypt, translated the Hebrew Bible into Greek to make the Septuagint LXX. Unfortunately, they imbibed some of the Greek cosmologies by translating the Hebrew word יָרֹן (ra‘īya’) into στέρεομα (stereóμα). This comes from the word στερεώ (stereo)—“to make or be firm or solid.” We see this meaning carried over into Jerome’s Latin Vulgate, firmamentum. This was basically transliterated into the KJV’s “firmament”. Thus, this is an example where the science of the day influenced Bible translation, and vestiges remained for almost 2,000 years! [note: This is not a slam on the KJV necessarily. CMI does not take any particular stand on Bible translations, but this one word is demonstrably taken from the scientific views of the time.]
There is some debate among creationists on the meaning of rāqiya’ in this context. Kulikovsky points out:

Note also that the semantic ranges of stereōma and firmamentum do not match rāqiya’. The Hebrew word rāqiya’ refers to something flexible or malleable which has been stretched out. As Livingston puts it: “The emphasis in the Hebrew word raqia is not on the material itself but on the act of spreading out or the condition of being expanded.”[12] Stereōma and firmamentum, on the other hand, refer to something hard, solid and inflexible.[13] Indeed, Seely admits that his historical etymology of rāqiya’ and rāqa “does not absolutely prove that rāqiya’ in Genesis 1 is solid.”[14]

J.P. Holding puts it this way:

… the description of the raqiya’ is so equivocal and lacking in detail that one can only read a solid sky into the text by assuming that it is there in the first place. One can, however, justifiably understand Genesis to be in harmony with what we presently know about the nature of the heavens.[16]

Thus, even though multiple interpretations could equally well fit, rāqiya’ does not mean “solid dome”.

The nature of the relationship of the earth to the heavens is an open subject that begs for exploration.

**R. Sungenis:** It does beg for more exploration, but the fact remains that although RAQUIA does not mean “solid dome,” it can refer to something solid. “Firmament” was the only word in use for this concept, as long as it was understood that a Firmament could be stretched and thus be flexible. The problem with the Flat Earthers is that they confine a Firmament to a dome over the earth when, in fact, Genesis 1 says that the firmament is both the sky that the birds fly in and the space in which the stars are placed.

**Carter/Sarfati:** And as will be seen, most of the debate was about the science; or as philosopher of science Thomas Kuhn (1922–1996) put it, a shift in scientific paradigms. Most people in history spoke in geocentric terms, as most people do today—we say, “The sun is setting” not “The earth’s rotation is now bringing our line of sight to the sun into a tangent at my position on the earth’s surface.” But this does not mean that most of us today are geocentrists!

**R. Sungenis:** But it *does* mean that the figurative expressions in the Bible of “the sun rising” cannot be used to say that the Bible only speaks in figurative language when it describes the cosmos, as we saw, for example, in Joshua 10, which even Carter/Sarfati do not figuratize but seek to interpret the passage literally, e.g., an Earth stopping its rotation.

**Carter/Sarfati:** Thus, there is no real biblical problem with a geokinetic view.

**R. Sungenis:** No, there remains a “real biblical problem with a geokinetic view” since the Bible never says the Earth moves and never says the Earth goes around the sun. In every passage, whether figurative or literal, it is always the sun moving around the Earth and never vice-versa. Even their own Fathers, Calvin and Luther, stated so. So the burden of proof is on Carter/Sarfati. They cannot use obvious figurative passages of the Bible (e.g., “the sun rises) to give themselves a rationale to then claim that the Bible is impartial to what revolves around what. The Bible is clear that the sun revolves around a fixed
Earth. No amount of accumulating descriptions in the Psalms about “the righteous” or various figures of speech in the Bible (e.g., “the hills clapped their hands”) can be used to give room for discounting the literal interpretation of cosmological passages in the Bible, as Carter/Sarfati have already admitted in their interpretation of Joshua 10.

Carter/Sarfati: This is not the same argument as “is evolution true?” or “can we add millions of years of earth history to the Bible?” This is not using “science” to inform us about biblical theology, which all attempts at merging evolutionary time and the Bible end up doing. The nature of the relationship of the earth to the heavens is an open subject that begs for exploration. This is an example of the difference between the ministerial and magisterial uses of science. Geokineticism is ministerial in that it helps us to elucidate texts that could go either way. In contrast, long-age views of evolution are based on a magisterial abuse of science in order to override Scripture, with baneful theological consequences, like death before Adam’s sin.

R. Sungenis: Hence, we see what Carter/Sarfati are trying to do, and it becomes the foundation of their whole argument. They propose that since the Bible sometimes uses figurative language, and since this figurative language is also used of cosmic motion (e.g., “the sun rises”), then the Bible is not definitive on the issue and thus “the texts could go either way.” Hence, if the texts can go either way, Carter/Sarfati will then seek to prove to us that they should be going in a geokinetic way and not a geocentric way. As noted, however, their assumption about the “either way” is incorrect since the Bible does not base its cosmology on figurative passages, and their attempt to prove geokineticism will fail.

Carter/Sarfati: Logic and science

This study is designed both to help Christians refute critics and to understand why geokineticism is both good science and biblically allowable.

R. Sungenis: So, if in their view, the Bible allows both views, then the only thing Carter/Sarfati can do is provide at least “good science” to show that we should interpret the Bible geokinetically or acentrically. But as noted above, they have not proven that the Bible allows heliocentrism or acentrism, since there is no passage that even remotely suggests that the Earth revolves around the sun, not even figuratively, much less literally.

Carter/Sarfati: Here’s the main logical problem with absolute geocentrism: it’s not that we could not construct a geocentric cosmology, as one of many allowable reference frames. It’s that there is no scientific or biblical reason why we would—there is no dynamic model to explain it, i.e. in terms of forces as efficient causes of motions. Therefore it has essentially no predictive value.

R. Sungenis: This is false. Again, Carter/Sarfati seem to be ignorant that geocentric science has the same “predictive value” that heliocentric or acentric science has, as we have seen demonstrated earlier by the statements of Einstein and Newton. Heliocentrists admit this openly. Here is another physicist who admits it:

As we have seen, Leibniz and Mach emphasized that the Ptolemaic geocentric system and the Copernican heliocentric system are equally valid and correct…the Copernican world view, which is usually seen as being proved to be true by Galileo and Newton…the gravitational attraction between the sun and the planets, the earth and other planets do not fall into the sun
because they have an acceleration relative to the fixed stars. The distant matter in the universe exerts a force, \(-m_g \ddot{a}_{mf}\), on accelerated planets, keeping them in their annual orbits.

In the Ptolemaic system, the earth is considered to be at rest and without rotation in the center of the universe, while the sun, other planets and fixed stars rotate around the earth. In relational mechanics this rotation of distant matter yields the force \((8.17)\) such that the equation of motion takes the form of equation \((8.47)\). Now the gravitational attraction of the sun is balanced by a real gravitational centrifugal force due to the annual rotation of distant masses around the earth (with a component having a period of one year). In this way the earth can remain at rest and at an essentially constant distance from the sun. The diurnal rotation of distant masses around the earth (with a period of one day) yields a real gravitational centrifugal force flattening the earth at the poles. Foucault’s pendulum is explained by a real Coriolis force acting on moving masses over the earth’s surface in the form \(-2m \ddot{u}_m \times \omega_{ue}\) where \(\ddot{u}_m\) is the velocity of the test body relative to the earth and \(\ddot{\omega}_{ue}\) is the angular rotation of the distant masses around the earth. The effect of this force will be to keep the plane of oscillation of the pendulum rotating together with the fixed stars.\(^\text{12}\)

A simpler way of viewing this is to take the “Absolute Space” in Newton’s \(F = ma\) and replace it with Absolute Matter, namely, the stars and their collective gravity. Whereas in Newton’s Absolute Space the centrifugal (\(C_i\)), Coriolis (\(C_c\)) and Euler (\(E\)) forces are “fictitious” or secondary, in the model for Absolute Matter they are real and written \(F = ma + C_i + C_c + E\), the latter three caused by the gravity of the stars (\(G_s\)), so that we can write \(F = ma + G_s\) or \(F - ma = G_s\). In essence, the gravity of the stars acts precisely like the rigid Absolute Space that Newton wanted but could not find. Any object \([m]\) in sudden movement \([a]\) against the spatial rigidness caused by stellar gravity \([G_s\) or \(F\)] will result in equal and opposite inertial forces, which is why T. E. Phipps once said: “When the subway jerks, it’s the fixed stars that throw you down.”

\textbf{Carter/Sarfati}: Yes, it could describe planetary positions accurately enough for pre-telescope astronomy, admittedly a great achievement, but it fails to explain the orbital motions of satellites of other planets. It is useful in some respects, however, for launching things into orbit, for pointing earth-based antennae at geostationary satellites, for plotting the position of stars, etc. Yet, because it lacks predictive power, a fully-comprehensive geocentric model would be very, very complicated. They would need to add terms almost at random to account for the thousands of variations easily explained by geokineticism.

\textbf{R. Sungenis}: Again, this is false. In fact, the one who had to “add terms” was Newton, not geocentrism. Newton, because he separated the rest of the universe from the solar system, had to add in inertial forces to \(F = ma\) in order to make certain calculations and predictions. Today they are called “fictitious forces.” Geocentrism has no fictitious forces, since its inertial forces are real, as noted above by Assis, and also admitted to by Einstein and others.

\(^{10}\) \[\vec{r}_{lm} = -\Phi m_y \{\ddot{u}_{ms} + \ddot{\omega}_{us} \times (\ddot{\omega}_{us} \times \ddot{r}_{ms}) + 2\ddot{u}_{ms} \times \ddot{\omega}_{us} + \dddot{r}_{us} \times \frac{\ddot{\omega}_{us}}{dt}\}, \quad p. 176.\]

\(^{11}\) \[
\sum_{j=1}^{n} \vec{r}_{jm} - \Phi m_y \{\ddot{u}_{ms} + \ddot{\omega}_{us} \times (\ddot{\omega}_{us} \times \ddot{r}_{ms}) + 2\ddot{u}_{ms} \times \ddot{\omega}_{us} + \dddot{r}_{us} \times \frac{\ddot{\omega}_{us}}{dt}\} = 0, \quad p. 185.
\]

Carter/Sarfati: There is another, perhaps stronger, point to make: geokinetics is the best way to understand the physics. The equations of motion are the simplest for the particles that orbit in a center-of-mass system and when the center is used as the origin in the co-ordinate frame. Science thrives on making predictions, and Newton’s three Laws of Motion and theory of gravity (with Einstein’s further refinements) are one of the most amazing predictive engines in history.

R. Sungenis: Geokinetics is not the best way to understand the physics. In fact, the geocentric system makes more sense. For example, in the geokinetic system, the Earth has to rotate exactly 23 hours, 56 minutes and 4.1 seconds to keep sidereal time. How can it do so when so many inertial forces (e.g., earthquakes, tsunamis, volcanoes, etc.) are impeding its rotation? Venus, which does rotate, has slowed its rate by 6 minutes in the last few years.

Likewise, in the geokinetic system, the Earth has to revolve around the sun exactly in 365.25 days. How does it do so in the face of the inertial forces it undergoes internally, as well as the cosmic forces and planetary perturbations it incurs externally? Geocentrism has a much better explanation. The sidereal rate can stay exactly as it is due to the tremendous momentum that a massive rotating universe will produce. Like a giant flywheel, the universe keeps turning at the same rate year after year, and nothing is able to slow it down. (Later we will address the claims that the Earth has slowed its rotation). As for Newton and Einstein, geocentrism can use both a rotating Earth in a fixed universe or a fixed Earth in a rotating universe, if desired, since all we need to do is invert the equations, as Einstein himself did.

Carter/Sarfati: Since Scripture doesn’t demand that a stationary earth is the only valid reference frame (absolute geocentrism), why would we hold to an earth-centered, earth-fixed reference frame?

R. Sungenis: Notice how Carter/Sarfati keep insisting that the Bible doesn’t demand a stationary earth, yet they haven’t given us any proof that this is so. All they did was show us a few figurative passages in the Psalms but then made the grandiose but presumptuous conclusion that all references to a non-moving Earth in Scripture must be interpreted figuratively. They also assumed that Joshua 10 can be explained by a “slowing of the Earth’s rotation,” which defies the context of Joshua 10. These assumptions about Scripture and guesses about the science are by no means showing that the Bible allows heliocentrism or acentrism. Again, the Bible does not suggest or allude to a moving Earth, either figuratively or literally.

Carter/Sarfati: If you can’t use gravity to explain the motion of objects in the solar system, you can’t use gravity to explain the motion of space probes flying among those objects. It is that simple. Here’s the main scientific problem with geocentrism: if absolute geocentrism is true, then the laws of physics are not universal. That is, experiments we do on earth cannot apply to things outside the atmosphere because Newton’s laws of motion and gravity cannot explain what we are seeing. This is a big problem, for every time we do something in outer space everything behaves as if it would here on earth. Absolute geocentrism requires a universe that does not work according to Newton’s laws. Yes, you can attempt to describe the way things revolve around the earth in a absolute geocentric system, but gravity cannot be used to explain the motion of those objects; another force is required to glue the universe together. Where does the change occur? Certainly before we get to the moon, for that must orbit the earth once a day. But we cannot detect any such transition! We can fly a plane, launch a satellite, send things to the outer solar system and there is no place where Newtonian mechanics does not apply. For example, late in 2014, the Rosetta spacecraft from the European Space Agency successfully arrived at and orbited comet 67P/Churyumov–Gerasimenko. In a delicate and complex series of maneuvers, the craft deposited
the Philae lander on the surface of the comet. Everything about that rendezvous is explained by Newtonian physics, and it is the same physics that works here on earth. If everything out there behaves as expected based on experiments here on earth, does this not mean that geokineticism is true and absolute geocentrism is not? If you can’t use gravity to explain the motion of objects in the solar system, you can’t use gravity to explain the motion of space probes flying among those objects. It is that simple.

Absolute geocentrism is then nothing more than ‘stamp collecting’. One cannot make many predictions. One can only describe what is seen. Essentially, they can describe observations without being able to explain those observations. The power of the geokinetic model lies in the fact that it is based on a simple observation that can then be used to explain multiple phenomena. The Achilles’ heel for those few who still believe the earth does not move is that their “model” is nothing more than a list of unrelated phenomena.

R. Sungenis: Again, I submit that Carter/Sarfati only did a cursory study of geocentrism before they wrote this paper. They made assumptions and created their own straw man. The only ones doing “stamp collecting” here are Carter/Sarfati.

Carter/Sarfati: The Greeks: The main protagonist in the geocentrism debate is a man named Claudius Ptolemy (AD 90–168), a Greek scholar living in the Egyptian city of Alexandria in the second century AD. He had a profound influence on this debate, to the point that today the terms “geocentric” and “Ptolemaic” are interchangeable. Prior to him, however, there was no unanimity among Greek thinkers. In fact, several solar-centric views predated Ptolemy’s geocentrism. The Greek scholar Aristarchus of Samos (310–230 BC) is but one of those people. Interestingly, he also said that the sun must be further away than moon (because the moon can eclipse the sun). Since they have the same apparent size, he reasoned the size of the sun must be proportional to its distance behind the moon. He underestimated the size of the sun (and thus its distance) by a factor of 10, but his model was clearly heliocentric. And he was not the only ancient to struggle with it. The debate was known to famous people like Archimedes (287–212 BC), Seneca (4 BC – AD 45), Pliny the Elder (AD 23–79), and Plutarch (AD 45–120). There were good reasons for most early people to believe in geocentrism and the scholars listed multiple evidences in support of it. Nicolaus Copernicus (1473–1543) summarized the arguments in Chapter 7 of his book On the Revolutions of the Celestial Spheres: Therefore, remarks Ptolemy of Alexandria (Syntaxis,20 1, 7), if the earth were to move, merely in a daily rotation, the opposite of what was said above would have to occur, since a motion would have to be exceedingly violent and its speed unsurpassable to carry the entire circumference of the earth around in twenty-four hours. But things which undergo an abrupt rotation seem utterly unsuited to gather (bodies to themselves), and seem more likely, if they have been produced by combination, to fly apart unless they are held together by some bond. The earth would long ago have burst asunder, he says, and dropped out of the skies (a quite preposterous notion); and, what is more, living creatures and any other loose weights would by no means remain unshaken. Nor would objects falling in a straight line descend perpendicularly to their appointed place, which would meantime have been withdrawn by so rapid a movement. Moreover, clouds and anything else floating in the air would be seen drifting always westward. Copernicus uses the Aristotelian terminology of his opponents, where “violent” simply means “caused by an outside force”, and no one then knew Newton’s Second Law. For example, a book falling from a table is ‘natural motion’, while picking it up is ‘violent’ motion. Yet think about the implications of this Aristotelian view: if any outside force is ‘violent’, experimental science is invalid because any experimental manipulation cannot then be
natural’. Some of the ancients tried to argue that, if the earth rotated, it would fly apart, people and animals would be flung from the surface, falling objects would curve as they fall to the surface, and there should be a perpetual east wind, as Copernicus explained. But he then takes the argument and turns it back on itself, issuing an even greater challenge in Chapter 8: For these and similar reasons forsooth the ancients insist that the earth remains at rest in the middle of the universe, and that this is its status beyond any doubt. Yet if anyone believes that the earth rotates, surely he will hold that its motion is natural, not violent … Ptolemy has no cause, then, to fear that the earth and everything earthly will be disrupted by a rotation created through nature’s handiwork … But why does he not feel this apprehension even more for the universe, whose motion must be the swifter, the bigger the heavens are than the earth? Or have the heavens become immense because the indescribable violence of their motion drives them away from the center? Would they also fall apart if they came to a halt? Were this reasoning sound, surely the size of the heavens would likewise grow to infinity. For the higher they are driven by the power of their motion, the faster that motion will be, since the circumference of which it must make the circuit in the period of twenty-four hours is constantly expanding; and, in turn, as the velocity of the motion mounts, the vastness of the heavens is enlarged. In this way the speed will increase the size, and the size the speed, to infinity. Yet according to the familiar axiom of physics that the infinite cannot be traversed or moved in any way, the heavens will therefore necessarily remain stationary. As we will see, not only has ‘the earth will fly apart’ argument been answered, but so have the other arguments some of the ancients attempted to make.

R. Sungenis: The whole argument about rotation and centrifugal force gets back to Newton’s bucket. The question arises that, if the Earth rotated but it was by itself and there was no other matter in the universe, would the Earth feel centrifugal force? The answer is no, which is why Newton invented Absolute Space, a space that was rigid and against which the Earth would rotate in order to account for centrifugal force. But Newton couldn’t prove Absolute Space existed, which is why he had to add in inertial forces for various calculations, but they were deemed “fictitious.”

Mach showed Newton that the only “absolute space,” as it were, that we knew of was the stars and their gravity, and thus both Mach and Einstein agreed that a rotating star field against a fixed Earth would create the same centrifugal force as a rotating Earth in a fixed star field.

Be that as it may, a rotating Earth, with its specific mass and adhesion, will go slow enough so that the centrifugal forces are sustainable, and so will a rotating universe. This is also why the issue of the “firmament” becomes important, since if it is both solid and flexible and is the essence of space, then it would have to be a substance that can sustain the centrifugal forces at distances far away from Earth. This is where quantum mechanics comes into play, for it has suggested that “space” is not empty (and neither could it be, since “nothing,” metaphysically, cannot exist), but is made of substance that is highly granular and highly dense (i.e., solid yet flexible). I have much more to say about this in my book, Galileo Was Wrong: The Church Was Right, for those interested.

Carter/Sarfati: The Church Fathers:

However, it is not quite fair for modern geocentrists to quote the early Church Fathers in support. The few Church Fathers who discussed the issue were geocentrists. However, it is not quite fair for modern geocentrists to quote the early Church Fathers in support. First, all the pagans of their day also supported geocentrism, so the Church Fathers just reflected common sense, common contemporary scientific ideas,
or common use of language. They were hardly making a principled theological opposition to geokineticism.

**R. Sungenis**: This is false. The Church Fathers based their position on their literal interpretation of Scripture, as they did with all the doctrines they formulated. As for the “pagans,” some followed the Pythagorean heliocentrists and some followed the Aristotelian geocentrists, with various positions in between the two poles. Also, there were not just a “few Church Fathers” but at least two dozen that wrote on the issue, the same two dozen that wrote on many other doctrine for the Church. All of them were geocentrists, and specifically against the Greek heliocentrists, who were also evolutionists.

**Carter/Sarfati**: Second, they were influenced by the faulty translation of the raqia’ in the available Greek and Latin translations.

**R. Sungenis**: Jerome knew the Hebrew language and it was he who translated it into Latin for the Church. Firmament was not a “faulty translation” as much as it was a concept that needed a lot of contemplation. In the end, the firmament had little to do with why the Fathers were all geocentrists. They were geocentrists because they all believed Scripture taught geocentrism. To a man, that is what they all say. There was not a one of them who did not base it on Scripture.

**Carter/Sarfati**: Third, their geocentrism was Ptolemaic Geocentrism, while modern geocentrists actually hold the Tychonian hybrid geo-heliocentrist view (see below). Since no Church Father held this modern view, how can one quote them in support?

**R. Sungenis**: The same way a modern heliocentrist can support Copernicus even though he knows his model doesn’t work without the ellipses of Kepler. The Tychonic model adjusted the Ptolemaic model just as Kepler adjusted the Copernican model. In fact, Ptolemy’s equant was the forerunner of Kepler’s ellipses, something that Copernicus carelessly discarded from Ptolemy. Ptolemy knew his model might have fault due to his ignorance about the distances to the planets, but he left six variables in his model to account for his lack of information, which Brahe eventually corrected.

Further, the Bible doesn’t tell us how the model works, since that is our job to figure out in the six days of labor God gives us. The Bible simply says the Earth is fixed and the universe revolves around it. Many models and readjusted models have tried to figure out how it works. The important thing to start out with, however, is the foundational truth, which is geocentrism. Building a model on a false foundation will only lead to more error.

**Carter/Sarfati**: Fourth, the first genuinely intellectual challenge to absolute geocentrism came from devout adherents to a broadly biblical world view.

**R. Sungenis**: Rather, the first ones to try to get around a literal interpretation of Scripture were those who imbibed esoteric philosophies and heretical doctrines in theology, like Bruno’s belief in people living on other planets; and Galileo’s membership in a secret society to undermine Church doctrine, as we shall see later.
Due to the work of leading lights like Boëthius (AD 480–525), who was following the lead in this case of Aristotle and Ptolemy (they were not wrong about everything, after all), scholars in the Middle Ages knew the earth was just a point compared to the vastness of space, saying:

As you have heard from the demonstrations of the astronomers, in comparison to the vastness of the heavens, it is agreed that the whole extent of the earth has the value of a mere point; that is to say, were the earth to be compared to the vastness of the heavenly sphere, it would be judged to have no volume at all.21

Yet most of them accepted the geocentric views of their day. Thomas Aquinas (1225–1274) had a great deal of influence in nearly fixing Aristotelian philosophy, and its cousin, Ptolemaic astronomy, in the minds of his contemporaries. However, after Aquinas, some clergy-scientists in the Middle Ages directly questioned Aristotelian philosophy. In fact, the Middle Ages saw the birth of the universities, where questioning authority was often encouraged.22 Because of the infinitesimally small size of the earth compared to the heavens, Buridan and Oresme proposed that it might be more elegant that the earth itself rotated rather than the cosmos revolving around it (following in the steps of several Greek philosophers who said the same). They answered most of the biblical and scientific objections that would be thrown at Galileo a few centuries later, but came short of asserting geokineticism as a fact, as Hannam explains:

What Oresme had done was prepare the groundwork. He refuted most of the objections to a moving earth two centuries before Copernicus had suggested that it might actually be in motion.23

A common thought in the Middle Ages was that the centre of the universe was the worst place to be. For example, Dante’s Divine Comedy(c. 1310) has nine circles of Hell inside the Earth, getting worse as they approach the center. Satan was right at the centre of a (spherical) earth, at the centre of the universe. In the opposite direction, the nine celestial spheres of heaven increased in virtue and closeness to God as they got further from the center. We certainly do not hold to Dante’s vision, but in this light moving the earth away from the center was a promotion in the eyes of people in the Middle Ages, not a demotion, as 21st century anachronistic skeptics claim.

Was heliocentrism the result of Hermetic paganism?

Some recent historians have tried to make the claim that Copernican theory was driven by some sort of Hermetic24 sun worship, but this is grossly anachronistic. By taking the ‘perfect’ sun and putting it at the center, instead of worshiping the sun, Copernicans were demoting it to the worst place.25 And even though the Hermitica was widely read among the scholars of Copernicus’ time (the Renaissance), we do not believe Copernicus was among the adherents. Copernicus had one passing mention of Hermes among other ancient writings:

At rest, however, in the middle of everything is the sun. For in this most beautiful temple, who would place this lamp in another or better position than that from which it can light up the whole thing at the same time? For, the sun is not inappropriately called by some people the lantern of the universe, its mind by others, and its ruler by still others. (Hermes) the Thrice Greatest labels it a visible god, and Sophocles’ Electra, the all-seeing. Thus indeed, as though
seated on a royal throne, the sun governs the family of planets revolving around it. Moreover, the earth is not deprived of the moon’s attendance. On the contrary, as Aristotle says in a work on animal, the moon has the closest kinship with the earth. Meanwhile the earth has intercourse with the sun, and is impregnated for its yearly parturition.

**R. Sungenis:** There is more to the story of Copernicus than what Carter/Sarfati are revealing. Besides the fact that Copernicus was in an unlawful relationship with a woman and refused to heed the admonishment of the Church and separate from her, he was dabbling in profane areas and getting heavily influenced by them. Karl Popper shows the origin of them:

Copernicus studied in Bologna under the Platonist Novara; and Copernicus’ idea of placing the sun rather than the Earth in the center of the universe was not the result of new observations but of a new interpretation of old and well-known facts in the light of semi-religious Platonic and Neo-Platonic ideas. The crucial idea can be traced back to the sixth book of Plato’s *Republic*, where we can read that the sun plays the same role in the realm of visible things as does the idea of the good in the realm of ideas. Now the idea of the good is the highest in the hierarchy of Platonic ideas. Accordingly the sun, which endows visible things with their visibility, vitality, growth and progress, is the highest in the hierarchy of the visible things in nature….Now if the sun was to be given pride of place, if the sun merited a divine status…then it was hardly possible for it to revolve about the Earth. The only fitting place for so exalted a star was the center of the universe. So the Earth was bound to revolve about the sun. This Platonic idea, then, forms the historical background of the Copernican revolution. It does not start with observations, but with a religious or mythological idea.13

Popper, being a supporter of the heliocentric revolution, couches his critique of Copernicus in rather polite terms, but essentially he is saying that Copernicus’ brainchild had all the earmarks of originating from pagan sun-worship. As Wolfgang Smith notes:

…in the Renaissance movement championed by Marsiglio Ficino, the doctrine came alive again, but in a somewhat altered form; one might say that what Ficino instituted was indeed a religion, a kind of neo-paganism. Copernicus himself was profoundly influenced by this movement, as can be clearly seen from numerous passages in the *De revolutionibus*.14

Upon reading *De revolutionibus*, one is struck by the preponderance of philosophical and humanistic arguments Copernicus brings to his aid. As J. D. Bernal notes: “[Copernicus’] reasons for his revolutionary change were essentially philosophic and aesthetic,” and in a later edition he is more

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13 *Conjectures and Refutations: The Growth of Scientific Knowledge*, p. 187. Popper is referring to Dominicus Maria da Novara, a mathematician and astronomer in Italy. Indulging in a bit of anachronistic evaluation, Popper goes on to defend him, suggesting that even though Copernicus’ idea came before the observation, he was nevertheless correct and “not a crank.” More of Popper’s *a-posteriori* thinking appears later in the book: “The Copernican system, for example, was inspired by a Neo-Platonic worship of the light of the Sun who had to occupy the ‘centre’ because of his nobility. This indicates how myths may develop testable components. They may, in the course of discussion, become fruitful and important for science” (*ibid.*, p. 257).

14 Wolfgang Smith, *The Wisdom of Ancient Cosmology*, p. 174. Copernicus was also influenced heavily by the liberal humanist, Codrus, who was known for denying various Church doctrines.
convinced that the “reasons were mystical rather than scientific.” Overall, Copernicus presents about five-dozen arguments, at least half of which are solely philosophical in nature. Although the other half of his argumentation depends more on mechanics, these also have philosophical appendages to them. Very few of his arguments are based on his own personal observations, since, as we noted earlier, Copernicus merely reworked the observations of his Greek predecessors. In fact, Copernicus concludes that, because the Greeks did not detail their cosmological models more thoroughly, history (and God) have called upon him to provide the long-awaited documentation of true cosmology.

Thomas Heath sheds more light on this connection:

“Copernicus himself admitted that the [heliocentric] theory was attributed to Aristarchus, though this does not seem to be generally known….But it is a curious fact that Copernicus did mention the theory of Aristarchus in a passage which he afterwards suppressed: ‘Credibile est hisce similibus causis Philolaum mobilitatem terrae sensisse, quod etiam nonnulli Aristarchum Samium ferunt in eadem fuisse sentential.’”

Heath also shows by quotes from Plutarch and Archimedes that Aristarchus was the originator of the heliocentric view. J. L. E. Dreyer provides a more readable translation of Archimedes’ words:

“You know that according to most astronomers the world (κόσμος) is the sphere, of which the center is the center of the earth, and whose radius is a line from the center of the earth to the center of the sun. But Aristarchus of Samos has published in outline certain hypotheses, from which it follows that the world is many times larger than that. For he supposes (ὑποτιθέωται) that the fixed stars and the sun are immovable, but that the earth is carried round the sun in a circle which is in the middle of the course…”

This brings us to another disturbing aspect of Copernicus’ approach to cosmology. Since Copernicus was a Canon of the Catholic Church and one who rubbed shoulders with high-placed Cardinals and enjoyed audiences with the reigning pope, one might expect him to have been a high churchman in his own right, with regular recourse to the Church Fathers, especially since he knew that a good number of them wrote definitive works on cosmology and cosmogony. Moreover, one would also expect him to have sought out their consensus on important issues, since this was the Church’s most formidable weapon against erroneous ideas, even as Robert Bellarmine admonished Foscarini and Galileo. But one searches in vain

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18 Chief among them were Basil the Great, bishop of Caesarea. Advancing a dogmatic assertion of geocentrism, he writes: “There are inquirers into nature who with a great display of words give reasons for the immobility of the Earth….Do not then be surprised that the world never falls: it occupies the center of the universe, its natural place. By all necessity it is obliged to remain in its place, unless a movement contrary to nature should displace it. If there is anything in this system which might appear probable to you, keep your admiration for the source of such perfect order, on the wisdom of God” (Hexameron, Homily 1, 10); and Chrysostom: “For they who are mad imagine that nothing stands still, yet this arises not from the objects that are seen, but from the eyes that see. Because they are unsteady and giddy, they think that the Earth turns round with them, which yet turns not, but stands firm. The derangement is of their own state, not from any affection of the element.” (Homilies on Titus 2:1).
19 Bellarmine states: “Second, I say that, as you know, the Council [of Trent] prohibits interpreting Scripture against the common consensus of the Holy Fathers; and if Your [Reverence] wants to read not only the Holy Fathers, but
for any patristic references in *De revolutionibus*, or, for that matter, in any of Copernicus’ works. After prefacing his remarks to Pope Leo X with a castigation of those who “…although wholly ignorant of mathematics… shamelessly distorting the sense of some passage in Holy Writ to suit their own purpose,” the only time Copernicus crosses the threshold into the patristic witness for Leo’s sake is a derisive remark about Lactantius:

> For it is not unknown that Lactantius, otherwise a distinguished writer but hardly a mathematician, speaks in an utterly childish fashion concerning the shape of the Earth, when he laughs at those who have affirmed that the Earth has the form of a globe.  

Consequently, as a lot, the Fathers are made to appear as ignorant partisans against the goals of science and not worthy of comment on so important a subject. The reality is that Lactantius was the only Father of the Church (and he was not a highly esteemed patristic witness) who held to the idea of a non-spherical Earth. Every other Father who wrote at length on cosmological issues stated his belief, based on Scripture and science, that the Earth was a sphere. But one would never know these essential facts from the biased Copernicus. Instead, Copernicus rests his lot with the Greek philosophers and astronomers, the very individuals upon whom the Church Fathers focused their critiques in the areas of cosmology and cosmogony. *De revolutionibus* is saturated with nothing but praise for the Greek cosmologists, the ones who advocated a moving Earth:

> I found in Cicero that Hicetas [of Syracuse, fifth century B.C.] had realized that the Earth moved. Afterwards I found in Plutarch that certain others had held the like opinion. I think fit here to add Plutarch’s own words, to make them accessible to all: “The rest hold the Earth to be stationary, but Philolaus the Pythagorean says that she moves around the [central] fire on an oblique circle like the Sun and Moon. Heraclides of Pontus and Ecphantus the Pythagorean also

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also the modern commentaries on Genesis, the Psalms, Ecclesiastes, and Joshua, you will find all agreeing in the literal interpretation that the sun is in heaven and turns around the earth with great speed, and that the earth is very far from heaven and sits motionless at the center of the world. Consider now, with your sense of prudence, whether the Church can tolerate giving Scripture a meaning contrary to the Holy Fathers and to all the Greek and Latin commentators” (Bellarmine to Paolo Antonio Foscarini, April 12, 1615).


21 Lactantius, *Divine Institutes*, Bk 3, Ch 23: “they thought that the world is round like a ball…but if this were so, the Earth also itself must be like a globe…and if this were so, that last consequence also followed, that there would be no part of the Earth uninhabited by men and the other animals. Thus the rotundity of the Earth leads, in addition, to the invention of those suspended antipodes.”

22 Athanasius: “And wells, again, and rivers will never exist without the Earth; but the Earth is not supported upon itself, but is set upon the realm of the waters, while this again is kept in its place, being bound fast at the center of the universe. And the sea, and the great ocean that flows outside round the whole Earth, is moved and borne by winds wherever the force of the winds dashes it.” (*Against the Heathen*, First Book, Part 1, 27); Gregory of Nyssa: “As, when the sun shines above the Earth, the shadow is spread over its lower part, because its spherical shape makes it impossible for it to be clasped all round at one and the same time by the rays, and necessarily, on whatever side the sun’s rays may fall on some particular point of the globe…” (*On the Soul and the Resurrection*); Augustine: “Think we, had he ascended to the peak of some very high and pointed mountain, and looked out thence and seen the compass of the Earth, and the circles of the round world, and therefore said, ‘I have seen the end of all perfection’?” (*Homilies on First John*, x, 5); Jerome: “…the sphere which I have called motionless and all that it contains will be dissolved into nothing, and the sphere in which the antizone itself is contained shall be called ‘good ground,’ and that other sphere which in its revolution surrounds the Earth and goes by the name of heaven shall be reserved for the abode of the saints” (*Letters*, 124, *To Avitus*).
make the Earth to move, not indeed through space but by rotating round her own center as a wheel on an axle from West to East.\textsuperscript{23}

In the text of \textit{De revolutionibus} he continues:

It is the vault of Heaven that contains all things, and why should not motion be attributed rather to the contained than to the container, to the located than the locater? The latter view was certainly that of Heraclides and Euphantus the Pythagorean and Hicetas of Syracuse (according to Cicero). All of them made the Earth rotate in the midst of the Universe…That the Earth, besides rotating, wanders with several motions and is indeed a Planet, is a view attributed to Philolaus the Pythagorean, no mean mathematician, and one whom Plato is said to have sought out in Italy.\textsuperscript{24}

We see that, despite the fact that the Greeks have quite a confusing assortment of views on the cosmos, Copernicus is still enamored with their cosmologies, and especially with their mathematics, but he holds dear only the select few who believed in heliocentrism. As we have noted earlier, the appeal to “mathematics” or “mathematical harmonies” is a common thread running through most of the new cosmology, from Copernicus to Kepler through Einstein and Quantum Mechanics. The appeal, although appearing logical and formidable, is baseless. Mathematics proves very little, except that the right side of the equation often equals the left side.

\textbf{Carter/Sarfati:} If this is a problem, then what about the Apostle Paul quoting pagan poets with approval: Aratus (\textit{Acts 17:28}), Menander (\textit{1 Corinthians 15:33}), and Epimenides (\textit{Titus 1:12})? Also, Copernicus had also cited Scripture with approval:

For would not the godly Psalmist (92:4) in vain declare that he was made glad through the work of the Lord and rejoiced in the works of His hands, were we not drawn to the contemplation of the highest good by this means, as though by a chariot?

Then see the alleged Hermetic heliocentrism:

Since it is the visual ray itself, the sun shines all around the cosmos with the utmost brilliance, on the part above and on the part below. For the sun is situated in the center of the cosmos, wearing it like a crown. Like a good driver, it steadies the chariot of the cosmos and fastens the reins to itself to prevent the cosmos going out of control. And the reins are these: life and soul and spirit and immortality and becoming. The driver slackens the reins to let the cosmos go, not far away (to tell the truth) but along with him. …Around the sun are the eight spheres that depend from it: the sphere of the fixed stars, the six of the planets, and the one that surrounds the earth.

The above is hardly science at all, but mystical nonsense. So if any heliocentrist was influenced by Hermeticism, it was surely Giordano Bruno (1548–1600), a New-Agey non-scientist beloved of atheist Neil deGrasse Tyson.

\textsuperscript{23} \textit{De revolutionibus}, Dedication to Pope Paul III. Heraclides (d. 310 BC) a Greek astronomer who was one of the first to propose that the revolution of the stars around the Earth could also be understood as the Earth rotating on its axis in the midst of stationary stars.

\textsuperscript{24} \textit{De revolutionibus}, 5. \textit{Whether Circular Motion Belongs to the Earth; and Concerning its Position.}
Furthermore, this passage talks about a sphere surrounding the earth, and only the other planets surrounding the sun. Thus Hermeticism is also probably even more compatible with the Tychonian geoheliocentrism hybrid beloved of modern geocentrists (see below). They would undoubtedly take umbrage if they were accused of being Hermeticists, so they should practise “do unto others” when it comes to accusing geokineticists.

A final point: geokineticism does not fall even if Copernicus was a rabid hermeticist (this would be the genetic fallacy), and in any case, this objection can’t touch Copernicus’ medieval predecessors or most other geokineticists. What we have to do is assess the evidence for and against absolute geocentrism and not resort to ad hominem distractions.

R. Sungenis: Yes, each theory must be examined on its own merits, but since at this time there was hardly any experimental science that could prove either theory, the fact remains that Copernicanism was developed from Copernicus’ love of Greek heliocentric theory, and not from Scripture. Copernicus broke from the Church and went with the Greeks. The only thing that could be done after that was to claim that Scripture allowed geokineticism, as Foscarini and Galileo also tried to do. They failed in this attempt, since Scripture does not teach geokineticism. As noted, trying to use figurative passages in Scripture to claim that Scripture’s description of the sun’s movement is also figurative cannot be supported, since Scripture never says the Earth moves and always says the sun moves, both figuratively and literally.

Carter/Sarfati: Did the Church suppress geokinetic theory?

Already the new astronomy of Copernicus had shown its practical superiority, also showing that the Church permitted this view as a working mathematical hypothesis.

R. Sungenis: Quite the contrary. Copernicus’ model, that he got straight from Aristarchus, never worked properly. Copernicus was forced to use more epicycles (48) than his rival Ptolemy (40) in order to make his model come close to Ptolemy’s. The Church’s allowance for a corrected and edited Copernican model to be used as a mathematical hypothesis was not because they saw any merit in it, but to demonstrate the Copernicanism could not be theological or biblical doctrine unless its thesis was modified to a hypothesis. If this were not the case, then the Church would not have condemned the Copernican model as false.

Carter/Sarfati: Others have argued that the “Church” suppressed scientific advance by persecuting those who argued against absolute geocentrism, but history paints a very different picture. The Catholic Church, instead of being opposed to astronomy, spent tremendous amounts of money on it. Why? Because once the “Church” covered a significant portion of the globe, the calculation of the date of Easter became problematic. “The first Sunday after the first full moon after the vernal equinox” (Council of Nicea, AD 325) sounds like a precise formula, but it was entirely probable that different observers, even without making a mistake, could celebrate Easter on different days in different parts of the world. Add to that the fact that the Julian calendar was causing the calendar year to get farther and farther from the solar year (10 days off by the 1500s) and they had a real problem. To resolve these issues, cathedrals were enlisted as giant pinhole cameras projecting onto meridian lines (meridiane, singular meridiana). Thus the sun’s path through the sky could be accurately recorded, as documented by science historian John Heilbron (b. 1934).26 The cathedrals were ideal because they were huge, works of architectural genius, and were old enough for the foundations to have stabilized, so the positions of the meridiane would not
shift. They were even more accurate astronomical instruments than the best telescopes of the day; telescopes did not surpass the meridiane until the mid-18th century.

The result of this work was the adoption of the Gregorian calendar in 1582, which we still use today. The calendar change occurred 50 years before the trial of Galileo and was “based on computations that made use of Copernicus’ work”, as Kuhn pointed out. So already the new astronomy of Copernicus had shown its practical superiority, also showing that the Church permitted this view as a working mathematical hypothesis.

**R. Sungenis**: Not quite. The Gregorian calendar was superior because it recognized that the revolution of the sun was 365.25 days instead of the Julian calendar’s 365.00 days. Copernicus had nothing to do with this change. As for Kuhn’s comment, since Carter/Sarfati give no page number, then the context of Kuhn’s comment cannot be analyzed. Suffice it to say, if the Church had used Copernicus’ model, it would have ended up with a more distorted calendar than it already was.

**Carter/Sarfati**: After that, the work was refined even further. Interestingly, by 1655 (13 years after Galileo’s death) observations made in the Cathedral of Bologna by Giovanni Cassini (1625–1712) answered a great debate of the time, and gave concrete evidence that Kepler’s theory was correct and that Ptolemy’s was not. He also showed that the distance to the sun changed over time, meaning circular orbits were out of the question, so Kepler was right about elliptical orbits.

**R. Sungenis**: It wasn’t because of Kepler’s elliptical orbits that Ptolemy’s model was proved wrong, but the fact that Ptolemy put Mercury and Venus in the wrong place, which was later corrected by Brahe. Moreover, if the same elliptical orbits from Kepler were applied to Brahe’s model, the Brahe model would show the same orbits as Kepler. Ptolemy knew of the problem, which is why he created the Equant, which allowed the planets to have irregular orbits, and thus he was the forerunner to Kepler’s elliptical orbits. Further, the elliptical orbits of Kepler did not show “that Kepler’s theory was correct.” All it showed was that if the planets are put in irregular orbits, the model more accurately reflects their actual movements. But the truth is, even Kepler’s elliptical orbits were not completely accurate, which can readily be seen in the orbit of Saturn.

**Carter/Sarfati**: Timeline of events—a fun romp through history

There are many names that enter into the story. Too many, in fact, to do justice to them all. Yet, it is good to put several of the more important names in a proper historical perspective. When the subject comes up, most people immediately think of Galileo and his trials, but he was actually not the first nor the most important figure. Nicolaus Copernicus (“the man who stopped the sun and moved the earth”) died more than two decades before Galileo was even born, and Galileo’s censure did not occur until he was 70 years old.

The quest to solve this mystery was pushed by people with a Christian worldview who more or less believed the Bible. They saw no conflict between science and faith. Even the great astronomer Johannes Kepler said of his work that it was “like thinking God’s thoughts after him”, and:

The chief aim of all investigations of the external world should be to discover the rational order and harmony which has been imposed on it by God and which He revealed to us in the language of mathematics.
R. Sungenis: But this supposition led Kepler to believe that the solar system was modeled after geometrical solids that could fit into each other, but which was eventually disproven.

It is also a fact that Kepler, although a Lutheran, was heavily influenced by the occult, as was his mother, Katherina Kepler, and the latter’s endeavor may have led to her trial as a witch.25 Following his particular philosophy, Kepler’s main motivation for bringing the sun into the center of the planetary system, as had Copernicus before him, was that he considered it worthy of symbolic deification. In one passage he describes the sun as: “Who alone appears, by virtue of his dignity and power, suited…and worthy to become the home of God himself, not to say the first mover.”26

As would be the case with Galileo the Catholic, Kepler felt the need to justify his heliocentric views against the geocentrism of the Bible, which is what any Christian heliocentrist will be forced to do, including Carter/Sarfati. Kepler dismissed the Bible’s language as merely phenomenal. He writes:

…astronomy discloses the causes of natural phenomena and takes within its purview the investigation of optical illusions. Much loftier subjects are treated by Holy Writ, which employs popular speech in order to be understood. Within this framework and with a different purpose in view, only in passing does the Scripture touch on the appearances of natural phenomena as they are presented to sight, whence human speech originated, and proceed to do so even though it was perfectly clear to everyone that optical illusions are involved. Not even we astronomers cultivate astronomy with the intention of altering popular speech. Yet while it remains unchanged, we seek to open doors of truth. That the planets are stationary or retrogress; the sun stands still, turns back, rises, sets, goes forth from one end of heaven like a bridegroom coming out of his chamber and goes down into the other end, mounts to the midst of heaven, moves against certain valleys and mountains – these expressions are used by us along with laymen, that is, with the visual sense, even though not one of these locutions is literally true, as all astronomers agree.27

Carter/Sarfati: But there was resistance to geokinetic ideas. This was mainly led by other scientists, not the “Church”. The views of Copernicus were known to the Pope and many bishops of the day, and they supported him. This is not to say that his views were not controversial, but that neither the Protestant nor Catholic churches summarily rejected geokineticism.

R. Sungenis: Not quite. Except for one cardinal who befriended Copernicus (Nicholas Schönberg, Cardinal of Capua), the Church at large was immediately against Copernicus’ model.

26 On the Motion of Mars, Prague, 1609, Chapter 4, as cited in Thomas S. Kuhn, The Copernican Revolution, 1959, p. 214. Kuhn notes: “This symbolic identification of the sun and God is found repeatedly in Renaissance literature and art” (ibid., p. 130). Later adding: “This conviction [of Kepler’s], together with certain intrinsic incongruities discussed above, was his reason for rejecting the Tychonic system” (ibid., p. 214). Kepler’s reference to the “first mover” encapsulates his concept that as the sun rotated on its axis, its rays would act like a brush to move the planets.
27 Johannes Kepler, Epitomie Astronomie Copernicanae, Book I. It was the Epitomie that would eventually be put on the Index of Forbidden Books by Pope Alexander VII.
First, Rheticus’ heliocentric works, including the earlier pro-Copernican work, *Narratio prima*, were all placed on the Index of Forbidden Books published between 1559-1593, with a subsequent suppression of *Narratio* ordered by the Inquisition in 1598.\(^{28}\) Rheticus published his books two years before Copernicus. In it Rheticus attacks what he senses is the prime battle ground of the controversy, assuring his readers that we should see “very clearly…that the motion of the earth does not contradict the Holy Scriptures.”\(^{29}\)

Tiedeman Giese (d. 1550), Bishop of Culm, whom Copernicus cites in his Dedication to Paul III as “my devoted friend…urged me…into publishing this book,” had published his own book in 1536, titled Hyperaspisticon, taking the same course as Rheticus, that is, that Scripture was compatible with heliocentrism.

Pope Paul III, having the historical distinction of forming the Congregation of the Roman Inquisition in 1542 for the precise purpose of defending the Catholic Church from heresy,\(^{30}\) started the opposition against Copernicus. Bartolomeo Spina, the Master of the Sacred Palace from 1542 until his death in 1547, sought to have Copernicus’ book banned, which was eventually carried out by his Dominican colleague Giovanimaria Tolosani, who died two years later in 1549. Similar to Copernicus’ effort to persuade Paul III, Tolosani wrote a detailed geocentric treatise in 1546, which he dedicated to Paul III and which included an endorsement from Spina. In it Tolosani vehemently rejected Copernicus’ universe and declared it an extreme danger to the faith precisely because of its attempt to deliteralize Scripture.\(^{31}\)

As the 16th century reached the midway point, the staunchest anti-Copernican of the day was the Jesuit Christoph Clavius (d. 1612). He writes in his highly esteemed work:

> We conclude, then, in accordance with the common doctrine of the astronomers and the philosophers, that the earth lacks any local motion, either rectilinear or circular, and that the heavens themselves revolve continually round it…. Holy Scripture is also in favor of this doctrine, stating in a great number of places that the earth is stationary. It also bears witness to the fact that the sun and the other heavenly bodies are in motion.\(^{32}\)

**Carter/Sarfati:** Later, Galileo was encouraged in his work by Pope Urban VIII at first a close friend, but they later became bitter enemies after Galileo insulted him by putting the Pope’s words in the mouth of Simplicio (the fool) in a book that argued against geocentrism.\(^{31}\)

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28 Lerner notes that the suppression of *Narratio prima* was “recently discovered” in a “document from the Archepiscopal Curia of Naples.”

29 The words of Tiedeman Giese in his letter to Rheticus of July 26, 1543 that are included in Copernicus’ *Briefe Texte*, letter no. 194, 359, the original Latin being: “opusculum tuum, quo a sacrarum scripturarum dissidentia aptissime vindicasti telluris motum.” Cited in *The Church and Galileo*, p. 27.

30 Also known as the Congregation of the Holy Office or the Sacred Congregation. In 1965, Pope Paul VI changed the name to the Congregation for the Doctrine of the Faith.

31 The work’s title is: *On the Highest Immobile Heaven and the Lowest Stable Earth, and All Other Movable Heavens and Intermediate Elements*. Tolosani insisted Copernicus’ teaching “could easily provoke discord between Catholic commentators on Holy Scripture and those who have resolutely decided to follow this false opinion. It is in order to avoid such scandal that we have written this short work” (English translation of the French translation *Aux origines*, p. 708, cited in *The Church and Galileo*, pp. 15-16).

**R. Sungenis:** This is a myth unsupported by the history. There is no documentation stating that Urban VIII censored Galileo because he felt insulted (and this fact is confirmed by many Galileo historians, which are available in my book for review). Rather, the documented history shows that Urban VIII was in protracted discussions with the archduke of Tuscany to stop Galileo because Galileo was “teaching heresy.” Galileo was first condemned 16 years earlier in 1616 by Pope Paul V, for the same reason – that heliocentrism was against Scripture, so the stage had already been set for Urban VIII to follow through, which he did by declaring heliocentrism a formal heresy. Paul V told Galileo never to teach or write on heliocentrism again, which Galileo disobeyed when he started to write his new book in 1623, hoping that Urban VIII would accept it, but he didn’t, and his decision was based on what Paul V had determined before him, not on being miffed by Galileo.

**Carter/Sarfati:** Only a few decades after the death of Galileo and Urban VII, (sic) Jesuit astronomers were teaching geokineticism to astronomers in China. Georgio de Santillana (1902–1974), philosopher/historian of science at MIT, wrote:

> It has been known for a long time that a major part of the church’s intellectuals were on the side of Galileo, while the clearest opposition to him came from secular ideas.32

Considering that the argument had been going on for centuries, it should not be surprising that there was a controversy among the scholars. Some of this came though the Protestant/Catholic divide, some of it came through hard-headedness of various people, and much of it has been manufactured by 19th-century anti-Christian polemicists.33,34

**R. Sungenis:** Santillana was a biased historian who began his thesis by stating that the Church was wrong in its decision against Galileo. On the first page he writes, “Readers, who know quite well that the Earth goes around the sun…” yet does not present one scientific proof for his claims. De Santillana then goes on to argue:

> “…the tragedy was the result of a plot of which the hierarchies themselves turned out to be the victims no less than Galileo – an intrigue engineered by a group of obscure and disparate characters in strange collusion who planted false documents in the file, who later misinformed the Pope and then presented to him a misleading account of the trial for decision” (p. xx).

Suffice it to say, there were no “false documents planted in the file” or any “misinformation given to the Pope.” No one but Santillana has argued such a position. The one who is misinformed is Santillana, not only of the Church’s role, but, as we will see later, of false results of experiments engineered by a group of prominent and influential scientists in collusion, who made false conclusions from scientific experiments and then presented a misleading account to the public.

As for who was on the side of heliocentrism, Dorothy Stimson lists the advocates and dissidents of the Copernican theory as catalogued by Giovanni Riccioli, SJ, who held that there were “40 new arguments in behalf of Copernicus and 77 against him.” Those advocating heliocentrism were: Copernicus, Rheticus, Maëstlin, Kepler, Rothman, Galileo, Gilbert, Foscarini, Didacus Stunica, Ismael Bullialdus, Jacob

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Those disavowing heliocentrism were: Regiomontanus, Alfraganus, Macrobius, Cleomedes, Petrus Aliacensis, George Buchanan, Maurolycus, Clavius, Barocius, Michael Neander, Telesius, Martinengus, Justus-Lipsius, Scheiner, Tycho, Tasso, Scipio Claramontius, Michael Incofer, Fromundus, Jacob Ascarisius, Julius Caesar La Galla, Tanner, Bartholomæus Amicus, Antonio Rocce, Marinus Mersennius, Polacco, Kircher, Spinella, Pineda, Lorinis, Mastrius, Bellutris, Poncius, Delphinus, Elephantutius (The Gradual Acceptance of the Copernican Theory of the Universe, p. 81-82).

Others not on Riccioli’s list who advocated geocentrism are: Francis Bacon, Thomas Feyens, Libert Froidmont, Gerogius Agricola, Johann Henrich Voight, André Tacquet, S.J., Giovanni Cassini.

Carter/Sarfati: Nicolaus Copernicus

Perhaps the most important name in our brief tour of history is Nicolaus Copernicus. Copernicus was not only an astronomer but also a linguist, classical scholar, physician, doctor in canon law of the church, and an insightful economist. Although his geokinetic ideas were in place decades before his death, and even though he shared his views with many other people, he delayed publication of his opus De revolutionibus orbium coelestium (On the Revolutions of the Celestial Spheres) until right before his death in 1543. This major event in the history of science triggered what we now call the “Copernican Revolution”. He took the same observational data that others were using, but added a much simpler explanatory model—that the planets, now including Earth, orbited the sun. “Occam’s Razor” (named after William of Ockham, AD 1287–1347) is a well established principle in science. It states that when two theories are in conflict, the one with the fewest assumptions is more likely to be correct. Copernicus’ model was much simpler than the Ptolemaic system.

R. Sungenis: As noted, Copernicus’ model was a failure since it did not improve on calculating the positions of the planets. Copernicus was in love with the circle from the Greeks as the most perfect shape, and thus put the planets in circular orbits, throwing out the very thing that Ptolemy had used to give more correct orbits—the Equant. Copernicus’ model was not “simpler,” it was actually more complicated because, having rejected the Equant, he was forced to use more circular epicycles than Ptolemy.

Carter/Sarfati: In the same way, the modern geokinetic system is much simpler than the modern absolute geocentric system. In fact, modern versions of absolute geocentrism are far more complex than even the Ptolemaic system, because they have to deal with many more phenomena than Ptolemy was aware of. Therefore, Occam’s Razor ‘cuts’ them deeply.

R. Sungenis: The only thing that is “cutting deeply” is Carter/Sarfati’s misrepresentation of not only the original Copernican system, but also of the “modern absolute geocentric system.” As a result they have created their own boogeyman. They also seem unaware that the heliocentric system has the same problems. It is not simple by any stretch of the imagination. Its “simplicity” is simply a myth. Each system must deal with very complicated movements of the celestial bodies, such as the obliquity of the ecliptic; the intersection of the equator, ecliptic and meridian; declinations and ascensions of stars; angles of the ecliptic with the horizon; precessions of solstices and equinoxes; irregularities of the equinoctial precession; the magnitude and difference of the solar year; the irregularity of the sun’s movement; the
changes of the apsides; regular and apparent movement; the moon’s very complicated and irregular movement; the unequal apparent diameter of the moon and its parallaxes; the mean oppositions and conjunctions of the sun and moon; ecliptic conjunctions; the irregular movements of the other planets; the latitudes of the planets; the planets’ angles of obliquation; and many other issues, including the perturbations of the planets due to gravity. No system has been able to solve the riddle. The best we can do is estimate.

Carter/Sarfati: However, there was room for improvement. For example, he still claimed the planets orbited in perfect circles, and clung to the Ptolemaic idea that the stars orbited in a crystalline sphere far above. Thus he also needed some epicycles to make his theory fit observations. Yet, his logic, math, and observational evidence started a fuse burning. In fact, he played a great role in re-starting the Scientific Revolution during the Renaissance, after the Medieval scientific revolution had been stalled by the Black Death. There were still obstacles to overcome, however, and the fact that there was no observed parallax among the stars was used as strong evidence against his theory by many detractors.

R. Sungenis: As noted earlier, Copernicus not only needed epicycles, he needed more of them than Ptolemy. Schoolbooks never admit this historical fact. Most people grow up thinking that Copernicus had no epicycles and thus his system was better because of its “simplicity.”

Carter/Sarfati: What is Parallax?

Put your finger on your nose. Now alternately open and shut one eye at a time. Your finger should move to the left and right as you look at it from each eye. This is called parallax. Because you are looking at something from two different angles, its position seems to shift relative to the background. Now hold your arm out straight and point your finger. Again, alternately open and close each eye. Your finger should still move back and forth, but less than before. Why? Because the difference in the angle between your finger and each eye is much less.

Parallax is very useful in astronomy. The earth’s orbit is 150 million kilometers in radius. Thus, when we look at a star in the summer and in the winter, that is like having two eyes that are very, very far apart. If the star is close, its position will change through the seasons. However, most stars do not measurably change position because they are too far away for us to measure the change in angle. The few that do are closer to us than the ones that do not. Therefore, we can infer the distance to nearby stars, we can infer that different stars are at different distances, and we can infer that some things are very far away. All of this is consistent with geokinetics. In fact, all of this answers one of the gravest objections to geokinetics: the perceived lack of parallax in the early years.

Parallax was also used to determine how far away the earth is from the sun. This distance is called the ‘astronomical unit’ or AU for short and for a long time we did not know its value. Edmund Halley (1656–1742) suggested that we could use the transit of Venus across the sun to determine the AU by getting multiple people to view it and by accounting for the difference in parallax between their locations. This was difficult on many fronts. First, transits occur in pairs separated by several years, but the pairs are separated by 121.5 or 105.5 years! Second, you needed to know exactly where on the earth each observer was and we had not yet perfected the measurement of longitude, so we could only use a parallax based on latitude. Third, you needed to accurately time the event and clocks were only just beginning to be built with enough precision to do this. Fourth, even with a very precise clock, the time difference (seconds)
between the start of the transit from one place to the next would be negligible. However, he reasoned that if multiple people measured the total time from start to finish (hours), the accuracy would be high enough to get a good figure. He was correct.

The first recorded transit of Venus across the sun was made in 1639 by a young minister named Jeremiah Horrocks (1618–1641), who projected an image of the sun through a telescope onto a piece of paper [Warning: do NOT try this without proper eye protection, and children should never do this without adult supervision. Concentrating sunlight in this way can permanently damage your eyes.] Horrocks was able to estimate the size of Venus as well as the AU: 59.4 million miles. This was about \( \frac{2}{3} \) the true value, but it was the most accurate measurement to date. Further sightings in 1761/1769 and 1874/1882 involved some of the greatest international scientific collaborations ever. In fact, the great navigator Captain James Cook (1728–1779), the first person recorded to circumnavigate New Zealand, was sent to Tahiti with the express purpose of recording the 1769 transit (this was successful).

But parallax can also be used to measure the distance to stars. Friedrich Bessel (1784–1846) made the first stellar parallax measurement, of the star 61 Cygni, in 1838! He concluded the star was 10.3 light years distance (less than 10% off), although the parallax amounted to less than 0.00009 degrees. By the close of the 19th century, we had a very good idea of the AU, the size of the solar system, and that parallax was very useful for measuring great distances, and all of that helped to solidify geokinetic theory.

The recently launched European Space Agency (ESA) Gaia unmanned observatory will be able to measure parallax out to tens of thousands of light years (about 1% of the diameter of the Milky Way). Since stars are obviously at different distances, there is no single ‘crystal sphere’. Are there different spheres? One for each star, perhaps? Maybe the stars are embedded in a universal solid? Perhaps a series of high-tension wires? Or, maybe the universe is geokinetic after all!

**R. Sungenis**: Carter/Sarfati fail to advise the reader that parallax can be shown just as easy in the geocentric system as the geokinetic system. The neo-Tychonic model of stellar parallax has been known to astronomy for some time and is admitted by those who know better. At the department of physics at the University of Illinois, for example, one class lecture states:

> It is often said that Tycho’s model implies the absence of parallax, and that Copernicus’ requires parallax. However, it would not be a major conceptual change to have the stars orbit the sun (like the planets) for Tycho, which would give the same yearly shifts in their apparent positions as parallax gives. Thus if parallax were observed, a flexible Tychonean could adjust the theory to account for it, without undue complexity. What if parallax were not observed? For Copernicus, one only requires that the stars be far enough away for the parallax to be unmeasurable. Therefore the presence or absence of parallax doesn’t force the choice of one type of model over the other. If different stars were to show different amounts of parallax, that would rule out the possibility of them all being on one sphere, but still not really decide between Tycho and Copernicus. In fact, if we don’t worry about the distant stars, these two models describe identical relative motions of all the objects in the solar system. So the role of

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observation is not as direct as you might have guessed. There is no bare observation that can distinguish whether Tycho (taken broadly) or Copernicus (taken broadly) is right.35

Figure 1: The heliocentric parallax is on the left, the geocentric on the right. In the heliocentric model, the Earth is at the 11:00 o’clock position and is moving counterclockwise. In the geocentric model, the sun is at the 5:00 o’clock position and moving counterclockwise with the stars. The white lines converge at Earth and form the parallax angle. Notice that in both models the parallax angle is the same. At the top of the box is the “View from Earth.” Each box has the same view, showing the equivalence of the heliocentric and geocentric models.36

Carter/Sarfati: Galileo Galilei

Galileo Galilei (1564–1642) was the first person to point a telescope at celestial bodies—and contrary to popular myth, there is no record of anyone ‘refusing’ to look through Galileo’s telescope.38 He was the first to see the moons of Jupiter (and correctly interpreted them as such) and the rings of Saturn. He was the first to see sunspots, which refuted the Aristotelian and Medieval idea of perfect heavenly bodies. He noticed that Venus grew considerably larger and smaller over time, and, with his telescope, observed that Venus went through phases like the moon. The Ptolemaic theory had Venus orbiting the earth quite close to the sun, because we observe it only that way. However, under that scenario, the apparent size would not change by a factor of almost 7.39 This is explained by the fact that Venus orbits the sun at an average distance of 108 million km, while Earth orbits at 150 million km, so its closest approach to Earth is about 42 million km (150–108) and furthest about 258 million km (150+108).40 The phases cannot be explained under the Ptolemaic/Neo-Tychonic model that had Venus orbiting the earth close to the sun without the earth in between the sun and Venus to observe full and gibbous phases. But Venus orbiting the sun explains the huge difference in apparent size, the phases, and why the crescent phase is by far the brightest, since at that time Venus is closest to Earth.41

R. Sungenis: Although it is true that the Ptolemaic system could not account for Venus’ phases, the Neo-Tychonic model certainly does. The Neo-Tychonic model is just an inversion of the Copernican model wherein the planets orbit the sun but the sun orbits the Earth. Contrary to what Carter/Sarfati claim above, Venus does not orbit the Earth in the Neo-Tychonic model. It orbits the sun, which then allows Venus to come close to Earth and then far away, just as in the heliocentric system. See Galileo Was Wrong for more information.

35 University of Illinois, Physics 319, *ibid.*
36 See CDROM for animations of the geocentric and heliocentric versions of stellar parallax.
Carter/Sarfati: Galileo was the first to suggest a (correct, and workable when on land) way to solve the “Longitude Problem” by compiling a table of Jovian moon cycles for a reference location (including times and angles), then making observations of these events (same times, different angles) at a location whose longitude is unknown. There is a lot more to this man than most people realize!

R. Sungenis: Yes, there is a lot more, including the fact that Galileo was part of an underground movement to undermine the Church, and only had a true conversion to the Church three years before he died in 1542 (See David Wootton’s *Galileo Watcher of the Skies*, 2010). Included is the fact that Galileo, on his own, renounced the heliocentric theory one year before he died, which was revealed in a letter that Galileo wrote to Francesco Rinuccini who claimed that heliocentrism had been proven by stellar parallax (See Stillman Drake, *Galileo At Work: His Scientific Biography*, 1978, p. 418). Included is the fact that Galileo was not the first to invent the telescope. Included is the fact that Galileo was a deadbeat dad who had four children out of wedlock. Galileo had a rap sheet as long as the proverbial arm. One can read all about it in my book, Galileo Was Wrong.

Carter/Sarfati: Much has been written on his trial by the Catholic Church, and urban myths on the subject abound. Let us just say that the Church did not actively suppress geokinetic theory so much as Galileo insulted the Pope in such a way as to permanently break their friendship, at which point his opponents gleefully used the occasion to bring him to trial for heresy.

R. Sungenis: As noted earlier, this is nothing but a myth. From the day Copernicus published his book, the Church sought to ban it, and it was put on the Index of Forbidden Books just a decade or so later. The Church in 1616 and 1633 declared Copernicanism a “formal heresy,” and the publication of the Church’s condemnation was spread all over Europe by the Church herself in an unprecedented effort to stop a heresy. See my book Galileo Was Wrong for the full story.

Carter/Sarfati: However, Heilbron points out:

> Galileo’s heresy, according to the standard distinction used by the Holy Office, was “inquisitorial” rather than “theological”. This distinction allowed it to proceed against people for disobeying orders or creating scandals, although neither offence violated an article defined and promulgated by a pope or general council. … Since, however, the church had never declared that the Biblical passages implying a moving sun had to be interpreted in favour of a Ptolemaic universe as an article of faith, optimistic commentators … could understand “formally heretical” to mean “provisionally not accepted”.42

R. Sungenis: And what proof does Heilbron present from the Church to prove his thesis? None. The fact is, the Church declared Copernicanism a formal heresy because, in the Church’s own words, it disregarded the teaching of Scripture that the sun revolves around the Earth and that the Earth is fixed, no more, no less. The Church does not, and never has, declared something a “formal heresy” if it only means that it is not accepted at the present time. This is proven by the fact that the Church has never made an official statement that rescinded the condemnations of heliocentrism, to this very day. It is also proven by the fact that modern science has not come up with any scientific proof that the Earth is moving.

Carter/Sarfati: A map of known stars within 14 light years of earth, based on parallax measurements. Importantly, they are not just moving with respect to earth; they are moving with respect to each other,
meaning the constellations will change shape over time in a predictable manner. Absolute geocentrism can’t explain this in any practical way.

R. Sungenis: Contrary to what Carter/Sarfati are trying to promote, it is well-known among those who know and have studied the Neo-Tychonic system that it explains the movements of the constellations in the same way the geokinetic system does. The only difference is that the sun and stars go around the Earth as opposed to the Earth revolving around the sun against fixed stars. All the angles and distances of observation are identical in the two systems.

Carter/Sarfati: As shown above, it was really science vs. science, but Galileo also did not have all the science on his side. His favourite ‘proof’ for geokineticism was the tides, now known to be fallacious. Bede had proposed the right explanation centuries earlier: the moon was the main cause of tides. So the usual atheopathic historiography of science vs. ignorant religious geocentrism is based on historical ignorance and anachronism: many of the geocentrists were following what they thought was the best scientific evidence they had at that time. The detractors err by reading back modern science into people who could not have had this knowledge. We should not make the opposite error by ignoring modern science and adopting absolute geocentrism.

R. Sungenis: In actuality, it is precisely the findings of modern science that support “absolute geocentrism.” If it didn’t, I wouldn’t waste my time or my reputation on a theory that had no scientific evidence. Galileo Was Wrong is filled with scientific evidence, as well as the mathematical equations to demonstrate it. We will see a small portion of this proof later in this critique.

Carter/Sarfati: Tycho Brahe

Tycho Brahe (1546–1601) was yet another man of intelligence and diligence who left his mark on history. Without the aid of a telescope, he compiled careful astronomical observations over multiple decades, with a precision equivalent to the width of a US quarter seen at a distance of 100 meters. After the supernova of 1572, Brahe argued that the celestial sphere was not immutable, as Aristotle taught. He then argued that the Great Comet of 1577 traveled through the supposed crystal spheres (meaning they must not
exist). In the end, he proposed a mixed model where the other planets orbited the sun but the sun and moon orbited the earth. This was supported by the fact that Copernicus’ model did not fit the newest available data (but this was because of Copernicus’ perfect circle assumption).

R. Sungenis: It wasn’t a “mixed” model as much as it was the inversion of the Copernican model.

Carter/Sarfati: The Church did not actively suppress geokinetic theory so much as Galileo insulted the Pope in such a way as to permanently break their friendship, at which point his opponents gleefully used the occasion to bring him to trial for heresy.

R. Sungenis: This is the third time that Carter/Sarfati have repeated this myth.

Carter/Sarfati: Brahe also made a good point: that if the earth moved around the sun, then we should see parallax with the stars. Copernicus answered, rightly as it turns out, that the stars were even more distant than the vast distances already imagined. However, not so fast. At the time, stars were thought to have a definite apparent size, and stars like Vega were perceived to be larger than Polaris, for example. So Brahe calculated that if the stars were as far away as Copernicus required, they must be also be unimaginably huge, dwarfing the sun. These arguments would soon be answered by the geokineticists, but some weakly. One Copernican, Christoph Rothmann, answered Brahe’s point about the huge stars, essentially saying, “Who cares how big the stars are?” because size means nothing to an infinite God. This turns the usual atheopathic science vs. religion canard on its head: here the geocentrist was appealing to science, while a Copernican resorted to a sort of ‘God of the Gaps’ response. Once the earth spins, the pseudo-biblical arguments (e.g., “The Bible speaks of ‘sunrise’ so the universe must be geocentric”) go up in smoke. And once the earth spins, all the supposed observational evidence for geocentrism suddenly disappears.

However, it was not known—either by Brahe or by his opponents—that the apparent sizes of stars is an optical illusion—almost all stars are really point light sources when viewed from the earth, and the ‘size’ is a refraction or scattering effect. Even with a telescope, the scattering causes the ‘Airy Disc’, as realized by the 19th century scientist Sir George Biddell Airy (1801–1892). In reality, Vega, which Brahe thought was huge, is only 2.36 times as big as the sun, but it’s quite close. Polaris, which Brahe thought was a lesser star, is 43 times the sun’s size. The first direct image of a star outside our solar system, in the sense of the stellar disk as opposed to a point of light, was a Hubble Space Telescope picture of Betelgeuse, taken in 1996. But Betelgeuse really is a huge star, bigger even than the diameter of Jupiter’s orbit, and relatively close (about 643 light years), so it was possible to image its size. However, Airy disc diffraction wasn’t discovered until relatively recently, so we can conclude that Brahe was acting as a real scientist, using the best data available at the time. And although Brahe took Scripture seriously, he based his modified geocentric model on what he thought was the best scientific evidence. It is not surprising that for a few years Brahe’s geo-heliocentric theory, and many competing but similar theories, were more popular. Several of those competing theories involved a rotating earth in a geocentric universe, but every one of these, like their Greek progenitors, had a short shelf life. Once the earth spins, the pseudo-biblical arguments (e.g., “The Bible speaks of ‘sunrise’ so the universe must be geocentric”) go up in smoke. And once the earth spins, all the supposed observational evidence for geocentrism suddenly disappears.
Johannes Kepler

Kepler's Platonic solid model of the Solar system (1596).

Johannes Kepler (1571–1630) worked for Brahe and inherited his data upon Brahe’s death. Unlike Brahe, however, he was an early convert to Copernicus’ heliocentrism, believing that its mathematical elegance reflected the glory of the Trinitarian God of the Bible, and tried to refine it further. His first attempt was ingenious, even though he eventually abandoned it: he proposed that the orbits of the six known planets had the radii of imaginary spheres that circumscribed one of the five Platonic solids (octahedron, icosahedron, dodecahedron, tetrahedron, and cube), with each solid nested in the next with its vertices touching a circle that inscribed the next larger solid, and with all centered on the sun.49 Kepler found that the predictions differed from Brahe’s observations of Mars’ orbit by a mere 8 arcminutes. Since 1 arcminute = 1/60 of a degree, there was thus a tiny difference between observation and theory. The moon’s angular diameter as seen from earth is between 29.3 and 34.1 arcminutes, and Ptolemy’s and Copernicus’ earlier work was precise only to 10 arcminutes. However, Kepler held Brahe’s observation skill in such high esteem, since they were precise down to 2 arcminutes, that this tiny difference was enough to abandon the theory:

If I had believed that we could ignore these eight minutes [of arc], I would have patched up my hypothesis accordingly. But, since it was not permissible to ignore, those eight minutes pointed the road to a complete reformation in astronomy.

He then developed what are now called Kepler’s Three Laws of Planetary Motion: 1) all planets orbit the sun in elliptical orbits with the sun at one of the two foci, 2) planets sweep out equal areas in equal times, and 3) the square of orbital period is proportional to the cube of the semi-major axis of the orbital ellipse. His ideas were not universally accepted (e.g., Galileo and Descartes both rejected them), but his book Epitome of Copernican Astronomy would become the most-read astronomy text of the era.50 Still, what was lacking was a physical reason for the way things were. At that point in history, astronomy was allied with astrology and mathematics and was thus deeply steeped in philosophy. Physics was treated as an entirely separate subject and Kepler received criticism for even his minor attempts to bridge the two realms.

Isaac Newton

Isaac Newton (1642–1727) was simply one of the greatest scientists who ever lived. Among his many accomplishments, he developed the universal theory of gravity (1687), which stated that all objects in the universe attract all other objects, and that the attractive force is related to the mass of the two objects and their distance apart.51 He also gave us the Three Laws of Motion: 1) an object at rest will remain at rest, and an object in motion will remain in motion, unless acted upon by an outside force, 2) force, mass, and acceleration are related by the formula $F = ma$, and 3) there is always an equal and opposite reaction to any force applied to an object.

Think about it: Galileo first saw that smaller moons orbit larger planets. Newton then gave the reason for this. Apply this thought to the solar system. We know size of the sun. The sun has much more mass than the earth. If moons orbit their more massive planets, then the earth (and other planets) must orbit the much more massive sun.
R. Sungenis: The same is true in the Neo-Tychonic geocentric system. The planets orbit the much more massive sun, and the center of mass for the solar system is somewhere near or inside the sun. The difference, however, is that the Earth is the center of mass for the universe and thus is locked in place by the massive universe (of which the sun is only a very small fraction). As the universe spins clockwise each day, it carries the stars and our sun with it, although because of the inertial drag of the planets the sun lags behind by about 4 minutes per day. Briefly, there will always be local systems in the universe in which the smaller body revolves around the larger body, but in non-local systems, like the whole universe, it must revolve around its own center of mass. With the right size and mass, the Earth can occupy the universe’s center of mass.

Carter/Sarfati: At larger scales, we see globular clusters where stars are orbiting their common center of mass, as best as super-computer modeling can tell. Although here is where ‘dark matter’ is often added to the mix, so obviously there is more to learn (e.g. maybe we should adopt the new physics of Carmelian Relativity).

R. Sungenis: The need for dark matter to accommodate the rotation of spiral galaxies tells us that Newton’s mechanics may not be universally correct. This is what happens when someone gives us an equation for how much force gravity gives but can’t tell us how gravity works.

Carter/Sarfati: Importantly, Kepler’s three laws of planetary motion can be directly derived from Newton’s work (in fact, Newton did this). When one uses Newton’s law of gravitation and his 1st and 2nd laws in a heliocentric system, it turns out that one of the foci of the Keplerian ellipses is the barycenter (the center of mass of the system). But Newton went farther than that, and this is part of his brilliance. Newton very carefully explained that evidence for his theory should only be applied to limited sets of data. In building up explanations for various phenomena, results could be pooled into larger and larger explanatory models, but also any deviations from what is expected should be attributed to specific causes. This is one of the most important developments in the history of experimental science, for it led to more and more observational measurements and more and more refinement of his models.

R. Sungenis: As I have shown earlier, Newton’s own laws can be applied to the geocentric system, provided that the rest of the universe is incorporated into the equations. In fact, a system that does not incorporate the rest of the universe is shortsighted and thus needs to create things like Absolute Space and “fictitious forces” in order to compensate. The geocentric system does not have to compensate, since it includes all the forces of the universe in its system.

Carter/Sarfati: The simple idea that every particle in the universe is attracting every other particle can now explain, to an amazing degree of accuracy, the observational evidence, and that evidence stands in sharp contradiction to absolute geocentrism.

R. Sungenis: This is false. Carter/Sarfati seem very unfamiliar with how the geocentric system works, much less can they declare that it disagrees with the idea of “every particle in the universe is attracting every other particle.” In fact, geocentristers have a much better idea of how “every particle in the universe is attracting every other particle,” since they are not bound by Einstein’s Special Relativity theory which limits the speed of gravity and inertia to \( c \) (186,000mps). The present system of Carter/Sarfati has a hard time explaining why planets don’t zoom off into space since the gravity to hold them only travels at \( c \). In the geocentric system, gravity travels virtually instantaneously across the universe, and thus there is a true
and real action of “every particle in the universe is attracting every other particle,” whereas, because of Einstein, Carter/Sarfati are still waiting for certain particles to detect other particles.

Carter/Sarfati: There are many chaotic effects even in the solar system (perturbations from objects not yet cataloged), and as a result the math is not as precise as perfect clockwork, as one might expect. But these are small effects. An amazing number of phenomena can be explained. For example, Edmund Halley (1656–1742) announced that the moon appeared to be slowing over time (based on ancient eclipse data). Multiple theories were put forth by very smart scientists (e.g., Euler and Laplace), but Newtonian mechanics eventually won the argument (in the mid 1800s it was concluded that tidal friction was causing the slowing—and its resultant recession53). More and smaller discrepancies were noted over time, and in the early the 1900s the Hill–Brown theory was developed. On purely Newtonian grounds, it accounted for the many small variations in the earth’s rotation in relation to the moon, and most of this was explained by accounting for irregularities in the structure of the earth itself—in other words, further refinements of the Law of Gravity.

R. Sungenis: The rotation between Earth and space does not vary at all. The rate of 23 hours, 56 minutes and 4.1 seconds has not changed (more on this later). But it should vary if the Earth is rotating. Considering all the earthquakes, tsunamis, volcanoes, meteor showers, planetary perturbations, cosmic winds, tidal friction, etc. that have occurred over thousands of years, the inertial effects of these phenomena should have slowed the Earth’s rotation significantly. As for the moon, it will slow down and move farther away because it moves independently of the sun and universe, but a moon movement does not mean the Earth is moving.

Carter/Sarfati: Newtonian theory works to an incredibly high degree of precision here on earth, explains satellites, works on the moon, basically works everywhere we have tried it. If absolute geocentrism were true, none of these things should necessarily be true. Nor could we have derived such simple laws, resulting in many true predictions, from a geocentric universe. Therefore, why would we seek an alternative explanation to geokineticism?

R. Sungenis: We should seek an alternative to geokineticism because Scripture, the word of God who cannot lie, tells us so. With that foundation, we can then start to apply either Newtonian, Machian or Einsteinian physics, or a hybrid of them all, to show that God knew what He was talking about when he said the sun revolved around the Earth. Apparently, Carter/Sarfati don’t know how to apply Newtonian mechanics to a geocentric universe. But that is what will happen if one considers geocentrism as mere “stamp collecting.”

Carter/Sarfati: For those who think the Bible demands absolute geocentrism, it is notable that Newton wrote even more about theology than science, and thought his greatest work was an exposition of the prophecy of Daniel.54 He saw the solar system as evidence of the biblical God:

This most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent Being. … This Being governs all things, not as the soul of the world, but as Lord over all; and on account of his dominion he is wont to be called “Lord God” Παντοκράτωρ [Pantokrator cf. 2 Corinthians 6:18], or “Universal Ruler”. … The Supreme God is a Being eternal, infinite, absolutely perfect.55
Further, he was scathing of the atheism that dominates so much of academia today:

Opposition to godliness is atheism in profession and idolatry in practice. Atheism is so senseless and odious to mankind that it never had many professors.56

Also, despite accusations to the contrary, Newton was a confirmed Trinitarian, despite not being able to assent to all of Anglican doctrine.57

R. Sungenis: It matters little that Newton “wrote even more about theology than science”? Newton was a known Catholic-hater, and what better way to discredit the Church than to claim she got the wrong interpretation of Scripture and didn’t have the science to back her up?

Although Isaac Newton is much deserving of scientific credit for at least providing mathematical formulas of motion that, within the margin of error, are quite accurate, his personal life was little to be admired. Kepler’s jealousy of Brahe was only slightly worse than the avarice that drove Newton’s to confiscate the work of his contemporaries and credit it to himself. Newton won the day against Hooke by using his influence at the Royal Society, just as he did in heading off the new discoveries of Robert Boyle, all in an effort to advance his own career.37 On at least three separate occasions Newton introduced fallacious figures into the Principia in order to increase its apparent power of prediction.38 As Westfall notes:

And having proposed exact correlation as the criterion of truth, it took care to see that exact correlation was presented, whether or not it was properly achieved. Not the least part of the Principia’s persuasiveness was its deliberate pretense to a degree of precision quite beyond its legitimate claim. If the Principia established the quantitative pattern of modern science, it equally suggested a less sublime truth that no one can manipulate the fudge factor quite so effectively as the master mathematician himself.39

Because of Newton’s vast social influence, the book was considered an “epoch-making” work long before it was thoroughly reviewed, the highly popular John Locke having accepted it based merely on the word of Newton.40 In addition to the ill-treatment he gave to his scientific colleagues, Newton was rumored to have had a homosexual relationship with one John Wickins, a friend with whom he had lived for twenty years. He is also said to have had a liaison with Nicholas Fatio De Duillier, a man twenty years his junior and with whom he exchanged intimate letters, many of which were later censured by Newton or a confidant. Newton was also deep into alchemy (illegal at the time) and the Jewish Kabbalah, the occult

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musings of medieval Talmudic authors. Although he was reputed to have Christian moorings, Newton embraced the heresy of Arianism (i.e., the denial of both the divinity of Christ and the Trinity).41

Unknown to most, Newton spent most of his time interpreting biblical prophecy, writing over a million words on the subject. One of his more intriguing predictions is the date of 2060 A.D. as the end of the world, but that date surfaces only because Newton decided that the Roman Catholic Church was the Antichrist. Having arbitrarily put the Church’s historical peak at 800 A.D., he interpreted the 1260 days of Apocalypse 11-13 as years, adding them to 800 A.D. to come up with 2060 A.D. as the date of the end of the world.42 As Westfall says, Newton “hated and feared popery,”43 and as Koestler concludes, Newton was “a crank theologian like Kepler…and held that the tenth horn of the fourth beast of the Apocalypse represented the Roman Catholic Church.”44

Carter/Sarfati: Einstein

The universe is unintelligible under a system of absolute geocentrism and almost everything we think we know about the most profound astronomical discoveries of all time must be wrong.

Before the turn of the 20th century, several problems had become evident in Newtonian mechanics. Urbain Jean Joseph Le Verrier (1811–1877) first noted that the Mercury’s orbit had deviated from Newtonian predictions by a tiny ~40 arcseconds per century. Albert Einstein (1879–1955) answered this by concluding that Newtonian mechanics are valid approximations at low gravity, but at more extreme levels (e.g., the orbit of Mercury), gravity distorts space and time. In his 1916 paper on general relativity, he suggested three tests of his theory: 1) the precession of Mercury could thus be explained, 2) deflection of light by the sun, and 3) gravitational redshift. All three, and much more, have been confirmed.

41 Westfall writes: “In Newton’s eyes, worshiping Christ as God was idolatry, to him the fundamental sin” (Richard S. Westfall, Never at Rest: A Biography of Isaac Newton, Cambridge University Press, 1981, 1983, p. 314). On Newton’s intimacy with Wickens and Fatio, see Isaac Newton: The Last Sorcerer, Michael White, 1997, pp. 235-254. In addition, Voltaire had accused Newton of using his niece to entice politicians so that Newton could gain various positions of prestige. Voltaire writes: “I thought in my youth that Newton made his fortune by his merit. I supposed that the court and the city of London named him Master of the Mint by acclamation. No such thing. Isaac Newton had a very charming niece, Madame Conduitt, who made a conquest of the minister of Halifax. Fluxions and gravitation would have been of no use without a pretty niece” (Dictionnaire Philosophique, as cited in N. Martin Gywnne’s Sir Isaac Newton and Modern Astronomy, Britons Catholic Library, n. d., p. 8). Westfall, although an admirer of Newton and predisposed to dismiss any hearsay, adds: “The wider ramifications with Halifax, and Newton’s involvement in it, do not evaporate with equal ease,” although “With Halifax the libertine, Victorian eulogizers could not bear to associate Newton. Nor could they bear the thought, the point of Voltaire’s joke, that Newton used the degradation of his niece to advance his own career.” (Never at Rest: A Biography of Isaac Newton, 1981, 1983, pp. 596-597).

42 Newton borrowed the ‘1260 days = 1260 year’ scheme from the Puritan mystic Joseph Mede. Mede added the 1260 years to 400-455 AD and held that the end of the world would come around 1760-1815 AD. Others began at different dates (e.g., Bengel at 576; Ellicott at 608; Melanchthon at 660, et al., most trying to bring the terminus to the Reformation). Newton believed that the Second Coming of Christ would follow plagues and war and would precede a 1,000-year reign of Christ and the saints on Earth, otherwise known today as “premillennialism.” He spent close to 50 years delving into biblical prophecy, writing over 4,500 pages in an effort to determine the end of the world. Many of these papers had lain undisturbed in the house of the Earl of Portsmouth for 250 years, which were eventually sold by Sothebys in the late 1930s. This collection of papers was purchased by Abraham Yahuda, and was stored in the Hebrew National Library. It was among these documents that the date 2060 was found. (See also Michael White’s The Last Sorcerer, pp. 156-157).


R. Sungenis: Contrary to popular opinion, they have not been confirmed. Rather, they were made to appear as if they were confirmed. See Appendix 1.

Carter/Sarfati: Einstein’s theories also argue against an absolute-geocentric universe. This is a one-two punch. Geocentrism must address the experimental verification of both Newton and Einstein.

R. Sungenis: I have already shown that both Newton and Einstein support a geocentric universe, by their own words. Their only problem was that they didn’t like the logical conclusion of their own theories and thus opted for heliocentrism on philosophical grounds, which is not unusual either in Newton’s day or Einstein’s. As physicist George Ellis notes:

> People need to be aware that there is a range of models that could explain the observations. For instance, I can construct [for] you a spherically symmetrical universe with Earth at its center, and you cannot disprove it based on observations. You can only exclude it on philosophical grounds. In my view there is absolutely nothing wrong in that. What I want to bring into the open is the fact that we are using philosophical criteria in choosing our models. A lot of cosmology tries to hide that.45

Carter/Sarfati: Einstein famously said, “A thousand experiments cannot prove me right. A single experiment can prove me wrong” (rough translation).

R. Sungenis: There were, indeed, experiments that proved Einstein wrong, but he didn’t accept them. The 1887 Michelson-Morley experiment detected a small presence of ether in space,46 but Einstein tried his best to dispense with it. The Dayton Miller experiments in the from 1904 to 1923, with the same style interferometers, also found ether, but Einstein hired Robert Shankland to attempt to discredit them. The 1913 Sagnac experiment showed the same ether, but Einstein never mentioned it in any of his papers.47

The 1925 Michelson-Gale experiment, which used the same ether principle as the 1887 experiment and

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46 Michelson writes: “Considering the motion of the Earth in its orbit only, this displacement should be $2D \frac{v^2}{c^2} = 2D \times 10^{-8}$. The distance $D$ was about eleven meters, or $2 \times 10^7$ wavelengths of yellow light; hence, the displacement to be expected was 0.4 fringe. The actual displacement was certainly less than the twentieth part of this, and probably less than the forty-fifth part. But since the displacement is proportional to the square of the velocity, the relative velocity of the Earth and the ether is probably less than one-sixth the Earth’s orbital velocity, and certainly less than one-fourth” (A. A. Michelson and E. W. Morley, “On the Relative Motion of the Earth and the Luminiferous Ether,” Art. xxxvi, *The American Journal of Science*, eds. James D and Edward S. Dana, No. 203, vol. xxxiv, November 1887, p. 341.)

47 Sagnac writes: “In clear conception, it ought to be regarded as a direct manifestation of the luminiferous ether. In a system moving as a whole with a respect to the ether, the elapsed time of propagation between any two points of the system should be altered as though the system were immobile and subject to the action of an ether wind which would blow away the light waves in the manner of atmospheric wind blowing away sound waves. The observation of the optical effect of such a relative wind of ether would constitute evidence for the ether, just as the observation of the influence of the relative wind of the atmosphere on the speed of sound in a system in motion would (in the absence of a better explanation) constitute evidence of the existence of the atmosphere around the system in movement” (*Comptes Rendus de l’ Académie des Sciences* (Paris) 157, 1913, pp. 708-710, 1410-1413, (Gallica: Academie de sciences at http://visualiseur.bnf.fr/CadresFenetre?O=NUMM-3110&I=1&M=tdm) also cited in *The Einstein Myth and the Ives Papers*, pp. 247-248. Einstein’s biographer, Ronald Clark, who does not hide his favoring of Einstein, fails to mention Sagnac’s experiment in his over 800+ page book.
sought to measure a relative rotation between Earth and space, got 98% of a sidereal rate of rotation, but Einstein and his colleagues dismissed it.

**Carter/Sarfati:** And his theories have been tested, and passed those tests, thousands of times.

**R. Sungenis:** No they haven’t. For example, no one has detected length contraction. It was just an *ad hoc* theory first proposed by Lorentz and the commandeered by Einstein, and both did so in order to have an excuse for why Michelson’s 1887 experiment showed the Earth wasn’t moving in space. Additionally, no one has detected time dilation, only the fact that clocks slow down mechanically because of various environmental factors (e.g., gravity, inertial forces), but time itself does not slow down or speed up. The claims of mass increase can be easily shown by the fact that protons moving very fast are running up against ether, and thus will appear to gain mass. As Appendix 1 shows, Einstein fudged his numbers on the perihelion of Mercury, and there was really no evidence in Eddington’s eclipse photos to show a bending of starlight; besides the fact that General Relativity would require a gradation of bending depending on how far the light beam was from the gravitational source, but there was no gradation.

**Carter/Sarfati:** Thus, it is absolute geocentrism that lacks experimental validation, suffers from experimental contradictions, and supporters are forced to resort to more and more exotic ideas in order to explain away the many contradictions.

**R. Sungenis:** This is simply false. The 1887 Michelson experiment showed that the Earth wasn’t moving around the sun, since Michelson’s interferometer detected only a small fraction of the ether drift required for an Earth moving at 30km/sec. All subsequent interferometer experiment to Joos in 1930 showed the same results, but Einstein ignored them all and proposed that there was no ether. It is Special Relativity that “lacks experiment validation,” not geocentrism. It was Einstein who invented “more and more exotic ideas in order to explain away the many contradictions,” such as length contraction, time dilation, mass increase, and a constant $c$, not geocentrism. Today, the GPS system proves that light speed is not constant, since there is a 50 ns variation between EM beams traveling east to west as opposed to those traveling west to east. This is all covered over by adjusting the GPS computers with a Sagnac correction. After this correction, the GPS is then surreptitiously used as “proof” of Special Relativity.

**Carter/Sarfati:** But Einstein’s theories are based on those of James Clerk Maxwell (1831–1879) and his famous equations of electrodynamics,

**R. Sungenis:** Not true. Einstein admitted in 1920 that the 1887 Michelson-Morley experiment was the first reason he invented Special Relativity. He writes:

> Soon I came to the conclusion that our idea about the motion of the Earth with respect to the ether is incorrect, if we admit Michelson’s null result as a fact. This was the first path which led me to the special theory of relativity. Since then I have come to believe that the motion of the Earth cannot be detected by any optical experiment, though the Earth is revolving around the sun.\footnote{Yoshimasa A. Ono, *Physics Today*, 35 (8), 45 (1982).}

Regarding Maxwell, Einstein did not like the fact that similar to Sagnac’s finding of absolute motion in his 1913 interferometer experiment, Maxwell had found the same absolute motion between electric...
currents and magnetism, and thus he had to have two separate equations, one for an electric current going around a magnet, and one for a magnet going around an electric current. But Einstein tried to “relativize” Maxwell’s equations, the same as he did with Michelson and Sagnac.

**Carter/Sarfati:** Hendrik Lorentz (1853–1928) and his equally famous Lorentz Transformations,

**R. Sungenis:** Yes, Einstein did use Lorentz’s transform equation, but his use of it was even more dubious than Lorentz’s. At least Lorentz proposed a physical mechanism for why lengths contracted, that is, that moving matter was contracted by the ether. He thus proposed his “transform” equation to make all things equal, that is, to compensate for the contracted length. Einstein didn’t like the fact that ether was being used to contract the moving object, so he proposed that the contraction is just a mysterious principle of nature that occurs by “relative motion,” but never explained how such “relativity” could physically contract objects in motion. It was an effect without a cause, and Einstein was rightly criticized by philosophers for defying the laws of causality.

The most important fact, however, is that both Lorentz and Einstein used length contraction as a means to escape the fact that Michelson’s 1887 experiment showed the Earth wasn’t moving around the sun. To do so, they both claimed that the measuring stick to detect the Earth’s revolution around the sun, namely, Michelson’s interferometer, shrunk just enough (i.e., length contraction) to make it appear as if the Earth was standing still in space. In the end, they would do anything to make it appear as if the Earth were revolving around the sun, even if it meant turning science and causality on their respective heads.

**Carter/Sarfati:** and Jules Henri Poincaré (1854–1912), whose re-working of the Lorentz Transformation paved the way for Einstein.

**R. Sungenis:** No one needed to “rework” the Lorentz transform. It was simply a mathematical equation provided by Lorentz to make it appear as if the contraction was real and legitimate. All in all, it was an ad hoc theory invented out of desperation – to keep the Earth moving when the actual experimental evidence showed it wasn’t moving.

**Carter/Sarfati:** Thus, geocentrism runs into even more problems with experimental science. The universe is unintelligible under a system of absolute geocentrism and almost everything we think we know about the most profound astronomical discoveries of all time must be wrong.

**R. Sungenis:** Yes, indeed, most of what we “know” presently is wrong, and that is because it has all been governed by a bogus theory that was invented to keep the Earth moving when the “experimental science” of Michelson showed it wasn’t moving. Today, modern science is finding out that Einstein’s theories have put them into a bind precisely because the universe has become “unintelligible” the more they depend on Einstein’s theories to explain it. This was no better shown than in the invention of Inflation for the Big Bang. Since Einstein limited light speed to $c$, there was no way for the Big Bang to occur, since it could only occur at $c$. So modern science was forced to claim that the universe expanded beyond $c$ by another ad hoc theory – Inflation. Additionally, since the Big Bang must now expand beyond $c$ at its edges, once again, modern science must defy the $c$ speed limit.
We have often pointed out that when discussing astronomy the Bible is simply making a valid choice of reference frame. Someone sitting in a train does not seem to be moving with respect to the train but seems to be moving quickly compared to the world outside. Likewise, someone standing on the ground outside the train sees the person zipping by at the same speed as the train. The difference is that the two people have different frames of reference. Thus, for someone here on earth, the sun, moon, planets, and stars appear to be circling us, so why should the Bible not use earth as a frame of reference?

**R. Sungenis:** The fact that there are “frames of reference” depending on the observer is a simple fact of life, but it has little to do with determining what the Bible says about the actual state of the Earth. It is merely a sneaky way to get someone to consider that the Bible’s relative language (e.g., “the sun rises”) is the language it always uses for describing the universe. It is not, clear and simple.

**Carter/Sarfati:** And we always talk about a ‘stopped’ car, meaning stopped relative to the ground. Speed limits and stop signs are likewise set relative to the ground, and the GPS in many of our cars uses a car-centered reference frame! Only a pedant would point out that in the geokinetic system a car stopped at the equator travels at about 1,670 km/h (about 1,000 mph) relative to the centre of mass of the earth due to the earth’s rotation on its axis,58 and is orbiting 108,000 km/h around the sun, and is traveling 800,000 km/h around the centre of the galaxy. Sir Fred Hoyle (1915–2001), no friend to Christianity, affirmed:

> The relation of the two pictures [geocentricity and geokineticism] is reduced to a mere coordinate transformation and it is the main tenet of the Einstein theory that any two ways of looking at the world which are related to each other by a coordinate transformation are entirely equivalent from a physical point of view. Today we cannot say that the Copernican theory is ‘right’ and the Ptolemaic theory ‘wrong’ in any meaningful physical sense.59

But once you bring in physics (gravity), one model works with the physics and the other is just a set of equations of motion with no relation to physics. Note that Hoyle is speaking about a coordinate transform between any two reference frames in a geokinetic universe, not a dynamical explanation of the physics involved in how things move in a geokinetic vs. absolute geocentric model.

**R. Sungenis:** Although in the above quote Hoyle does not mention dynamics, it is only because he is concerned with geometrics in that particular context. But when he is in a context of dynamics, he states that geocentrism is also dynamically valid. He writes:

> …we can take either the Earth or the Sun, or any other point for that matter, as the center of the solar system. This is certainly so for the purely kinematical problem of describing the planetary motions. It is also possible to take any point as the center even in dynamics, although recognition of this freedom of choice had to await the present century.49

**Carter/Sarfati:** Once you have a set of equations of motions for a geocentric and heliocentric model, you can switch between them. Fine. But once you bring in physics (gravity), one model works with the physics and the other is just a set of equations of motion with no relation to physics.

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49 Fred Hoyle, *Nicolaus Copernicus: An Essay on his Life and Work*, p. 82.
**R. Sungenis:** This is false, and I am surprised that Carter/Sarfati would have the audacity to make such a conclusion. Since Einstein stated that his General Relativity theory (GRT) presents two ways of looking at the world (e.g., the geocentric or the geokinetic), are Carter/Sarfati suggesting to us that in the first of those ways, namely, geocentricm, Einstein didn’t have any “physics” or “gravity” as the reason it was viable? Certainly not. As we noted earlier, Einstein’s GRT allowed the same physics and notions of gravity to be used in equations to support geocentrism. As Max Born noted earlier:

> ...Thus we may return to Ptolemy’s point of view of a ‘motionless Earth.’ This would mean that we use a system of reference rigidly fixed to the Earth in which all stars are performing a rotational motion with the same angular velocity around the Earth’s axis…one has to show that the transformed metric can be regarded as produced according to Einstein’s field equations, by distant rotating masses. This has been done by Thirring. He calculated a field due to a rotating, hollow, thick-walled sphere and proved that inside the cavity it behaved as though there were centrifugal and other inertial forces usually attributed to absolute space. Thus from Einstein’s point of view, Ptolemy and Copernicus are equally right. What point of view is chosen is a matter of expediency.50

In addition, we have also shown earlier that even Newton’s laws of motion could be used to support geocentrism, which was admitted by Newton himself. We also saw that Andre Assis used the same principle of the co-equivalence of Newtonian physics wherein the whole universe was included in the calculations, which is precisely what geocentric math does. Our book, Galileo Was Wrong shows even more mathematical solutions to geocentrism, such as the paper by Dr. Luka Popov that was published in the *European Journal of Physics* in 2013. Apparently, Carter/Sarfati are oblivious to these, as well as oblivious to the mathematical implications of their own GRT equations for geocentrism. Unfortunately, since they haven’t done their due diligence, Carter/Sarfati insist on categorizing geocentrism as mere “stamp collecting.”

**Carter/Sarfati:** Note that Hoyle is speaking about a coordinate transform between any two reference frames in a geokinetic universe, not a dynamical explanation of the physics involved in how things move in a geocentric vs. absolute geocentric model. Once you have a set of equations of motions for a geocentric and heliocentric model, you can switch between them. Fine. But once you bring in physics (gravity), one model works with the physics and the other is just a set of equations of motion with no relation to physics.

Also, one of Stephen Hawking’s collaborators, South African cosmologist and theistic evolutionist, George Ellis, was quoted as follows:

> “People need to be aware that there is a range of models that could explain the observations,” Ellis argues. “For instance, I can construct you a spherically symmetrical universe with Earth at its center, and you cannot disprove it based on observations.” Ellis has published a paper on this. “You can only exclude it on philosophical grounds. In my view there is absolutely nothing wrong in that. What I want to bring into the open is the fact that we are using philosophical criteria in choosing our models. A lot of cosmology tries to hide that.”60

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Ellis is speaking here about big bang vs. other cosmological models, not geocentrism vs. geokinetics. The point here is that philosophy often intrudes itself into arguments about how the universe works. Ellis could have said the same about a literally-earth-centred frame.

**R. Sungenis:** What other “cosmological models” include a “spherically symmetrical universe with Earth at its center” other than geocentrism and “a literally-earth-centred frame”? Ellis is saying the same thing Einstein said, which is that the GRT equations support a geocentric universe as much as a geokinetic universe, since all one needs to do is invert the equations. This false conclusion about what Ellis is saying only shows the desperation of Carter/Sarfati.

**Carter/Sarfati:** Geocentrist often quote gleefully about supposed geocentric evidence in cosmology, but this is on a galactic scale – a scale far too large to differentiate heliocentrism from geocentrism.

**R. Sungenis:** No they do not. The galactic scale is only one of the aspects of geocentric cosmology. What Carter/Sarfati are referring to are the proposals by Hartnett and Humphries that the galaxies are geocentrically oriented, from their interpretation of the 2005 Sloan Digital Sky Survey, and which we enhanced in our movie, *The Principle*, which included the fact that the Cosmic Microwave Radiation was also geocentrically oriented. But geocentrist have also dealt with local phenomena, such as the dozens of interferometer experiments that show the Earth isn’t moving but that space is rotating around Earth on a daily sidereal rate. We have also explained stellar aberration, stellar parallax, retrograde motion, the Foucault Pendulum, geostationary satellites, and many other phenomena that are local, not galactic. Unfortunately, Carter/Sarfati only make general references to these issues with derisive comments like, “Geocentrist often quote gleefully about supposed geocentric evidence in cosmology.”

**Carter/Sarfati:** If choice of reference frame were the only issue, we would not have a problem with a geocentric reference frame in ordinary usage. However, this is not what modern geocentrist claim. Rather, they insist that the earth is the only valid reference frame, often combined with abusive ad hominem attacks on the faith of the Christian geokinetic pioneers.

**R. Sungenis:** Sorry, the “abusive language” usually comes from the “Christian geokinetic pioneers” (and Carter/Sarfati are no exception) against those who would dare question the status quo of modern science, and especially the theories of Albert Einstein. Evangelical Protestants, by and large, have swallowed hook, line and sinker many of the theories of modern science (e.g., Copernicanism and Relativity), yet claim to devote themselves to literal interpretation of the Bible only when it comes to discrediting the theory of Evolution. Perhaps they forgot that Genesis 1:1-20 is just as literal as Genesis 1:21-31.

As for “the earth is the only valid reference frame,” we hold to it because that is all the information that Scripture gives us. Scripture never says the Earth moves, either figuratively or literally, and it always says the sun moves, both figuratively and literally. Unfortunately, since Carter/Sarfati are blinded to that truth by their devotion to the Copernican status quo, they will continually demote Scripture in favor of Copernicus.

**Carter/Sarfati:** In the same way, the simplicity, elegance, and far-reaching predictive value of geokinetics puts a huge burden of proof on the geocentrist.

**R. Sungenis:** No, the burden of proof is on the geokineticist, since Scripture is clear that the sun moves and the Earth is fixed. The attempt to circumvent this clear language by claiming that every passage in
Scripture depicting these two phenomena is a figure of speech is simply untrue. Protestants have a bad habit of turning Scriptures that don’t fit into their world view into figures of speech.

The burden is also on the geokineticist because modern science has furnished no proof of a moving Earth, since every single “proof” that has been used in the past has been discredited. In fact, the prima facie results of the experiments show that the Earth is not moving (the 1887 and 1897 Michelson-Morley experiments, the 1902-04 Miller-Morley experiments) and that the universe is rotating on a daily sidereal rate (the 1913 Sagnac and 1925 Michelson-Gale experiments, etc.). The CMB alignments with the Sun-Earth ecliptic and the Earth’s equator, as well as with the galaxy, quasar and gamma ray busters geocentric alignment is also evidence for geocentrism. At best, Carter/Sarfati give glib allusions to these but do nothing to refute them. How can they? Newton, Mach and Einstein all agree that geocentrism is a viable scientific position!

**Carter/Sarfati**: Hoyle, Einstein, and Ellis (as well as the Cardinal of Cusa back in the 15th century) all said we could switch from one to the other just by transforming coordinates. But why would we want to, for any sort of study of motions in the solar system, galaxy, or cosmos? It is true that you can easily switch between Copernican, Tychonic, and Ptolemaic systems because they all relied on circular orbits. You could build a more complex geocentric model with elliptical orbits, but you are still going to fall short, because in order to make a comprehensive geocentric model, you would need dozens if not hundreds of ad hoc parameters added almost willy nilly to explain the many small perturbations that Newton’s model explains with the simple Law of Gravity. Geocentrism does not really have a “model” in a mathematical sense. Thus, the mathematics for converting from a geokinetic to a geocentric universe are almost unbelievably cumbersome.

**R. Sungenis**: There are no “ad hoc parameters” that need to be added, and, in fact, Carter/Sarfati give us no examples of such parameters that need to be added. Instead, they create a boogeyman of their own choosing. As we have shown, the only thing that needs to occur for a Newtonian geocentrism is to change $F = ma$ in the solar system only model to $F = ma +$ inertial forces for in a rotating universe/fixed earth model. The “Law of Gravity” is not partial to either heliocentrism or geocentrism.

**Carter/Sarfati**: Many modern ‘geocentrists’ make another ad hoc adjustment that should doom their theory by definition: placing the earth off-center—a tacit admission that Kepler was right all along that the sun was at the focus, not the centre of elliptical orbits. Thus, they have a neo-Tychonic system in which the moon and sun orbit the earth but the planets orbit the sun, and all with elliptical orbits. This bait-and-switch is hardly solved by their preferred neologism ‘geocentricity’.61 It was the accumulation of these ad hoc parameters in geocentric models that made scientists seek for a better explanation in the first place. The transform only works in practice at the basest of levels.

**R. Sungenis**: Carter/Sarfati can make all the assertions they want. Proving them is another story. They have not even shown a transform, much less discredited it. As for the “off-center” issue, why Carter/Sarfati propose that this should “doom” geocentrism is anyone’s guess. There are two centers in the geocentric system—the geometric center and the mass center. The sun is the geometric center since the sun and stars move together around the Earth. The Earth is the mass center because it is the center of mass for the rotating universe. Carter/Sarfati make reference to “geocentricity,” which is a term coined by my colleague, Dr. Gerhardus Bouw. Similar to Danny Faulkner’s attempt over a decade ago to refute
geocentrism, Carter/Sarfati cherry-pick their way through Bouw’s work, and even when they do hit upon something of important, they fail to give any evidence to the contrary, except their assertions.

Carter/Sarfati: The geokinetic argument starts with a very simple Newtonian law: all objects in the universe attract each other according to the inverse square law.

R. Sungenis: This is geokineticism’s most obvious flaw, since as Carter/Sarfati admit, they are following Einstein’s Special Relativity which limits the speed of gravity to $c$ (186,000 mps). Hence, “all objects in the universe CANNOT attract each other” because they are not only too far away, but the time lag for such a slow speed of gravity would wreck havoc in the universe. Even in the solar system, the planets should be going off into space since the gravity from the sun takes too long to reach them. As a result, the whole system is flawed.

Carter/Sarfati: Everything else follows naturally from there. Why does not everything in the solar system collapse into the sun? Orbital angular momentum balances the attractive force of gravity.

R. Sungenis: Does it? From where is the planet getting its constant force to move forward? In other words, what is Carter/Sarfati’s explanation for inertia? Newton didn’t have one. It was an effect without a cause. Geocentrism has an answer. It comes from the inertia created by a rotating universe, and the universe can rotate ad infinitum since there is nothing outside of it to stop it from rotating.

Carter/Sarfati: This works until you get to the size of galaxies and galactic clusters, but this is an ongoing field of study among evolutionists and creationists, with multiple competing models.

R. Sungenis: You now see how it works. Geokineticists don’t know why Newton’s laws are not working outside our solar system, which shows that there is a major contradiction in their model. Yet the geocentrists who propose a complete model that includes the whole universe is said to be “ad hoc and without mathematical equations” or “stamp collecting.” This is prejudice, not science.

Carter/Sarfati: Also, because of Newton’s second law, acceleration = force/mass, the more massive objects accelerate less with the same applied force. So when dealing with objects of vastly different masses, it makes more sense as an approximation that the most massive object is treated as an unmoving centre. In reality, everything in the solar system revolves around the centre of mass (the barycenter). For the earth-sun system, this is 450 km from the centre of the sun (0.065% of the radius of the sun), so treating the sun as the center is a very good approximation.63

R. Sungenis: So if the sun can be the center of mass for the planets, then why can’t the Earth be the center of mass for a rotating universe? Carter/Sarfati have given no reason why. They just don’t like it because they are wed to geokineticism.
The location of the barycenter of the solar system changes over time based on the position of the planets.

**R. Sungenis:** Geocentrist holds to the same understanding of the sun’s center of mass, so there is no reason to make such a display and imply that it only applies to geokineticism.

**Carter/Sarfati:** In many ways, the geocentrism debate is akin to the “Did men really land on the moon conspiracy”. Why could they not have done so when everything we know about experimental science (from the force of gravity, the properties of accelerating objects, the workings of jet engines, geometry, trigonometry, calculus, etc., etc.) all argue that it is entirely possible? In fact, a motivated high school student could work out many of the necessary calculations. In the same way, the simplicity, elegance, and far-reaching predictive value of geokinetics puts a huge burden of proof on the geocentrist.

**R. Sungenis:** Unfortunately, Carter/Sarfati continue to use the same boogeyman.

As for the moon landing itself, the issue is not whether man in the 1960s had the theoretical possibility to land a man on the moon, but could this really be accomplished with computers that were no more powerful than a Walmart watch; and were we able to protect a very fragile man from the cosmic radiation that constantly bombards the space between the earth and moon? These are only two of the basic questions that still remain unanswered today, along with many others. Suffice it to say, Carter/Sarfati is out of line for engaging in such demagoguery.

**Carter/Sarfati:** In science, there are many useful reference frames. For example, electrical engineers often find it most convenient to use a ‘bug on the rotor’ as the reference frame when studying induction motors, to understand the way the rotating magnetic field ‘slips’. But if you average out the motions of all the stars in our local cluster, we are moving about 70,000 km/h, in the direction of Lyra (geokinetic), and in reference to the galactic center we are moving about 800,000 km/h.

**R. Sungenis:** No, that is simply unprovable. All we know is that we see redshifts and blueshifts, Doppler shifts, gravitational shifts, etc. We cannot prove whether the objects far away from us are moving toward
or away from us, or whether we are moving toward or away from them. In fact, the CMB anisotropies give us three different speeds and three different directions of the radiation. This isn’t possible if we are moving toward or away from the radiation, but only if the radiation is moving toward or away from us.

Carter/Sarfati: To say that all frames of reference are valid, as some do, is the central point of Relativity. However, to then say that a geocentric frame is the only true or valid frame is breaking the very rule they try in invoke.

R. Sungenis: No, it is not breaking any rules. Carter/Sarfati believe in Relativity, so they are stuck with the two-option dilemma. We only refer to Relativity because it traps Carter/Sarfati from denying geocentrism, not because we believe in Relativity. How could we, since we believe the Earth is absolutely fixed in the universe and thus nothing is relative? But as we argue from the scientific dilemmas that Carter/Sarfati are in, we urge them that, of the two models made possible by their own Relativity theory, they should choose the geocentric, because this is the prima facie information in Scripture, for Scripture always says the sun moves, literally or figuratively, and always says the Earth is fixed, literally or figuratively. If it wasn’t for the self-serving claims of apply figures of speech wily-nily, there would be no further argument, at least among Christians But somehow, today’s conservative Christians think they have the right to deny Darwin based on a literal interpretation of Scripture, but to allow Copernicus and Einstein in a deliteralization of Scripture. The contradiction speaks for itself.

Carter/Sarfati: And what is to prevent someone from claiming the center of the universe is at the tip of their nose (‘idiocentrism’), since that is 100% in agreement with every personal observation any person has ever made?

R. Sungenis: Funny as it seems, he would have a better chance arguing that his nose is the center than he would arguing that Promima Centauri is the center, since he lives on Earth which, according to Scripture is fixed and everything else goes around it.

Carter/Sarfati: Supporting Evidence (or, why the earth cannot be at the absolute center)

The rate of acceleration of objects in the universe

According to Newton’s first law, an object in motion will tend to go in a straight line. Thus, in order to orbit something, an object must turn. In other words, it must accelerate—to a physicist, this means any change of speed or direction. Newton’s second law states that the force required is proportional to the mass and the acceleration (F=ma). If the entire universe is rotating (accelerating) around the earth, how much force would be required to keep things from flying apart? And, the farther away the object, the greater the orbital radius, the more acceleration is required.

R. Sungenis: Let’s tackle this first objection by using the very Relativity theory that Carter/Sarfati espouse. As we have seen earlier, all advocates of GRT admit that the GRT principles of co-equivalence and co-variance mean that, geometrically and dynamically, a geocentric universe is viable. As such, GRT must also accept that light and any material object can exceed the speed of light. Hence, only in Einstein’s Special Relativity theory (SRT) are light and material objects limited to c or less, respectively. The reason is that SRT does not incorporate either gravity or inertial forces, but GRT does.
In effect, SRT really has no applicability in the universe, since there is no place that is not affected by gravity and inertial forces. So it is a phantom theory, to say the least; besides the fact that it was created to have some excuse why Einstein and his colleagues didn’t have to accept the prima facie evidence from the 1887 Michelson-Morley experiment that the Earth wasn’t moving.

Let’s see how a book on General Relativity explains the problem:

Relative to the stationary roundabout [the Earth], the distant stars would have…linear velocities exceeding $3 \times 10^8$ m/sec, the terrestrial value of the velocity of light. At first sight this appears to be a contradiction…that the velocities of all material bodies must be less than $c$ [the speed of light]. However, the restriction $u < c = 3 \times 10^8$ m/sec is restricted to the theory of Special Relativity. According to the General theory, it is possible to choose local reference frames in which, over a limited volume of space, there is no gravitational field, and relative to such a reference frame the velocity of light is equal to $c$. If gravitational fields are present the velocities of either material bodies or of light can assume any numerical value depending on the strength of the gravitational field. If one considers the rotating roundabout as being at rest, the centrifugal gravitational field assumes enormous values at large distances, and it is consistent with the theory of General Relativity for the velocities of distant bodies to exceed $3 \times 10^8$ m/sec under these conditions.\(^{51}\)

So, Carter/Sarfati are stuck with the fact that their own theory allows both the stars to exceed the speed of light in their rotation around a fixed Earth, and for the speed of light to exceed $c$. Special Relativity has no say in this issue, so it is specious for Carter/Sarfati to refer to it, at any time, in their attempts to refute geocentrism. But since the claim that “nothing can go faster than the speed of light” has been engrained in the human psyche, scientist and layman alike use it with abandon but don’t know what they are talking about.

**Carter/Sarfati:** Remember, there is overwhelming evidence against solid spheres holding the stars and planets in place, and since we can measure distance to many stars using parallax, there is no single “sphere” upon which they are stuck. Based on Newton’s laws, we can estimate the mass of many stellar objects and guess at the mass of many more. The force required to hold them in circular orbits around the earth at faster-than-light speeds (see below) would be astronomically huge.\(^{64}\)

**R. Sungenis:** Well, they might be greater away from the earth than they are closer to the Earth, but whether they would be “astronomical” is something that Carter/Sarfati haven’t proven and, basically, can’t prove. They have already admitted that Newton’s laws don’t work outside the solar system, so how are they going to use Newton’s laws to “estimate the mass of many stellar objects and guess at the mass of many more”? They can’t. Obviously, since galaxies rotate 10 times faster than they are allowed to by $F = ma$, this means that, at the least, Carter/Sarfati “estimations” could be off by one order of magnitude.

**Carter/Sarfati:** The speed of objects in the universe

If objects are rotating around the earth, we can calculate the speed at which they are moving, and the speed depends on their distance. They must travel the circumference of their orbit every day. In big bang
theory at least, there is nothing preventing stars from moving faster than the speed of light. This is called ‘superluminal speed’ and big bang cosmologists assume that anything outside one Hubble radius (about 14 billion light years) is receding from us at greater than c.

R. Sungenis: Notice how conveniently Carter/Sarfati allow themselves to exceed the speed of light for their geokinetic model, yet they give us not the slightest scientific justification for it, other than the fact that “big bang cosmologists assume that anything outside one Hubble radius (about 14 billion light years) is receding from us at greater than c.” This isn’t science. This is mere wishful thinking. Ironically, Carter/Sarfati won’t allow the universe to rotate beyond c, but they will surely allow the universe to expand beyond c. What’s the difference? There is none, but Carter/Sarfati don’t tell their audience that simple fact.

What Carter/Sarfati don’t tell you is that the only reason the Big Bangers allow for “superluminal speed” is because GRT allows them to. But GRT also allows for the universe to rotate at superluminal speed, as noted above. So, in effect, Carter/Sarfati are being honest scientists, since they are not admitting the logical conclusion of their own theory for geocentrism.

Carter/Sarfati: But in a geocentric universe any object beyond the orbit of Neptune would be moving faster than c, because it would take more than one day to travel a circle of that circumference at the speed of light.

R. Sungenis: So, as Carter/Sarfati continue to use the “speed of light” canard, let’s examine this claim on the face of it. Is any object in the geocentric universe beyond Neptune traveling faster than light? No. In the geocentric universe, the universe is rotating and carrying everything else with it. The planets have local movement only.

If Carter/Sarfati want to argue that the universe can’t spin that fast, on what basis could they make such a claim? They surely can’t make it using GRT. They surely can’t make it on a Newtonian basis, since Newton claimed there was Absolute Space against which he could calculate his famous F = ma, but against what are Carter/Sarfati going to measure the rotation of the universe? Is there an Absolute Space outside the universe? So Carter/Sarfati are stuck. They have no way to disprove a daily rotating universe.

But, if all things are equal, and since we claim to use the Earth as the center of mass for a rotating universe, let’s show Carter/Sarfati how we would use Newton’s laws to balance out the centripetal and centrifugal forces for the objects inside a rotating universe. Here is how we do it (and notice that the math is not complicated at all).

First, let’s give ourselves a picture of the inertial forces involved in a geocentric model. They are the centrifugal force, the Coriolis force and the Euler force. Remember that in the solar system model of the Newtonian physics, these three forces are “fictitious,” but in the geocentric model that incorporates the whole universe, the three forces are real. All together they would work geometrically in the geocentric system as follows:
One can see from the Wikipedia article on Coriolis force\(^{52}\) about half way down the page this statement:

“It is seen that the Coriolis acceleration not only cancels the centrifugal acceleration, but together they provide a net ‘centripetal’, radially inward component of acceleration (that is, directed toward the center of rotation)”

This is all we really need to show that Newton supports geocentrism. The “centripetal” force (i.e., that force which pulls the rotating object toward the center of mass) created by the three inertial forces is enough to counteract the outward pull of the object. The math works as follows:

\[ F_I = -2 m \Omega \times v - m \Omega \times (\Omega \times r) \]

\[ = 2 m \Omega \times (\Omega \times r) - m \Omega \times (\Omega \times r) \]

\[ = m \Omega \times (\Omega \times r) \]

\[ = m (\Omega (\Omega \cdot r) - r (\Omega \cdot \Omega)) \]

\[ = -m \Omega^2 (r - |r| \sin(\delta) u_{\Omega}) \]

where \( u_{\Omega} = \Omega^{-1} \Omega \) is a unit vector in the direction of \( \Omega \). The fictitious force \( F_I \) is thus a vector of magnitude \( m \Omega^2 |r| \cos(\delta) \), perpendicular to \( \Omega \), and directed towards the center of the star’s rotation on the Earth’s axis, and therefore recognizable as the centripetal force that will keep the star in a circular movement around that axis.

It’s a good thing we caught this Wikipedia treatment before someone took it off. Why would they take it off? Not because it’s wrong, but because it’s too right! Someone didn’t want you to see that if they applied the math to the “distant stars” we would see that in the Newtonian framework there is no problem

\(^{52}\) https://en.wikipedia.org/wiki/Coriolis_force
Carter/Sarfati: If geocentrism is true, there should be a ‘spatial Coriolis’ seen in the Pioneer probes and other objects we have sent into the heavens. Here on earth, the Coriolis force is seen when objects traverse an inertial reference frame other than the one in which they started. There should be a ‘spatial Coriolis’ as well, because objects leaving earth are starting with an inertial reference frame radically different from the one to which they are travelling. If we aimed them at a planet, they should miss—by millions of miles! Note that this argument is exactly the same as the one Copernicus quoted from Ptolemy above, only here instead of a curving falling object we have a curving rising object. In order to get to a planet, the ship would have to accelerate to unbelievable speeds. Where does this extra propulsive force come from? And if that acceleration did not happen, if one of our ships happened to run into one of the distant planets it would smack into it at such a high velocity as to completely obliterate the planet. This underscores the hopelessness of deriving any dynamical model for geocentrism once we leave the vicinity of the earth.

R. Sungenis: This is false. The Coriolis force/effect must be taken into account when launching a space probe from the heliocentric frame. In the Newtonian system, we calculate it by the F = ma + inertial forces equation. In the GRT system, they calculate it by the frame-dragging effect.

Carter/Sarfati: To go from a speed greater than c to a speed much less than c, and then back again, comets would have to come with warp-drive.

R. Sungenis: As noted earlier, the comets are not going the speed of light in the solar system or anywhere else in the universe. Carter/Sarfati need to distinguish between the star field and the universe that contains the star field.

Carter/Sarfati: Here is another example of the speed problem: the moon orbits the earth at about 1 km/s, with an average distance from the center of the earth of 385,000 km (this is based on simple trigonometry). In a geocentric universe, instead of orbiting every 27.32 days, it orbits daily, meaning it must move about 27 km/s. This is much faster than the Apollo spacecraft sent to the Moon in the 1970s. In fact, it is faster than the 11.2 km/s required to reach escape velocity. The Moon should sail away into space, but it does not because it is not orbiting at that speed and is held nicely in place by the force of gravity.

R. Sungenis: Again, the moon does not move at 27km/s in the geocentric system, since it is the universe that is rotating around the Earth and carrying all the celestial bodies with it. The moon is moving slightly independently of the universe (by 1km/s) as also the sun is moving slightly independently.

Carter/Sarfati: And think about what would be required to bring a long-period comet in from the apex of its orbit (aphelion) to a close approach with the sun (perihelion). We can estimate the mass of many different comets (and after the Rosetta/Philae rendezvous described above, we know the mass of one comet to a high degree of precision), and thus we know how much force it would take to account for the necessary acceleration to bring them closer in within a geocentric universe. To go from a speed greater than c to a speed much less than c, and then back again, comets would have to come with warp-drive.

R. Sungenis: Answered above.
Carter/Sarfati: Aberration of starlight

The velocity of the earth changes as it orbits the sun, therefore the expected position of the sun changes over time. In the same way that rain seems to fall at an angle while driving in a car on a rainy day, the perceived direction to various stars shifts as the earth revolves around the sun. This was first noticed in the 1500s, but it defied explanation and interfered with the search for stellar parallax. Aberration was first explained by James Bradley (1693–1762) in 1729. He also provided a decent approximation of the speed of light (183,000 miles per second, 98.4% of the true value). Aberration is a direct effect of the earth’s movement about the sun and is perfectly consistent with Newtonian physics. Under geocentrism, however, arbitrary explanations must be invoked to explain it.

R. Sungenis: Arbitrary explanations? If any system has arbitrary explanations of stellar aberration it is geokineticism, since Relativity provides a wholly different answer than Newton does. As for the geocentric explanation, there is really only one answer, and it is the same answer we give for stellar parallax, only in this case there is only one star involved, not two. If the sun-stars are off-set from the Earth by 1AU and revolve around the Earth, the stars will produce the same aberration as in the geokinetic system, exactly the same. If Carter/Sarfati had studied the geocentric system, they would know this. That is bad science. Here is a snapshot from our animation of stellar aberration. (To view the animation, purchase the CDROM we offer from www.galileowaswrong.blogspot.com)

Carter/Sarfati: Think about it. If the universe revolves around the earth, stars circle the earth 365 times a year. For a star exactly 10 light years away, the star would revolve 3,652.42 times before its light reached earth. In other words, the light beam should trace out a path that looks more like a very tight spiral, with arms 24 light-hours apart (assuming a finite and constant speed of light). This would be able to be measured easily. And, since we have sent multiple space probes (with cameras) far enough away from earth, this would have been discovered by now Thus, the stars do not rotate about a stationary earth.

R. Sungenis: Once again, Carter/Sarfati fail to realize that the stars do not revolve around the Earth individually, but only because the universe that rotates is carrying them. Any proper motion a star has (which is not much) is the only movement independent of the rotating universe.
In 1781, Sir Frederick William Herschel (1738–1822) discovered the planet Uranus. Upon subsequent observations, its orbit was worked out by Anders Johan Lexell (1740–1784). However, slight disturbances in the measured orbit of Uranus led to the prediction of another, undiscovered planet by Le Verrier in 1846. Neptune was discovered by Johann Gottfried Galle (1812–1910) the same evening Le Verrier’s letter to him predicting the existence of an undiscovered planet arrived at the Berlin Observatory. This was perhaps the greatest achievement of the Newtonian system, and ranks as one of the greatest achievements of experimental science. The perturbations of Jupiter and Saturn on Uranus are greater than that of Neptune and it was only by applying Newtonian gravitational theory to the situation (by factoring out the effects of Jupiter and Saturn) that Neptune could be discovered. What is even more amazing is that Uranus, with an orbital period of 84 years, had not even completed one orbit of the sun before it was used to find Neptune! We were able to better estimate the mass of Uranus after the Pioneer flybys of Neptune. This, in turn, answered a riddle that was created by earlier, less exact estimates and the need for a hypothesized 10th planet to account for certain discrepancies simply vanished. Can you see how Newton’s methodology has led to further and further successful refinements of the geokinetic system?

R. Sungenis: Carter/Sarfati fail to see that the same Newtonian dynamics would work in the geocentric system, since it is just an inversion of the geokinetic. As Hoyle noted, the dynamics are exactly the same in both systems.

Carter/Sarfati: Absolute geocentrism could never have predicted Uranus and Neptune from orbital mechanics. Remember, both the Ptolemaic and Tychonian models are kinematic: they merely describe how planets are observed to move. Any observed deviations are just tacked on to the model—what’s another epicycle here or there? Only under a dynamic model, with forces causing motions, can a deviation from predictions have any real meaning.

R. Sungenis: We can now see why Carter/Sarfati are having great difficulty. They continue to mis-categorize the Tychonian system as merely a kinematic model instead of also a dynamic model. CMI has thus misrepresented the geocentric system to its entire audience who may never know the difference.

Carter/Sarfati: The Return of Halley’s Comet

Alexis-Claude Clairaut (1713–1765) successfully calculated the return of Halley’s comet to perihelion in 1759. In order to do so, he had to account for the gravitational effects of Jupiter and Saturn on the comet, and the effects of Jupiter on the sun. Using the most advanced mathematics of the day (calculus), his detailed calculations took years. In the end, he was off by about 1 month, within his margin of error. This was taken as a triumph of Newtonian gravity theory and helped tremendously to bring mathematics and physics together. Prior to this, many thought math was just pure, applied logic and that the physical world was nothing if not mysterious. Theory and fact were not always expected to mesh together. This changed after 1759.66

R. Sungenis: Once again, as we have shown with other motions, the same calculations could have been made with the geocentric system.
**Carter/Sarfati:** Delicate orbital mechanics

There are several places in any planetary system called Lagrange points where the gravitational attraction of the sun exactly balances that of the planet, meaning an object can orbit at the same rate as the planet even though it is a different distance from the sun. The first three Lagrange points were discovered by the great mathematician, and staunch Christian, Leonhard Euler (1707–1783). In 1772, his able student and successor Joseph-Louis Lagrange (1736–1813) described the remaining two. These discoveries (and their later confirmation) were squarely based on Newtonian theory. In a fine example of applied Newtonian physics, ESA’s Gaia space telescope is placed on a Lagrange Point (L2, specifically). It was already known that L2 is unstable (small deviations from equilibrium grow exponentially over time), so in order to keep the satellite in place while using the smallest possible amount fuel to fine-tune the position, it was placed in a looping, Lissajous orbit that also had the effect of keeping it out of earth’s shadow. This elegant dance was made possible by geokinetic theory.

**R. Sungenis:** Once again, as we have shown with other motions, the same calculations could have been made with the geocentric system. See Appendix 2 for further explanation.

**Carter/Sarfati:** The equatorial bulge

Newton noticed that Jupiter had an equatorial bulge and reasoned that this was due to the fact that it was rotating, causing a fictitious centrifugal force in Jupiter’s reference frame.67,68. He then reasoned that earth must have a bulge as well and set about to estimate its magnitude. It turns out that sea level at the equator is about 21 km ‘higher’ than at the poles. Other rotating bodies also have an equatorial bulge, including Mars, Saturn, Uranus, Neptune and the asteroid Ceres. At the equator, there is a reduction in apparent surface gravity of \( \frac{1}{2} \) of 1% compared to the poles. 70% of that is due to the ‘centrifugal force’ counteracting the attractive force of gravity. The remainder is due to the difference in distance from the center of the earth caused by the bulge. However, this is enough to make the furthest surface point from the earth’s center the summit of the equatorial volcano Chimborazo, not Everest. The equatorial bulges of objects in near space are due to rotation. Earth has a similar bulge. Geocentrism must claim the two phenomena are due to different causes, which is nonsensical.

**R. Sungenis:** Again, the centrifugal force from a rotating universe will cause the same bulge as a rotating earth, since neither are independent systems, according to Mach and Einstein. As for Newton, if we rotate his Absolute Space against a fixed earth, the same inertial forces will be created that he calls “fictitious” in his non-rotating Absolute Space model. As it stands, Mercury does not have a bulge because it is not rotating. Earth does because the universe is rotating around it. The rest of the planets will have a bulge because they are rotating.

**Carter/Sarfati:** To be fair, geocentrists could in theory solve the problem with relativity. Max Born (1882–1970), Nobel laureate and quantum mechanics pioneer, pointed out:

> Thus we may return to Ptolemy’s point of view of a ‘motionless earth’ … One has to show that the transformed metric can be regarded as produced according to Einstein’s field equations, by distant rotating masses. This has been done by Thirring. He calculated a field due to a rotating, hollow, thick-walled sphere and proved that inside the cavity it behaved as though there were
centrifugal and other inertial forces usually attributed to absolute space. Thus from Einstein’s point of view, Ptolemy and Copernicus are equally right.69

But here again, Born just said it was possible, not mandatory or even practical. And ironically, many absolute geocentrists reject relativity, since they don’t want to concede that non-geocentrism is even as right as geocentrism.70

**R. Sungenis:** It does not matter whether the bulge or anything else co-equivalent with Relativity is “not mandatory or even practical.” This is not a test of morals or ethics. It is a simple fact that both systems can produce the same forces and/or effects, and thus, if Carter/Sarfati are going to advocate Einstein’s Relativity, then they are stuck with the fact that the major physics system working today supports geocentrism. The only thing Carter/Sarfati need to learn and apply now to geocentrism is the Newtonian system, since, as we saw earlier, even Newton admitted his laws of motion will work with his equations when an additional force is applied. That additional force comes from a rotating universe.

**Carter/Sarfati:** The oddly wiggling universe

If geocentrism is true, nutations and earthquakes change the rotational speed of the universe instead. Yet, strangely, even though there is no reason to believe all objects in the universe are connected, they all change their rates of rotation at the same time.

**R. Sungenis:** Wasn’t it Carter/Sarfati who earlier told us “The simple idea that every particle in the universe is attracting every other particle can now explain, to an amazing degree of accuracy, the observational evidence”? And now they are telling us “there is no reason to believe all objects in the universe are connected.” So which is it, or do they want their cake and eat it, too?

**Carter/Sarfati:** If the earth is the center of everything, we must explain why events happening here on earth affect the rest of the universe. For example, Bradley discovered that the earth wobbles on its axis much like a spinning top wobbles as it revolves. ‘Nutations’ like this are explained by Newtonian theory to a high degree of accuracy, but would be nothing more than arbitrary changes in the rotation of the cosmos under geocentrism. And earthquakes, like the one that caused the massive tsunami that hit Japan in 2009, are known to affect the rotation of the earth. Scientists actually measured a change in the rate of rotation of the earth after that event. If geocentrism is true, nutations and earthquakes change the rotational speed of the universe instead. Yet, strangely, even though there is no reason to believe all objects in the universe are connected, they all change their rates of rotation at the same time. And these objects are at vastly different distances to the earth. Thus, there is a time delay that must be accounted for. Do objects further out change earlier than objects closer in, and are all these sequential changes timed to future events here on earth? No. We see everything in the universe changing at the same time because it is the earth itself that is changing its rotational speed.

**R. Sungenis:** As I noted earlier, there is no appreciable change in the relative rotation between space and Earth. It is always 23 hours, 56 minutes and 4.1 seconds. This is precisely why the geocentric system is more stable for us earthlings, whereas Venus has changed its rotation by 6 minutes over the years it has been studied.

Invariably, when major earthquakes or tsunamis occur we are inundated with newspaper articles declaring that the Earth, as a result of the force coming from these catastrophes, was slowed in its rotation rate.
and/or its axis moved. The rotation rate is said to decrease by microseconds and the axial tilt by inches. The 2011 tsunami that hit Japan produced numerous articles. This one is from the New York Times:

The magnitude-8.9 earthquake that struck northern Japan on Friday not only violently shook the ground and generated a devastating tsunami, it also moved the coastline and changed the balance of the planet.

...Meanwhile, NASA scientists calculated that the redistribution of mass by the earthquake might have shortened the day by a couple of millionths of a second and tilted the Earth’s axis slightly. On a larger scale, the unbuckling and shifting moved the planet’s mass, on average, closer to its center, and just as a figure skater who spins faster when drawing the arms closer, the Earth’s rotation speeds up. Richard S. Gross, a scientist at NASA’s Jet Propulsion Laboratory, calculated that the length of the day was shortened by 1.8 millionths of a second.

The earthquake also shifted the so-called figure axis of the Earth, which is the axis that the Earth’s mass is balanced around. Dr. Gross said his calculations indicated a shift of 6.5 inches in where the figure axis intersects the surface of the planet. That figure axis is near, but does not quite align with, the rotational axis that the Earth spins around.

Earlier great earthquakes also changed the axis and shortened the day. The magnitude-8.8 earthquake in Chile last year shortened the day by 1.26 millionths of a second and moved the axis by about three inches, while the Sumatra earthquake in 2004 shortened the day by 6.8 millionths of a second, Dr. Gross said.53

From the Jet Propulsion Laboratory report, Gross and Chao added more:

Dr. Richard Gross of NASA’s Jet Propulsion Laboratory, Pasadena, Calif., and Dr. Benjamin Fong Chao, of NASA’s Goddard Space Flight Center, Greenbelt, Md., said all earthquakes have some affect on Earth’s rotation. It’s just they are usually barely noticeable.

“Any worldly event that involves the movement of mass affects the Earth’s rotation, from seasonal weather down to driving a car,” Chao said. Gross and Chao have been routinely calculating earthquakes’ effects in changing the Earth’s rotation in both length-of-day as well as changes in Earth’s gravitational field. They also study changes in polar motion that is shifting the North Pole. The “mean North pole” was shifted by about 2.5 centimeters (1 inch) in the direction of 145 degrees East Longitude. This shift east is continuing a long-term seismic trend identified in previous studies.54

All of this sounds very technical and convincing, but we shall go through it line by line to determine its validity. First, if we add up all the earthquakes occurring on an annual basis, there are on average 1,450,000 per year. About 90% are in the 2 – 2.9 Richter scale range; about 9% in the 3 to 3.9 range; and the rest between the 4 to 9.55 Let’s say for the sake of argument about 25,000 significant earthquakes occur per year that affect the Earth’s rotation and figure axis the way Dr. Gross claims. Let’s say we take

the estimates back 10,000 years to 8000 BC. That means 250 million noticeable earthquakes occurred since 8000 BC. Let’s also assume, based on present data, that Earth’s rotation changes by 0.5 microseconds for significant earthquakes. This means the Earth would have changed its rotation by 125 seconds or 2.08 minutes since 8000 BC. If we go beyond 8000 BC to 108,000 BC, we now have the rotation of the Earth decreased by 20.8 minutes, which yields a rotation of 23 hours, 36.2 minutes. If we use 1 million years, it lessens the rotation by about 200 minutes. If 10 million: 2000 minutes. If 100 million: 20,000 minutes. If 200 million, then 40,000 minutes, which means the Earth would have been rotating in about 12 hours. Anything beyond 86,400 minutes, the Earth will rotate once every second or less. If we use 4.5 billion years (which is the time modern science says the Earth has been in existence), the Earth would be spinning about 10 times every second.

It matters little if we change the 25,000 earthquakes to 15,000; or the 0.5 microseconds to 0.25 microseconds. Over time the Earth’s rotation will be dramatically affected, which includes only earthquakes. There are hundreds of aftershocks, tsunamis, atomic and high-powered explosions, hurricanes, tornados, and, as Dr. Chao of NASA said, anything “from seasonal weather down to driving a car” will affect the rotation rate. If we add up all those little forces over thousands of years, the heliocentric system has a very fragile Earth that is easily knocked out of whack and couldn’t possibly sustain life.

We can escape this frightening scenario by considering some very important facts. First, most of the so-called changes in the Earth’s rotation and figure axis are not actually measured with a yardstick, as it were. Rather, modern geology presumes that the changes in rotation and orientation occur, of necessity, from Newton’s laws of motion for a rotating object. In principle, scientists believe that the changes in the Earth’s rotation are as calculable as the ice skater who, in a pirouette twirl, suddenly draws in her arms and begins to spin faster. All one needs to do to calculate the effect of the earthquake on Earth’s rotation is to plug in the numbers of the mass of the Earth; the force of the earthquake; the velocity of rotation, etc., into Newton’s equations and it will show how much the Earth must change its rotation and axis in order to make the equation balance. Scientists then report this calculated change as a real change and a newspaper article is written declaring that the Earth has changed its rotation rate and its axis has shifted. The reality is, the conclusions were made on paper with equations, not by field research and measuring.

Second, although there is a purported method by which scientists could measure changes in Earth’s rotation, the method is flawed and presumes the Earth is rotating before it interprets the data. The method commonly used is VLBI or Very Long Baseline Interferometry. In brief, two interferometers (an instrument that can detect slight phase shifts in the wavelengths of light) are placed on either side of the Earth, which would make them 8000 miles apart. Light from a distant stellar object is absorbed by each interferometer, usually waves from a quasar or radio source galaxy. If there is any difference in the phases of the waves between the two interferometers, this means that something has moved. Either the source has moved, the Earth has moved, or even the radiation itself has moved. But because VLBI is commonly used by NASA and JPL under the assumption that the Earth is rotating, they find it perfectly justifiable to obtain the VLBI measurement from only one stellar source. Hence, if there is a difference in how the single stellar source is received by the two interferometers, it is then assumed the difference is because the Earth’s rotation changed, not because the source had moved. Essentially, the way in which NASA or JPL

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have set up the VLBI, they can have no means of determining whether the movement was due to the Earth or the source. This flaw is especially significant since it is already known that stars, quasars and galaxies have “proper motion,” that is, each of them have slight independent motion with respect to other stars. In fact, the proper motion of some objects is even greater than their parallax motion.\(^{57}\) They also have independent “long-term drift motion.”\(^{58}\) Both of these could very easily show up as a phase shift in a VLBI measurement. Consequently, it is absolutely necessary to distinguish whether the phase shift is caused by the source’s motion or caused by a modified rotation of the Earth. The only way NASA or JPL could distinguish between the two is for them to allow the VLBI to absorb radiation from at least three sources, if not more. If it is found that all the other sources are moving in the same precise way as the original source, then there is evidence that the Earth is rotating. Without this methodology, all VLBI measurements are invalid to prove whether the Earth is rotating.

Another problem for VLBI measurements is that they are performed using radio wavelengths. These are very long wavelengths compared to X-rays or gamma rays. Longer wavelengths create poor resolution. Hence, what may look like a phase shift in VLBI may, indeed, be only a false reading due to poor resolution.

All in all, we must look in retrospect at this issue. Not only is there no proof from the VLBI that the Earth is rotating, recorded history has shown that there is no evidence of any appreciable difference between solar time and sidereal time. If the theory were correct that the Earth changes its rotation rate every time there is a cataclysmic disturbance on its surface, we would have seen the difference over time. Moreover, we would have seen the effects in the weather, the jet stream, biological rhythms, and just about anything that is dependent on the precision of a sidereal day.

Conversely, the geocentric cosmos has a very stable system that keeps the sidereal clock from changing. There is no fragile Earth that changes its rate for every bump it encounters. Rather, the geocentric cosmos incorporates a whole universe that is rotating around the Earth. Due to the extreme mass of the universe, the tremendous inertia with which it completes its sidereal cycle can neither be increased or decreased. Like a giant flywheel, once pushed the geocentric universe will continue to rotate evenly, \textit{ad infinitum}. In fact, to move the Earth from its fixed position, one would have to move the universe itself. Due to the dense constitution of the universe, the force of any potential axis-changing or rotation-changing disturbance on Earth (\textit{e.g.}, earthquakes) will be transferred and spread out to the entire universe. As such, the force dissipates so much that it has less of an effect than throwing a small stone into the ocean.

\textbf{Carter/Sarfati: Coriolis force}

This is named after the French engineer and mathematician Gaspard-Gustave Coriolis (1792–1843). Newton’s Laws of Motion say that an object will move in a straight line unless an outside force acts upon it. This applies to any motion across the earth or any rotating body—any outside observer would see straight line motion.

\(^{57}\) http://en.wikipedia.org/wiki/Proper\_motion. Proper motion was suspected by early astronomers but proof was provided in 1718 by Edmund Halley, who noticed that Sirius, Arcturus and Aldebaran were over half a degree away from the positions charted by the Greek astronomer Hipparchus 1850 years earlier.

But from the viewpoint of a stationary observer on the rotating body itself, the motion would appear to be deflected. This is due to the fact that an object, decoupled from the moving and rotating earth, will travel in a straight line irrespective of what the earth itself does. So to apply Newton’s Laws, a fictitious force or pseudo-force must be postulated to cause this ‘deflection’. This is the ‘Coriolis Force’, acting perpendicular to both the rotation axis and the object’s motion.

This is important for cyclones, a large-scale weather pattern where air flows into a low-pressure region. Instead of flowing straight in, the air is deflected, so that cyclones flow counter-clockwise in the northern hemisphere, but clockwise in the southern hemisphere.

Because the earth is rotating so slowly—once per day—the Coriolis effect is negligible except over long distances. There is simply no good reason to attribute the observations to the universe spinning around a stationary earth.71,72

R. Sungenis: Notice how Carter/Sarfati claim “There is simply no good reason to attribute the observations to the universe spinning around a stationary earth,” but they don’t explain to us why there is no reason that is good, and thus we must assume that they know there is a reason but they don’t like it and thus they judge it as “no good.” This is not science. It is philosophy or religion. This is just another case of wanting their cake and eat it, too. Earlier they told us that the geocentric system has a “spatial Coriolis,” but here they claim that a geocentric Coriolis has “no good reason” to exist. Irrespective of their contradictions, the fact remains that a rotating system will have a Coriolis force. It will appear in a system with the earth rotating in a fixed universe or a rotating universe around a fixed earth. That is a fact, and no amount of hand-waving is going to make it disappear for Carter/Sarfati.

Carter/Sarfati: And when we look at the Great Red Spot on the southern hemisphere of Jupiter, we note that it behaves exactly like hurricanes do in the northern hemisphere here on earth—rotating anticlockwise (counterclockwise). That’s because hurricanes have wind rotating inwards towards a very low pressure area, while the Spot is an anticyclone (winds are spiraling outwards from a high pressure area). And, of course, the Spot is larger than any earth hurricanes—in fact, larger than the whole earth. From all appearances, its behavior is due to the Coriolis Force acting on an anticyclonic gyre moving across a spinning planet. We can observe Jupiter spinning. We see evidence of the physical effects of that spin. Now look at earth. We see evidence of the physical effects of spin in the Coriolis Force. Does this not mean that the earth also spins?

R. Sungenis: No, it doesn’t mean Earth is spinning. If Carter/Sarfati insist that it does, then they are not dealing in science but prejudice. Carter/Sarfati are making the same mistake Galileo made. Just because they see a certain phenomenon on Jupiter does not mean that the same phenomenon is duplicated on Earth. It is easily explainable that Jupiter has its Coriolis force because it is rotating; and the Earth has its Coriolis force because the universe is rotating around the Earth, and Carter/Sarfati gave us no good reason why it can’t happen that way.

Carter/Sarfati: Conclusions

There are many other geokinetic examples we could have brought into this discussion. We decided to stick to these few examples only, and we ordered the examples starting with the most important.
R. Sungenis: Of course, but all the other “examples” have also been discredited, and it would behoove Carter/Sarfati to read up on them, as well as those mentioned in this paper, before they write another paper trying to discredit geocentrism.

Carter/Sarfati: When all is said, it is clear that absolute geocentrism has extreme problems. We would encourage anyone dabbling with non-Newtonian ideas to let go and let the earth find its own place in the heavens.

R. Sungenis: I would suggest that Carter/Sarfati ‘let go and let God.’ Scripture is clear. It always says the sun and stars move and never says the Earth moves. It was written over 1500 years and inspired by He who does not lie, and in not one instance do we even get a hint that the Earth is revolving around the sun.

Second, the system with the problems is the one that confines itself to the solar system and disregards the rest of the universe, as Newton tried to do but covered it up with his Absolute Space. In the end, even he had to admit that if he included the proper forces outside the solar system then,

Since this force is equal and opposite to its gravity toward the Sun, the Earth can truly remain in equilibrium between these two forces and be at rest. And thus celestial bodies can move around the Earth at rest, as in the Tychonic system.

Third, any system that must invent ad hoc theories like length contraction, time dilation and mass increase as things that must have occurred to Michelson’s apparatus in order to account for its non-moving Earth is a theory built on a house of cards. Geocentrism doesn’t need any of these gimmicks. What you see is what you get. It is the much simpler and much more stable system. Unfortunately, the whole world worships at the feet of Albert Einstein, and thus they will cling to his bogus theories – theories that he himself admitted he invented in order to escape the non-moving Earth result of Michelson’s experiments.

Carter/Sarfati: The triumph of geokinetic theory is one of the greatest examples of the pursuit of science in the history of man.

R. Sungenis: In reality, considering the ad hoc theories of Lorentz and Einstein to answer Michelson’s experiment, as well as the unrelenting pursuit of Einstein to either ignore or dismiss subsequent experiments that would falsify his theory (e.g., the 1913 Sagnac or the 1925 Michelson-Gale), the geokinetic theory is one of the greatest frauds ever perpetrated on mankind that is put under the guise of “science” to make it appear respectable. The only “triumph” geokinetics has had is in duping the world into thinking that it can disregard the literal word of God and pretend that when it comes to the cosmos God can’t speak as plainly as He does about other doctrines of truth.

Carter/Sarfati: It was pioneered by scientists with a biblical worldview,

R. Sungenis: “Biblical worldview”? Copernicus got his model from the Greeks who did not have a “biblical world view,” besides the fact that he lived in sin with his paramour. Galileo was a fornicator who had four children out of wedlock and treated three of them like a dead-beat dad; he was also part of an underground movement to undermine the Church. It wasn’t until three years before he died that he had a conversion experience, and it was one year later that he thoroughly renounced, on his own recognizance, the entire heliocentric theory he had promoted for four decades earlier. Newton, likewise, was not the epitome of a Christian, but used and abused his colleagues with abandon, as well as having an
antipathy for the Catholic Church; and was suspect of Arianism. Kepler, as we noted earlier, was into the occult, as was his mother; and he is also suspected of murdering Tycho Brahe so that he could steal his 40-years worth of planet-charting. So, none of these forerunners of geokineticism were the poster boy for Christianity and a “biblical worldview.”

**Carter/Sarfati:** affirmed by theologians with a biblical worldview,

**R. Sungenis:** John Calvin and Martin Luther, the mentors of Carter and Sarfati, had a “biblical worldview” but didn’t accept Copernicus for the same reason I don’t accept it, that is, because the Bible doesn’t teach it. The real “biblical worldview” is the one that obeys what the Bible says and ceases to put what he doesn’t like about the Bible into the area of “figures of speech.”

**Carter/Sarfati:** and is accepted today by people with a biblical worldview.

**R. Sungenis:** The real truth is this: Ever since Henry Morris laid down the gauntlet in the 1960s and declared that Protestant evangelicalism was not going to advocate geocentrism due to the fact that he did not want to fight a war with the secular world on two fronts (i.e., evolution and heliocentrism), the Evangelicals have tried to bury geocentrism. Morris also figured out that, defending geocentrism would be a back-hand way of supporting the Catholic Church, which he despised, and thus it wasn’t in his best interests to do so. The last thing Morris wanted was to be required to bow to the Catholic Church for being right against Galileo. It was better to preserve the Evangelical status quo and give the appearance that its members were abiding by the literal interpretation of Scripture with its use of Genesis and the Psalms to counter the theory of evolution. They pretended the contradiction in their hermeneutic could be glossed over by a consensus for Creationism and a ridicule for anyone espousing geocentrism.

**Carter/Sarfati:** It also fits all the relevant data. These are the reasons why we support it. The greatest contribution of Western science, pioneered by Christians as it were, is the idea that the universe is rational. This is in line with the biblical presupposition that the universe behaves in an orderly manner because the Ultimate Lawgiver would not have created something that goes against his very nature. Our God is unchanging. There is no ‘shadow of turning’ with him (James 1:17). He is not fickle. He is not like pagan gods. He is not like Zeus, sitting on Mount Olympus waiting to throw down a lightning bolt whenever he wants to mess up a person’s life (or experiment). He is not ‘chaos’, which would prevent rational interpretations of events. He is not ‘nature’ – if nature were alive, it would have a volition of its own and science would not be possible. No, our God has created a universe for us to live in and that exults His name. He has also told us to use our minds and to understand the universe He made for us. This universe, therefore should be understandable, and geokinetic theory makes such an understanding possible.

**R. Sungenis:** As we have seen in my critique, the “data” in 1887 showed the Earth wasn’t moving in space. But Lorentz and Einstein concocted the idea of length contraction and time dilation to fix that leak in the Copernican consensus. They both knew that a motionless Earth could have easily answered Michelson’s experiment, but their rejection both of the God of Scripture and the God of the Catholic Church, as well as a devotion to unchain the world from the medieval ages, simply wouldn’t let them consider it. As Einstein biographers says it:

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In the United States Albert Michelson and Edward Morley had performed an experiment which confronted scientists with an appalling choice. Designed to show the existence of the ether…it had yielded a null result, leaving science with the alternatives of tossing aside the key which had helped to explain the phenomena of electricity, magnetism, and light or of deciding that the earth was not in fact moving at all.59

The problem which now faced science was considerable. For there seemed to be only three alternatives. The first was that the Earth was standing still, which meant scuttling the whole Copernican theory and was unthinkable.60

Everyone in the physics establishment saw the same implications, and they were beside themselves with consternation. As several authors describe it:

The data [of the interferometers] were almost unbelievable…. There was only one other possible conclusion to draw – that the Earth was at rest. This, of course, was preposterous.61

Always the speed of light was precisely the same….Thus, failure [of Michelson-Morley] to observe different speeds of light at different times of the year suggested that the Earth must be ‘at rest’…It was therefore the ‘preferred’ frame for measuring absolute motion in space. Yet we have known since Galileo that the Earth is not the center of the universe. Why should it be at rest in space?62

In the effort to explain the Michelson-Morley experiment…the thought was advanced that the Earth might be stationary….Such an idea was not considered seriously, since it would mean in effect that our Earth occupied the omnipotent position in the universe, with all the other heavenly bodies paying homage by revolving around it.63

Even Michelson couldn’t avoid the implications of his experiment:

This conclusion directly contradicts the explanation of the phenomenon of aberration which has been hitherto generally accepted, and which presupposes that the Earth moves.64

But….

As Einstein wrestled with the cosmological implications of the General Theory, the first of these alternatives, the Earth-centered universe of the Middle Ages, was effectively ruled out…65

Indeed it was “ruled out,” yet not by any scientific proof but only because, after having five hundred years of Copernicanism drummed into one’s head from childhood, it was “unthinkable” to believe that mankind got it wrong and that the Earth was actually motionless in space.

61 Bernard Jaffe, *Michelson and the Speed of Light*, p. 76.
65 *Einstein: The Life and Times*, p. 267.
But there was a price to pay for this presumption. Rejecting what was “unthinkable” created what was unmanageable. Since, on the one hand, an Earth-centered cosmos was “ruled out,” but, on the other hand, as Einstein was forced to answer the results of the interferometer experiments and Maxwell’s electromagnetic equations, his only “alternative” was to invent a whole new physics; in fact, it was necessary to adopt a whole new way of looking at the world. If the Earth wouldn’t budge, then science had to budge.

Consequently, Relativity theory advanced principles and postulates that heretofore would have been considered completely absurd by previous scientists, things such as matter shrinking, clocks slowing down, and mass growing larger; that two people could age at different rates, that space was curved, that light travels at the same speed for all observers (even observers moving at the speed of light); that time and space are one entity, and many other strange and bizarre concepts, all in a desperate effort to have at least some answer to the numerous experiments that showed the Earth was motionless in space. In that day *The Times* of London called Einstein’s Relativity “an affront to common sense.” Indeed it was, and still is.

As a result, Carter and Sarfati deceive themselves into thinking that modern physics exalts God and brings us closer to Him. Much of what Copernicanism has done is to create an inordinate conglomeration of atheists and agnostics who not only believe we have evolved from apes, but also believe that we are a speck of dust in the remote recesses of space that got there by time and chance.

But an Earth in the center of the universe and around which everything else revolves takes that atheistic foundation right out from under them, for no one in their right might can argue that a central Earth could have happened by chance. Someone much bigger and better than we must have put the Earth in that special position.

Unfortunately, Carter and Sarfati have only encouraged these godless men to continue in their delusion. Fighting a battle on one leg (as Carter and Sarfati do when the fight against evolution but embrace Copernicanism) will never let them win the battle. Fighting on two legs, and with the “Sword of the Spirit, which is the word of God” that they interpret literally and faithfully in all its remarks on cosmology and cosmogony, will be the only thing we can use to win the battle.

Robert Sungenis

May 2, 2016

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66 *Einstein: The Life and Times*, p. 101. In 1920, physicist Oliver Lodge said that Relativity was “repugnant to common sense” and of Relativists he said “however much we may admire their skill and ability, I ask whether they ought not to be regarded as Bolsheviks and pulled up” (“Popularity Relativity and the Velocity of Light,” *Nature*, vol. CVI, November 4, 1920, p. 326).
References and notes to Carter/Sarfati


4Hannam, J., Ref 3. Return to text.


6Hannam, J., Ref. 4. Return to text.

7Nicolas of Cusa, *De Docta Ignorantia* (On Learned Ignorance) 2(12), 1440, translated by Jasper Hoskins; jasper-hopkins.info/DI-II-12-2000.pdf. Return to text.


9Interestingly, this informs us about the time of month of this battle. The moon was to the west of the sun during the day, meaning it was late in the month and the moon was waning, or past full. Return to text.

10Most New Zealanders know about the Māori legend of the demigod Maui capturing the sun before it could rise, then beating it so it slowed down. The *paganism, as always, was a later addition* to the older belief in a single *supreme Creator God, Io*. Return to text.


13See BAGD, Louw–Nida. Return to text.


19Nicolaus Copernicus, *De revolutionibus orbium coelestium* (On the Revolutions of the Celestial Spheres), 1543. Return to text.
20Better known today as the Almagest. Copernicus uses a short form of the original name of Ptolemy’s tome: Hē Mathēmatikē Syntaxis (Ἠ Μαθηματικὴ Σύνταξις = The Mathematical Treatise). This became so admired it was called simply Hē Megalē Syntaxis (Ἡ Μεγάλη Σύνταξις = The Great Treatise). Then Arab scientists used the superlative Megistē (Μεγίστη), and named it al-kitabu-l-mijisti (The Greatest Treatise), which was Latinized to Almagest. Return to text.

21Boëthius, The Consolation of Philosophy (De consolatione philosophiae) 2(7)3–7, AD 524. This book was one of the most widely read and influential works in the west during the entire Middle Ages. Return to text.


23Hannam, J., Ref. 4. Return to text.

24Based on writings attributed to a mythical figure called Hermes Trismegistus (Greek Hermēs ho Trismegistos Ἑρμῆς ὁ Τρισμέγιστος, ‘thrice-greatest Hermes’). The writings advocated an esoteric monotheism with reincarnation, and taught that man could control nature with rituals (theurgy), alchemy, and astrology. Return to text.

25For an essay on this topic with many interesting quotes, see bedejournal.blogspot.com/2009/04/galileo-affair-2-cosmic-promotion.html. Return to text.


27Kuhn, Ref. 13. Return to text.


29Nicolaus Copernicus, De revolutionibus orbium coelestium (On the Revolutions of the Celestial Spheres), 1543. Return to text.


31Galileo Galilei, Dialogo sopra i due massimi sistemi del mondo (Dialogue Concerning the Two Chief World Systems), 1632. Return to text.


33See the discussion of Luther’s supposed antagonism to geokinetic theory, which was really a hearsay account of his rejection because it was new-fangled, in Sarfati, J., Refuting Compromise, Creation Book Publishers, Power Springs, GA, chapter 3. Return to text.

34See also Sarfati, J., Galileo Quindicentennial: myth vs fact, Creation 31(3):49–51, 2009. Return to text.

35Copernicus seems to have been the first to realize that increasing the money supply (or modern day ‘printing money’ or ‘quantitative easing’) would likely cause price inflation (Memorandum on monetary policy, 1517). Return to text.

Today, parallax is the basis of the standard distance measure for professional stellar astronomers: the parsec (from parallax-second): the distance at which an AU subtends an angle of 1 arcsecond (1/3,600 of a degree). This is 3.26 light years or 206,000 AU. A parsec is shorter than the distance to even the nearest star outside our solar system, Proxima Centauri, at a distance of 1.301 pc.

Hannam, J., Who refused to look through Galileo’s telescope? bedejournal.blogspot.com, 20 November 2006: “According to popular legend, when Galileo presented his telescope to senior cardinals/Jesuits/Aristotelian philosophers/the Inquisition they refused to even look through it. This tale has become a standard trope for when we want to attack anyone who won’t accept ‘obvious’ evidence. … So who refused to look through Galileo’s telescope? According to the historical record, no one did for certain. The argument was over what they could see once they did look.”

Williams, D.R., Venus Fact Sheet, nssdc.gsfc.nasa.gov, 9 May 2014. Venus’ angular size ranges from 9 to 66.7 minutes of arc.

Those figures assume circular orbits as a first approximation. In reality, since the orbits are elliptical, the closest and furthest distances are 38 and 261 million km. See Coffey, J., Venus Distance From Earth, universetoday.com, 8 May 2008.

This is why the difference in apparent magnitude is not as great as the difference in apparent size: 4.9 brightest, and 3 dimmest: the crescent phase simply has far less of the surface reflecting light towards us. NB, this is a logarithmic scale, where a magnitude 1 star is 2.512 times brighter than a magnitude 2 star. This number means that every five magnitude steps is a brightness factor of 100. So Venus ranges in brightness by a factor of 5.7 (2.512 1.9).

Heilbron, Ref. 18, pp. 202–3.

Note that in our Newtonian system, in a sun-centered frame the moon orbits the sun, not the earth. As viewed from outer space, the moon always follows a convex path towards the sun. The earth only perturbs the moon’s path in its journey around the sun. The monthly orbit of the moon around the earth is only an apparent one, and only exists in earth’s reference frame. But note that in this frame, the moon follows Kepler’s laws. An absolute geocentrist must explain why the moon follows these laws but apparently all other heavenly bodies are exempt.


Regarding how Tycho Brahe noted the absurdity of the Copernican Theory regarding the Bigness of Stars, while the Copernicans appealed to God to answer, arxiv.org/ftp/arxiv/papers/1112/1112.1988.pdf, 9 December 2011.

In the atmosphere it is pure refraction. When using a telescope, however, there is the added problem of diffraction due to the aperture size (diffraction angle ~ wavelength/diameter of aperture).

Hubble Space Telescope captures first direct image of a star, hubblesite.org, 10 December 1996.

The Prof says: Tycho was a scientist, not a blunderer and a darn good one too! The Renaissance Mathematicus, thonyc.wordpress.com, 6 March 2012; refuting the notorious Christophobe David Barash, whom CMI has refuted on another issue.
49Johannes Kepler, Prodromus dissertationum cosmographicarum, continens mysterium cosmographicum, de admirabili proportione orbium coelestium, de que causis coelorum numeri, magnitudinis, motuumque periodicorum genuinis & propriis, demonstratum, per quinque regularia corpora geometrica (Forerunner of the Cosmological Essays, Which Contains the Secret of the Universe; on the Marvelous Proportion of the Celestial Spheres, and on the True and Particular Causes of the Number, Magnitude, and Periodic Motions of the Heavens; Established by Means of the Five Regular Geometric Solids), 1596. Return to text.


51Newton’s formula for calculating gravitational attraction: F = -GMm/R^2. The negative sign means attraction, because it’s in the opposite direction to the vector from one of the bodies travelling to the other. The force is proportional to the masses of the objects and inversely proportional to the square of their distance apart—hence an inverse square law. Return to text.

52Hartnett, J., Has dark matter really been proven? Clarifying the clamour of claims from colliding clusters, creation.com/collide, 8 September 2006. Return to text.


54The Chronology of Ancient Kingdoms Amended, posthumously published in 1728; Observations Upon the Prophecies of Daniel and the Apocalypse of St. John, 1733. Return to text.


56A Short Scheme of the True Religion, manuscript quoted in Memoirs of the Life, Writings and Discoveries of Sir Isaac Newton, p. 347, by Sir David Brewster, Edinburgh, 1855. Return to text.

57Newton actually denied arguments for the Trinity from dubiously attested biblical texts, such as the Johannine Comma in John 5:7. Most informed Trinitarians today would agree that the texts are dubious. A very detailed defense of Newton’s Trinitarianism is Van Alan Herd, The theology of Sir Isaac Newton, Doctoral Dissertation, University of Oklahoma, 2008; gradworks.umi.com/3304232.pdf. This documents much evidence, including Newton’s words refuting tritheism and affirming Trinitarian monotheism, e.g.: “That to say there is but one God, ye father of all things, excludes not the son & Holy ghost from the Godhead because they are virtually contained & implied in the father. … To apply ye name of God to ye Son or holy ghost as distinct persons from the father makes them not divers Gods from ye Father. … Soe there is divinity in ye father, divinity in ye Son, & divinity in ye holy ghost, & yet they are not the forces but one force.” The argument against Newton is like someone 300 years from now citing our page ‘Arguments we think creationists should NOT use’ and claiming that CMI is anti-creationist. Return to text.

58Depending on the latitude of course—multiply by the cosine. Return to text.


Since Jupiter is so much more massive than Earth, and much further away, the barycenter of the Sun-Jupiter system is just outside the sun’s surface. A hypothetical alien astronomer would be able to deduce Jupiter’s presence from the sun’s ‘wobble’.

In chemistry, we use the Born–Oppenheimer approximation to simplify the Schrödinger equation for the atomic wavefunction—this treats the nucleus as basically stationary compared to the electrons because its mass is ~104 times greater.

In Newtonian physics, the force required to keep a body of mass moving in a circle of radius r at speed v is given by $F = \frac{mv^2}{r}$. See also Sarfati, J., More space travel problems: g-forces, creation.com/g-force, 9 February 2012.

Ptolemy was correct, by the way. Objects should curve as they fall, but he had no way to measure the effect because he could not get high enough to drop an object and see the curve. Indeed, when manned space ships are re-entering earth’s atmosphere, rocket scientists must account for both the horizontal motion of the ship as well as the rotational speed of the earth in order to land in the correct place. If a non-orbiting object (e.g., something orbiting the sun in the vicinity of earth) were to fall, say, from the altitude of a geostationary satellite, it would NOT fall in a straight line. In fact, it would appear to curve as the earth rotated beneath the falling object.

Under Newton’s First Law, any object with no force acting keeps moving in a straight line. So an object moving in a circle has a tendency to fly off in a literal tangent, just because of its inertia, with no force needed. But to observers on the rotating reference frame, it seems as if there is a force acting that pushes objects away from the center, i.e. centrifugal (‘center-fleeing’). This doesn’t exist in inertial reference frames.

In rotational spectroscopy, gas molecules are treated as rigid rotors to a first approximation. But the molecular rotation pushes the atoms apart, increasing the molecule’s moment of inertia. Since the molecular rotating reference frame is important, a centrifugal distortion parameter is applied to correct for this.


In technical terms, this is the Rossby number (Ro and not Ro), named after the Swedish meteorologist Carl-Gustaf Rossby (1898–1957). $Ro = \frac{v}{L \Omega} \sin \phi$ where $v$ is velocity, $L$ is the length, and $\Omega = 2 \frac{\Omega}{\sin \phi}$ where $\Omega$ is the angular frequency of planetary rotation and $\phi$ the latitude. For small Ro (caused by large lengths or spin speed), Coriolis effects are very important. For large Ro, caused by slow spin, small scale, or low latitude (near equator), Coriolis effects are negligible.

Some claim that the Coriolis effect causes water to drain counter-clockwise from a sink in the northern hemisphere and clockwise in the south. This is a myth—rather, an irregularity in the shape and latent water motion would almost always cause some turning in the flow towards the hole. As the water flow converges on the hole, the diameter shrinks, so the rotation rate increases. This is because of the Law of Conservation of Angular Momentum, which also explains why a spinning ice skater speeds up when she pulls her arms in.
In rotational-vibrational spectroscopy, if the molecule is rotating very fast, as the atoms vibrate they will experience Coriolis effects in the molecule’s rotational reference frame. So there is a need for correction terms known as Coriolis zeta coupling constants. Return to text.
Appendix 1: Does Mercury’s Perihelion Prove General Relativity

Einstein claimed that his prediction of the perihelion of Mercury supported his theory of General Relativity, but this assertion is disproven by the same inaccuracies and biases appearing in the eclipse photographs. By all accounts, determining the complete reasons for the perihelion of Mercury is a formidable task. Based on the gravitational contributions of each of the planets (Pluto excluded), most of Mercury’s perihelion is accounted for by Newtonian physics, but a residual remains (about 10% or less). Newtonian physicists tried many and various means to find the reason for the residual, hypothesizing such things as interplanetary movements; the existence of another planet (Vulcan); readjusting the square of the inverse square law to 2.0000001574 instead of 2.0, all with only marginal success. Still today, due mainly to unknown variables in the data, as well as the arbitrary means of interpreting the data, Mercury’s residual perihelion remains perplexing. There is at least a four-body calculation (the sun, Venus, Earth, Jupiter) if not a ten-body calculation (the sun, Earth and the eight planets) involved. In Newtonian physics, calculation of gravitational attraction between two bodies is relatively simple, but when three or more bodies are in the mix, Newton’s formula is virtually useless. As Poor states: “Under certain special conditions, mathematicians have been able to find an approximate solution of the problem, but even such approximate solution is extremely intricate. No solution of the general problem has been found.”

The first attempt to measure Mercury’s perihelion was made in 1843 and then again in 1859 by the French mathematician Urbain Leverrier. He began by analyzing records of sixteen of Mercury’s transits across the sun dating from 1677 to 1848. Calculating the entry and exit times of Mercury’s transit allows a determination of the planet’s angular position within one arc second. After taking account of the gravitational attraction of Venus, Earth, and Jupiter, Leverrier had a residual figure of 38” (arc seconds) per century, but he could not account for the discrepancy only by the perihelion, and thus he began to examine Mercury’s eccentricity. He then included 400 meridian transits of Mercury between 1801 and 1842, which he obtained from the Paris Observatory, and upon finding an eccentricity of 22” he then added the two figures (38” + 22’’) and concluded that the amount of precession was 60” per century. After preparing his final tables, however, he arbitrarily eliminated the 22” of eccentricity, leaving 38” as the final sum.

In 1895, Simon Newcomb became the next scientist to attempt to find the reason for Mercury’s residual perihelion. Working with Leverrier’s 38” figure, Newcomb arbitrarily decided to reduce the eccentricity, which in turn increased the rotation, and he obtained residual figures of between 41” and 43”. Hence, the 43” remained in the textbooks (at least up until Einstein), as the residual perihelion of Mercury not accounted for by Newtonian physics. At that time, however, Newcomb suggested that the sun’s

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67 Earth and each of the planets cause gravitational perturbations on each other. Additionally, the sun’s oblateness will also add to the general perturbation. The contributions to the perturbations on Mercury, amount to the following (as measured in arc seconds per century): Venus: 277.856; Earth: 90.038; Mars: 2.536; Jupiter: 153.584; Saturn: 7.302; Uranus: 0.141; Neptune: 0.042; Sun’s oblateness: 0.010 (as measured prior to the 1960s). These figures add up to 531.509 as the total perturbation on Mercury. But since Mercury’s precession is 574.10 arc seconds, this leaves 42.591 arc seconds unaccounted for. NB: the perturbations in the geocentric system (whether Ptolemaic or Tychonic) would be precisely the same.

68 Gravitation versus Relativity, p. 123.


70 S. Newcomb, “Tables of Mercury,” Astronomical Papers of American Ephemeris Nautical Almanach, 6, Washington, 1895-1898. The advance of Mercury’s perihelion was calculated by Newtonian physics to be 531.509 arc seconds per century. This falls about 43 seconds short of the observed value, which is 574 arc seconds. As it is commonly understood, the total apparent precession of Mercury’s perihelion (as observed from the Earth) is 5600”/100years. Of this, 5025” is attributed to the Earth’s
oblateness might provide the solution to the remaining puzzle. This would be a significant hypothesis, since both Newtonian and Relativistic calculations of perihelion assume a spherically symmetrical sun.

In Einstein’s attempt to account for the residual perihelion there has been some suspicion that, knowing the accepted value in advance (43 arc seconds), he juggled his figures to meet those expectations. That Einstein was already aware of the needed figure was made plain in his book on Relativity:

> In point of fact, astronomers have found that the theory of Newton does not suffice to calculate the observed motion of Mercury with an exactness corresponding to that of the delicacy of observation attainable at the present time. After taking account of all the disturbing influences exerted on Mercury by the remaining planets, it was found (Leverrier: 1859; and Newcomb: 1895) that an unexplained perihelial movement of the orbit of Mercury remained over, the amount of which does not differ sensibly from the above mentioned +43 seconds of arc per century. The uncertainty of the empirical result amounts to only a few seconds.71

The original Einstein-Grossmann theory accounted for only 18” of the residual 43” of Mercury’s perihelion, which is documented in the original Einstein-Besso manuscripts made public in 1914 by Dutch physicist Johannes Droste. Einstein subsequently retracted the paper, changed his Relativistic field equations no less than three times, and resubmitted them three times, respectively, to the Berlin Academy before the final result of 43” was achieved.72 Still, Charles Lane Poor adds that in arriving at the 43” Einstein did not use the unit of time required by Relativity theory; rather, he used the commonly accepted Newtonian unit of time. Poor also adds that Einstein insisted “in clear unequivocal language” in the Preface of the book that, of all the planets, only Mercury presented anomalous data.73 Yet Newcomb’s 1894-1895 data of 60,000 observations records discordances in the motions of other planets, totaling eleven in all, and four of which he considers highly significant. Thus Poor concludes: “Can it be possible that he [Einstein] has never read the very papers upon which the astronomical proof of the Relativity Theory is supposed to be based?”74

Physicist Tom Van Flandern studied Einstein’s calculations and found there were “three separate contributions to the perihelion; two of which add, and one of which cancels part of the other two; and you wind up with the right multiplier.” The same article reports that Van Flandern approached a University of Maryland colleague who had known Einstein in their respective work at Princeton’s Institute for Advanced Study regarding how, in his opinion, Einstein had arrived at the accepted figure of 43 arc seconds. The colleague replied that it was his impression that “knowing the answer, he juggled the arguments until they came out with the right value.”75 Poor says much the same, but points out an added twist in Einstein’s deception:

> Yet this coincidence of figures is largely due to the astuteness of Einstein in quoting the result of Newcomb’s preliminary investigation, and in ignoring the classic work of Leverrier and the final results

73 Einstein writes in the Preface: “The sole exception is Mercury, the planet which lies nearest the sun. That for all the planets, with the exception of Mercury, this rotation is too small to be detected…” In a July 30, 1921 letter Einstein writes: “The perihelial movement of Mercury is the only anomalous one in our planetary system which has been sufficiently attested” (*Gravitation versus Relativity*, pp. 185-186).
74 *Gravitation versus Relativity*, p. 187.
of Newcomb. According to Einstein the results of the astronomical investigations into the motions of Mercury are summed up as: “it was found (Leverrier – 1859 – and Newcomb – 1895) that an unexplained perihelion movement of the orbit of Mercury remained over, the amount of which does not differ sensibly from the above mentioned +43 seconds of arc per century. The uncertainty of the empirical result amounts to a few seconds only.” Leverrier in 1859 found 38”; Newcomb in 1895 found 41.6”; quantities quite different from the 43” quoted by Einstein…The coincidence of figures, the supposed agreement between observation and the relativity theory, vanishes the moment the real facts are stated.76

The problem for Einstein is, once he chooses 43” as the final figure, it cannot be changed in the future, since the equations he formulated from the General Relativity theory will not allow him to do so. Thus, if the real figure turns out to be anything more or less than 43”, Relativity is automatically disqualified as providing an explanation to Mercury’s perihelion. As Relativist Clifford Will admits: “…the prediction of general relativity is fixed at 43 arcseconds; it can’t be fiddled with.”77 Poor adds: “There is no flexibility in the Einstein formulas, no constant of uncertain value, no possibility of adjustment.”78 Being caught in such a corner, Relativists will create quite a fuss over anyone who claims to have an alternate figure, as we shall see below.

It is worthy of note that already in 1898 Paul Gerber had produced the equation that accounted for the precession of Mercury without any use of Relativistic tensor equations, since they would not be available until 1916. Gerber did, however, use one of the assumptions of Einstein’s General Relativity, that is, gravity traveled at the speed of light. Gerber published his finding in Mach’s Science of Mechanics. It wasn’t until Einstein published the same equation in Annalen der Physik 18 years later that the editors of Annalen reprinted Gerber’s equation, pointing out that Einstein should have given credit to Gerber. Although he was an avid reader of Mach’s writings, Einstein claimed ignorance of Gerber’s previous work (the same reason he gave when it was discovered that his Relativity equation was identical to Lorentz’s Transformation equation produced 10 years earlier).

Subsequent calculations of Mercury’s perihelion were made after Einstein supported the 43” figure. In 1930, the figure was raised to 50.9.79 Just prior to the 1960s, it was set back at 32.0. These wide-ranging values are due to the procedural difficulties stemming from having to account for all the mass and movements in the solar system. In reality, depending on how one views or juggles the figures, one can make the residual perihelion vary quite extensively. Charles Lane Poor shows, for example, that the original calculations by Leverrier had the perihelion of Mercury literally dancing in the sky. He writes:

The extreme complexity of the problem may be best illustrated by giving the actual expression for the position of the perihelion of Mercury, as affected by the action of Venus alone. This is taken from the work of Leverrier…These show that from February 25 to July 19 the perihelion was moving backward, while during the next period it was moving forward, but on December 10th it was still behind where it had been earlier in the year. All this is complicated enough, but it only accounts for the action of Venus; it requires twenty-one similar terms to account for the action of the Earth, sixteen for Jupiter, six for Saturn, and one for Uranus.80

76 Gravitation versus Relativity, p. 187.
78 Gravitation versus Relativity, p. 187.
80 Gravitation versus Relativity, p. 143.
By the 1960s, the figure was put at 39.6. Astronomer Robert Dicke (an important person in his own right since his work superseded the crucial experiments of Roland von Eötvös) proposed, after his intensive study, that the oblateness of the sun was responsible for a significant portion of the residual perihelion of Mercury. Dicke and his partner Goldenberg found that the sun’s polar axis is shorter than its equatorial axis by approximately 40 parts per million, thus making the sun oblate, and accounting for at least 3.4” of Mercury’s residual perihelion. This new evidence brought the residual down from 43.0 to 39.6, thus making Einstein’s attempt at securing 43’ through General Relativity somewhat dubious. Moreover, Dicke’s adjustment of 3.4 arc seconds could just as easily been used to offset the 50.9 or the 32.0 figures, thus making them 47.5 and 28.6, respectively.

Robert Clark describes the outcome of Dicke’s work: “Dicke began a series of experiments in the mid-1960’s whose results brought a headline in Nature of ‘Einstein in Crisis’” Nature followed in the article stating:

In spite of the great aesthetic and philosophical appeal of Einstein’s general theory of relativity, it is still, after 50 years of widespread acceptance, one of the least well-founded theories in physics as far as experimental confirmation is concerned.

Some astronomers, lending their support to Relativity, doubted Dicke’s findings, arguing that the sun’s oblateness could not account for such a large portion of the residual perihelion. Suffice it to say, the war was now in full swing. Dicke was definitely a threat to Relativity, since a deviation as large as 3.4’ would immediately topple General Relativity. In 1974, Dicke published a complete reanalysis of the data, and came up with the same result.

Afterward, Dicke and several other astronomers found that in addition to the oblateness, the sun’s gravitational quadrupole moment, its rapid internal rotation, and its oscillations in diameter and rate of rotation, all play a part in determining the residual figure of 39.6 arc seconds. If the sun’s inner core rotates faster than its exterior, this will cause a precession of the orbits of the planets and explain a significant portion of the residual perihelion. Dicke postulated that the interior core of the sun, at least out to one half its radius, rotates twenty times faster than the exterior. Ian Roxburgh was one of the first to make this evidence public. His abstract reads:

The hypothesis that the inside of the Sun is rotating much more rapidly than the surface layers...The angular velocity of the inner region is estimated and it is shown that the rotational distortion of the Sun produces a perihelion advance of the planets. If the angular velocity inside the Sun has the same magnitude as in a typical rapidly rotating star, then the anomalous advance of the perihelion of Mercury, usually counted as one of the crucial tests of general relativity, can be explained by the gravitational effect of the rotating Sun.

Subsequent experiments performed in 1973-1982 by Henry Hill gave results that were five times smaller than Dicke’s but still fifty-times larger than the conventional value. Dicke came back in 1985 with further

81 “Solar Oblateness and Gravitation,” Gravitation and the Universe, pp. 30f. In a report dated January 13, 1967, to the American Physical Society, Dicke and Goldenberg report: “New measurements of the solar oblateness have given a value for the fractional difference of equatorial and polar radii of $(5.0 \pm 0.7) \times 10^{-5}$. A corresponding discrepancy of 8% of the Einstein value for the perihelion motion of Mercury is implied” (Physical Review Letters, 18, 313). NB: 8% of 43.0 is 3.4.
83 Einstein: The Life and Times, p. 767.
experiments and stated that the results yielded 12 parts per million rather than the original 40 parts per million. These results show the extreme difficulty in obtaining accurate and reliable results. As Relativity supporter Clifford Will admits: “It is ironic that after seventy years, Einstein’s first great success remains an open question, a source of controversy and debate.”

In the face of the foregoing evidence, there has been an inordinate amount of pressure put on the scientific community not only to maintain a residual perihelion for Mercury of 43 arc-seconds, but to attribute it solely to General Relativity and to minimize any findings from the sun’s inherent characteristics that provide an alternative answer.

In the face of these difficulties, some have suggested using the perihelia of Venus, Earth or Mars to help prove Relativity theory. But this presents an even worse dilemma for Relativity, considering the anomalous results of Einstein’s predictions for the perihelia of the other planets. Indeed, it is puzzling why Relativists would want to open this Pandora’s Box at all. Perhaps they are hoping that no one will investigate the original records of Relativity’s predictions, but, unbeknownst to most, the investigation has already been done. A person close to the scene and one who obtained General Relativity’s original perihelia predictions was celestial mechanic Charles Lane Poor of Columbia University. Poor first reveals Einstein’s admission: “The only secular perturbation is a motion of the perihelion.” Poor interprets this statement as follows:

Thus the relativity theory cannot explain, or account for, any of the observed discrepancies in the motions of the planets, other than those in the perihelia. But it is clear that, under the Relativity theory, the perihelia of all the planets must rotate by various amounts depending upon their respective distances from the sun. The amounts of such rotations can be readily calculated from the formula given by Einstein for the case of Mercury.

Poor then shows that Einstein’s results vary widely from those of Newcomb. For example, Relativity would predict a +8.6” perihelion for Venus, but Newcomb recorded -7.3”. In other words, Relativity would predict a perihelion for Venus that was going in the opposite direction of what was actually observed. As Poor describes it:

The perihelion of this planet is rotating more slowly than the computations indicate it should, the difference being –7.3” per century. The Einstein formulas would increase the theoretical speed of

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rotation by an additional 8.6'', thus making the total discrepancy between observation and theory 15.9 or 37% of the entire observed motion. The Einstein formulas, in this case, make a bad matter worse; they give the orbit a rotation in the direction opposite to that which is required to fit the observations. Thus the Relativity theory is not sufficient to explain the discordances in the planetary motions. It accounts approximately for only one among the numerous discrepancies of the perihelion of Mercury. It fails completely to explain any position of several well-tested irregularities and it doubles the observed discrepancy in the motion of Venus.88

Some advocates of Relativity attempt to cover up these inconsistencies, as seen, for example, in Hugh Ross’ assertion that General Relativity found a precession for Venus of “8.6,” a figure, according to his endnotes, that he obtained from Steven Weinberg’s *Gravitation and Cosmology.*89 Perhaps because they were trying to save face for Relativity theory, neither of the two authors mention the observational figure of –7.3.

Poor also reports that Einstein’s Relativity predicted a perihelion for Mars of +1.3’’, but the observational figure is +8.1’’, a difference of 623%.90 Not surprisingly, Weinberg and Ross leave out General Relativity’s anomalous prediction, replacing it with the precession of the asteroid Icarus.91 Einstein’s formula also makes an erroneous prediction of Earth’s perihelion, assigning a figure of +3.8’’ when, according to heliocentric mechanics, it is actually 5.9''. Also, Newcomb was able to measure the nodes of Mercury (5.1’’), and Venus (10.2’’) as well as the eccentricity of Mercury (0.88’’), but Einstein’s formula simply isn’t able to make such calculations with a value greater than zero.

Other anomalies in Relativity’s ability to calculate the perihelion of the heavenly bodies crop up from time to time. For example, for the binary DI Herculis, composed of two stars which circle each other in about 10.5 days, General Relativity predicts that the orbit should rotate by 4.27º per century, but the actual value is 1.05º. Many such discrepancies occur in other binary systems.92 The discrepancies are more frequent when the gravitational field is stronger, as it is in binary systems, yet ironically General Relativity was invented in order to explain the phenomenon of gravity.

Lastly, Poor wrote two devastating critiques of Einstein’s use of the perihelion of Mercury to prove Relativity theory. The first was written in 1923 titled “Relativity: An Approximation,” presented to the American Astronomical Society; the other in 1924 titled “The Relativity Motion of Mercury: A Mathematical Illusion,” presented to the Physics Colloquium of Columbia University. The former is included at the end of this Appendix.

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89 *Gravitation and Cosmology*, New York: John Wiley, 1972, p. 198. Ross says that the observed value of Venus’ perihelion is “8.4’’ ± 4.8’’ and that General Relativity’s prediction was “8.6’’.”
90 *Gravitation Versus Relativity*, p. 191. In addition, the observed value of Mercury’s nodal precession is +5.1 ± 2.8 and Venus’ is +10.2, but Relativity calculated zero for both.
The Brans-Dicke Challenge to Einstein

In the 1960s, one of the premier astronomers of the day, Robert H. Dicke, put forth a challenge to General Relativity based on Mach’s principles. Our purpose in revealing the challenge, however, is not to propose that Brans-Dicke offered a viable alternative to General Relativity; rather, it is to show that the new theory forced Relativists to cease basing their theory merely on mathematics and demanded that they provide the world with real physical evidence for their beliefs. For our interests, it matters little which theory eventually wins in the minds of modern scientists. Rather, our interest lies in seeing one form of relativity challenge another form, and in the process, expose both for the erroneous concepts they present.

Robert Dicke’s first challenge to General Relativity regarded the perihelion of Mercury. Dicke found that, contrary to the theory of General Relativity, part of Mercury’s residual perihelion was due to the sun’s oblateness as well as its fast rotating inner core. With Carl Brans, Dicke put forth another challenge, much more formidable. Based on Mach’s principles, they offered a theory of gravity which was opposed to the one established by General Relativity.\footnote{C. Brans and R. H. Dicke, “Mach’s principle and a relativistic theory of gravitation.” Physical Review 124 (1961): 925-35. SCI reported that Brans and Dicke’s article was cited in over 565 publications between 1961 and 1983. See also R. H. Dicke, “Dirac’s cosmology and Mach’s principle,” Nature 192 (1961): 440-41.}

They posited that the gravitational force between two bodies should be determined not only by the two bodies themselves, but also by the distant matter in the universe (e.g., stars, galaxies, etc.).\footnote{Dicke wrote in his autobiography: “…the laboratory, Earth and Solar System could not be isolated even in principle from the rest of the universe” (R. H. Dicke, A scientific autobiography, unpublished manuscript on file in the Membership Office of the National Academy of Sciences, 1975). Dicke proposed considering the gravitational constant, $G$, as the ratio of gravitational to inertial mass. As Brans put it: “Any influence of the universe structure on inertial forces would then show up in terms of $G$, expressed in ‘standard’ units for which inertial mass is defined as constant. This also was consistent with Dirac’s conjecture $1/G \sim \text{M}/\text{R}$.” To calculate the gravitational effect of the universe on two bodies, one would need to determine the radius of the universe, multiply the radius by the square of the speed of light, and then divide the result by the mass of the universe, and then multiply by the volume of a sphere. The resulting number should equal the gravitational constant, $G$, which is 0.0000000667 cm$^3$/grams/second$^2$. Dicke came within a factor of 100 using a 10 billion light-year radius and 200 grams per cubic million kilometers. Of course, if Dicke’s radius is decreased and the grams/million kilometers$^3$ increased in line with the parameters of a smaller yet denser geocentric universe, the resulting factor would be a lot closer to the gravitational constant. For example, attaining $G$ for a 90 parsec radius universe, the mass of the universe is $1.31 \times 10^{61}$ grams.}

In effect, as Brans writes, they were proposing “to find a physical basis for inertial reaction forces,”\footnote{Carl H. Brans, “Citation Classic,” in Current Contents, March 7, 1983, p. 24.} a force of nature that had eluded a convincing explanation from the time of Aristotle, through Newton and down to Einstein. Dennis Sciama had also suggested the same in 1953.\footnote{Dennis W. Sciama, “On the Origin of Inertia,” Monthly Notices of the Royal Astronomical Society, 113:34-42, 1953; and The Unity of the Universe, New York, Doubleday, 1961.}

To the consternation of General Relativity advocates, the Brans-Dicke theory has a built-in mathematical variable that will not allow the theory to be disproved.\footnote{As Brans put it: “I started from this point, looking for field equations which would contain $1/G$ as a field quantity, and having mass as a source. A simple division of the Einstein Lagrangian by $G$, to isolate it from the matter Lagrangian, so that matter will be conserved as usual, came to mind quickly as a starting point. An extra term, involving $\phi$ and its derivatives, must then be added with its form determined by dimensional arguments. However, its numerical coefficient could not be determined and was left as a free dimensionless constant. Standard Einstein theory is recovered in the limit as this constant, $\omega$, approaches $\infty$. Thus, in principle, with no independent guide to the value of $\omega$, no experiment with finite error can rule out the scalar-tensor theory in favor of Einstein’s” (Carl Brans, “Citation Classic,” in Current Contents, March 7, 1983, p. 24).} As Clifford Will describes:
…the scalar-tensor theory was every bit as valid mathematically as general relativity, and was capable of making detailed predictions for the outcomes of experiments…the theory could do anything general relativity could do.98

Although various experiments were performed to distinguish between General Relativity and Brans-Dicke, the precision needed to do so was so high that it simply was not feasible. As Clifford Will puts it:

The problem of Mercury’s perihelion shift and the solar oblateness remained unresolved; if anything it was now even more contentious, because the prediction of the Brans-Dicke theory with $\omega$ larger than 500 for Mercury’s perihelion shift is indistinguishable from that of general relativity, so if the solar oblateness were to be as large as the original Dicke-Goldenberg 1966 value, both theories [General Relativity and Brans-Dicke] would be in violation of experiment. Could one say that the scalar-tensor theory was completely dead? Not exactly. Because $\omega$ is adjustable, the predictions of the theory can be made to be as close as desired to those of general relativity….At this point a certain subjectivity must enter the decision as to what is viable and what isn’t.99

What Will suggests as the judge of the issue is Occam’s razor, claiming that General Relativity is the simpler approach. In the end, Will has no proof to protect Einstein’s theory. He is left with relativistic mathematical formulae against relativistic mathematical formulae, both claiming to provide the definitive answer, yet neither being able to disprove the other by direct physical evidence.

Relativity: An Approximation

By Charles Lane Poor100

The generalized theory of relativity has been accepted as proved; proved by the motions of Mercury and by the bending of light rays near the edge of the sun; phenomena that, according to the relativists, cannot be explained or accounted for by the ordinary methods of astronomical research. Now, how does the relativity theory explain these motions of Mercury, this deflection of light? In what way do the formulas of relativity differ from those of the old fashioned classical mathematics of Newton, La Place, and Leverrier?

The formula of relativity, upon which is based the relativist’s explanations of these phenomena, is found, upon analysis, to be nothing more nor less than an approximation towards the well known formula of Newtonian mathematics. The relativity formula, as used in the astronomical portion of the theory, contains not the slightest trace of the basic postulates of relativity, of warped space, or the mythical fourth dimension. It is a formula of Newtonian gravitation, purely and simply; but an approximate formula, derived by a series of approximations.

In deriving the formulas for the transmission of light throughout space and for the motion of one particle of matter about another, the relativity mathematician encounters a serious difficulty. His formula, derived from the postulates of relativity, indicates that light travels with different speeds in different directions, that the velocity of light depends upon the direction of transmission. That such a mathematical result

98 Clifford Will, *Was Einstein Right?*, p. 154. Will relates that “…the joke that used to go around Kip Thorne’s relativity research group at Caltech: On Monday, Wednesday, and Friday, we believe general relativity; on Tuesday, Thursday, and Saturday, we believe the Brans-Dicke theory (on Sunday, we go to the beach)” (p. 156).
100 A paper presented to the American Astronomical Society, 13th meeting, 1923, Mount Wilson Observatory, California.
represents the facts of nature is highly improbable, for in free space there is no difference between right and left, between north and south, or east and west; there is no reason why a ray of light should travel faster to the north than to the south. To overcome this mathematical difficulty, or inconvenience, as he calls it, the relativist makes a substitution, or approximation. Instead of using the direct distance between the centers of two particles of matter, the relativist adds a small, a very small, factor to this distance; or, as Eddington puts it, “we shall slightly alter our co-ordinates.” Such an approximation is very common among physicists: it is done every day to simplify troublesome formulas. The only precaution necessary in such a procedure is to remember always that the final result is necessarily approximate, and, before drawing any conclusion, to thoroughly test the effects of the approximation.

Now the quantity, \( m \), which is thus added to the distance to simplify the relativity equation, represents the mass of the attracting body, expressed in linear relativity units. It is really very small indeed in all physical problems of the laboratory. For all ordinary masses of matter, such as can be handled and experimented with on the earth, this little quantity is very much less than the billionth part of an inch; for the earth itself it is only about one-sixth (\( \frac{1}{6} \)) of an inch. As applied to the earth as a gravitational body, the approximation really consists in adding \( \frac{1}{6} \)th of an inch to each and every distance measured from the center of the earth. As the radius of the earth is some 4,000 miles, it is easy to see that for bodies near the surface of the earth this approximation amounts to less than one part in a billion, a quantity absolutely inappreciable in any physical problem; in the case of the motion of the Moon about the earth, this little distance is less than one part in seventy-five billion.

To the physicist such a degree of approximation is amply sufficient; no laboratory methods can measure with this degree of accuracy. But it is radically different in astronomy: distance and motion are on enormous scales and time continues on interminably, and a minute approximation might become evident in the motions of the planets.

Now it must be clearly understood that this minute approximation is the sole appreciable difference between the so-called Einstein law of motion and the old fashioned mathematics of Newton. By omitting this approximation and using the exact distance between the centers of the two bodies the Einstein formula becomes identical with that of Newton: on the other hand, if, in the Newtonian formula the approximate distance be used, then this formula becomes identical with Einstein’s. There is no essential difference between the two formulas: Einstein’s formula is an approximation towards Newton’s; except for the approximation, it is Newton’s. In the Einstein formula for the orbit of a planet there is not the slightest trace of relativity; there is no warped space, no fourth dimension; there is nothing but every-day, ordinary Newtonian gravitation, but approximate gravitation. The approximation is in the Einstein equation; not in the Newtonian.

When the motions of the planets about the sun are considered, it must be remembered that the sun is many thousands of times larger than the earth, and, therefore, the little quantity, \( m \), becomes proportionally larger, being in fact about nine-tenths of a mile. And the relativity approximation consists, in this case, of using in their formulas, not the actual distance of a planet from the center of the sun, but that distance increased by nine-tenths (0.91) of a mile. This same distance, this \( \frac{9}{10} \)ths of a mile, is added to the distance of each and every planet, to that of Mercury, to that of Venus, of Jupiter and of Saturn. In all real astronomical work the position of the center of a planet is always determined from the center of the sun; the center of the sun is the fundamental point of reference in the solar system. No other point is ever used in actual astronomical observations, calculations, or tables; the actual distance of a planet from this point
is measured, or calculated, or tabulated. But the relativity approximate formula does not give this actual distance: in the case of each and every planet it gives this distance increased by $9/10$ of a mile.

The Motion of the Perihelion of Mercury

It is this approximation, which gives rise to the apparent, or so-called, Einstein motion of an elliptic orbit. According to the Newtonian formula the elliptic orbit of a planet (when the interaction of the other planets is omitted) is fixed in space; according to the Einstein formula the elliptic orbit is in slow motion, so that the perihelion appears to advance. But the Newtonian formula is mathematically exact; the Einstein formula contains an approximation, and the apparent theoretical Einstein rotation of an orbit, the theoretical Einstein advance of the perihelion is due, entirely, to the approximation so contained in his formula. The theoretical orbit of a planet is fixed in space, as shown by the mathematically exact Newtonian formula; there is no Einstein motion of the perihelion; the so-called Einstein rotation of an orbit is a mathematical illusion, caused by using an approximate formula.

But, while the Einstein motion is pure illusion, there is an actual motion of the perihelia of all the planets. When the mutual interactions of the planets, one upon another, are taken into account, then it is found that the orbits of all of them are in motion; the simple elliptic orbits writhe and squirm, so to speak, under the additional forces of the planets themselves. Not a single orbit is at rest, not a single orbit is a true ellipse. The orbit of Mercury, for example, swings around at the rate of 576 seconds of arc per century; that of Mars at the rate of 1606 seconds per century. Leverrier in 1859 computed the action of each and every planet upon the orbit of Mercury, and found that these attractions would account for only 538 seconds or arc, thus leaving an unexplained 38 seconds in the centennial advance of Mercury’s perihelion. This is the celebrated discordance, which has been so stressed by Einstein and his followers. Leverrier explained it by the action of an unknown planet, or of masses of matter, between Mercury and the sun. While it is now known that no large planet is there, yet observations and photographs, without number, show clearly the presence of great masses of scattered matter in the very places that Leverrier indicated as necessary to explain this motion of Mercury.

But the relativity approximate formula gives rise to an apparent, or fictitious, motion of the orbit of Mercury of some 43 seconds of arc per century. And it is this approximate coincidence of figures, 43 seconds of illusion as against 38 seconds of actuality, which has been used by Einstein and is followers as proof, conclusive, of the relativity theory. As the relativity advance, as this 43 seconds, is a mere mathematical illusion, as there is, in reality, no such thing as the Einstein rotation of an orbit, this approximate coincidence of figures has no bearing, whatsoever, upon the truth or falsity of the relativity postulates.

The Deflection of Light

There is nothing new in the idea that light may be bent, or deflected, from its course by the action of gravitation. Sir Isaac Newton certainly suspected that bodies might act upon light at a distance, and by their action bend its rays. Such action and such bending, of course, was predicated upon the theory that light consists of material particles of matter, shot forth form the luminous source. Such a material particle, or corpuscle, passing near the sun or other large gravitational mass would naturally describe a planetary orbit about such body, and the bending of the ray would be the amount of curvature in such orbit. The
character of the orbit and the amount of curvature, or bending, of the orbit depends entirely upon the velocity with which the particle passes the attracting body. At a certain rather low velocity, the path of the particle is a circle about the gravitating centre: as the velocity increases the circle becomes an ellipse, a parabola, and finally a hyperbola. With each further increase in speed the arms of the hyperbola open out more and more and the path approaches nearer to a straight line.

The velocity of light is so great that the path of a particle, traveling about the sun with that speed, will be an hyperbola, the arms of which are so widely separated as to make the path almost, but not quite, a straight line.

The corpuscular theory of light, as held by Sir Isaac Newton, explained all the optical phenomena known to him. But, during the years which elapsed after his death, new facts were learned and new experiments made. Facts and experiments, which could not be explained or accounted for on this theory, gradually led to the acceptance of the then rival, wave or undulatory, theory of light. With the passing of years, with each new experiment, the wave theory of light became more and more firmly established, until it became one of the fundamental theories, or concepts, of modern science.

Therefore von Soldner’s paper on the bending of light rays, which was published in 1801, attracted very little attention. For in this paper he assumed the corpuscular theory of light and calculated the amount that a ray should be bent in passing near the sun. He treated light as being material, a particle of light being attracted by the sun in the same way as a planet, and obeying the same laws of motion. He treated the problem of finding the light deflection in exactly the manner one would treat the path of a minute planet, which travels about the sun with the speed of light. He applied to the problem the ordinary, every-day, formulas of Newtonian gravitation.

It can be readily shown that, under the Newtonian laws of motion, a minute planet, traveling about the sun with the speed of light in a path which just grazes the surface of that luminary, will travel in an hyperbolic orbit; in a curve which is almost, but not quite a straight line. A very simple calculation shows that the total amount of bending in such path amounts to only 0.87 seconds or arc. This is the so-called “Newtonian” deflection. If the Newtonian, or corpuscular theory of light be true then all rays of light, grazing the edge of the sun, will be bent, or deflected from their straight paths by this amount, by 0.87 seconds of arc.

Now Einstein, in his generalized theory of relativity, introduces a factor two (2) into the formula for the bending of light rays, and gives the total deflection of a ray, passing the sun, as double the above amount, as 1.75 seconds of arc. This theoretical Einstein bending of a light ray is found, by Eddington and others, from the relativity equations by the use of the celebrated principle of equivalence. Under this principle of relativity, the track of a ray of light “agrees with that of a material particle moving with the speed of light.” The principle of equivalence, so stated, appears to be nothing more nor less than an assumption of the truth of the corpuscular theory of light; yet the relativist never distinctly acknowledges this assumption, never distinctly states which theory of light is to be accepted. To explain certain phenomena the wave theory seems to be used by the realtivists; other phenomena, under the principle of equivalence, by the corpuscular theory. Is not the principle of equivalence, so used, a handy device for passing readily form one theory to another as necessity drives?
But let us assume, with the relativist, the validity of the principle of equivalence, and from this principle find from the relativist’s own formulas the track of a ray light. The fundamental formula of relativity dynamics is given by Eddington and it differs from that of Newtonian mathematics by a single small term (which has been shown to be the result of an approximation). From this fundamental differential formula the relativist finds the path of a planet, and the track of a ray of light; finds the motion of the perihelion of Mercury, and the deflections of the rays from distant stars as they pass near the eclipsed sun. According to the principle of equivalence there is no essential difference between these two cases: Mercury travels about the sun at the distance of many millions of miles and at a comparatively slow speed; the ray of light grazes the edge of the sun and travels at a terrific velocity. But the same formula applies to both cases; substitute in it the speed and distance of Mercury for the motions of Mercury; substitute in it the speed and distance of the ray of light and obtain the track of such ray.

Now Eddington integrates this fundamental equation of relativity dynamics and finds the complete path of any body, Mercury, Jupiter, or a material particle travelling with the speed of light. This complete and general orbit of any body, of Mercury or of a ray of light, is given by Eddington in his discussion of the motion of the perihelion of Mercury, and this orbital equation of relativity, so given by Eddington, differs from the ordinary equation of celestial mechanics by a single small term, by the term which gives rise to the so-called relativity motion of the perihelion. According to repeated statements of Einstein, of Eddington and of other relativists, according to the printed formulas of relativity, the relativity orbit, or path of a body is identical with that of Newtonian mathematics, with the single exception of this perihelial motion. This complete formula for the orbit of a body is used by the relativists to find the so-called motion of the perihelion of Mercury, to find the celebrated 43 seconds of arc, upon which is based the Mercurial proof of the Einstein theory.

But, upon the equivalence principle, this same orbital equation should give the track of a ray of light, passing near the sun. Substituting in this equation the distance of the ray from the sun’s centre and its speed, the resulting orbit, or track of a ray is a hyperbola, and the total deflection, or bending is easily shown to be 0.87 seconds of arc, agreeing identically with that found from the Newtonian equation. This is necessarily so, for the two equations are the same, with the exception of the small term, which gives rise to the motion of the perihelion. In the case of Mercury, this minute term appears to give a motion of the perihelion of 0.103 seconds of arc in one revolution of the planet in its orbit (42.7 seconds per century): in the case of a ray of light, the same term amounts to about only thirty-five millionths (0.000,035) of a second of arc, a quantity absolutely negligible.

That is, the very formula, used by the relativists to prove their theory by the motion of Mercury, disproves their computed value for the light deflection. This equation, their own equation, gives the so-called Newtonian value, 0.87 seconds of arc, for the bending of a ray of light by the gravitational action of the sun.

The relativist, however, does not use this orbital equation in his calculations of the amount of the light deflection. He reverts to the fundamental differential equation and integrates it in an entirely different manner for the track of the light ray. This second method of integrating the fundamental equation is, however, frankly approximate and gives a result which applies solely to light. Before beginning the integration, Eddington discards a term from the fundamental equation as being, in the case of light, infinitely small in comparison with other terms in the equation. This simplifies the equation, and the
integration of the thus mutilated equation results in a curved path, which may approximate that of a light ray, but which is clearly approximate. The total bending, resulting from the use of this approximate path, is the relativity figure of 1.75 seconds of arc.

The validity of this method depends upon the question as to whether the discarded term is really very small with respect to those retained, or not. The omitted term is a constant, while the value of the term retained varies with the movement of the light particle along the curved orbit. A very simple comparison of this rejected term with the one retained shows that, in the most favorable case, the term, \( I/P \), which Eddington omits as negligibly small, is two-thirds \((2/3)\) as great as the term which he retains. Two-thirds can hardly be called negligibly small in comparison with unity. Further, except for a minute portion of the curve near perihelion, the omitted term \( I/P \) is actually very much larger than the term, \( 3mU^2 \), which is retained. Eddington, in fact, omits as negligibly small, the large, important term of the equation, and retains the insignificant term.

It would thus seem that the approximation used by Eddington to integrate the equation for the deflection of light is invalid, and that the resulting value for the bending of the light ray is erroneous. Both methods of integrating the fundamental relativity equation cannot be right: one or the other must be wrong. The first and more general method, as we have seen, is used by the relativist to obtain the so-called relativity motion of the perihelion of Mercury, but this method gives the deflection of light only 0.87 seconds of arc; the second method is restricted to light, is frankly approximate, and gives the amount of the deflection as 1.75 seconds. The same equation is handled by the relativist in two different ways and gives two radically different results. Which result is correct?

The relativist apparently checks his invalid calculation by the use of an entirely different method, a physical method of determining the deflection. But the method is faulty and contains obvious errors, and the fundamental formula for the velocity of light, upon which the entire method is based, is in direct contradiction to the principle of equivalence, for it shows that the speed of light decreases as it approaches the sun, while the equivalence principle demands that such velocity should increase.

It would thus seem that the calculations by which Eddington finds the deflection of light equal to 1.75 seconds of arc are invalid. The principle of equivalence, if true, shows that the total bending of a ray of light, passing near the sun, is 0.87 seconds of arc, and not the 1.75 seconds, as claimed by the relativists.

Conclusions

1. The fundamental formulas of relativity dynamics contain an approximation; the \( r \) of these formulas is not the direct distance between the centres of two particles of matter; it is this distance increased by a minute quantity.

2. The relativity formulas can be obtained directly from the corresponding Newtonian formulas by the introduction of the relativity approximation.

3. The relativity motion of the perihelion of an orbit is a mathematical illusion, due entirely to the use of the relativity approximation. The elliptic orbit of a particle of matter is fixed in space (when the interaction of the other planets is omitted).
4. The supposed confirmation of the Einstein theory by the motion of the perihelion of Mercury depends entirely upon the use of the approximation in the relativity formulas: when the approximation is removed from the formulas, all appearances of confirmation vanish.

5. Under the generalized theory of relativity, through the principle of equivalence, a ray of light, passing near the sun, will be bent by the same amount as under the corpuscular theory of light. The theoretical bending being thus the same for these two theories, a deflection, observed at an eclipse, cannot be used to prove the truth of the relativity theory as against that of the corpuscular theory of light.

6. The figure, 1.75 seconds of arc, given by the relativists for this deflection is obtained by approximate and invalid calculations. The relativists own formulas give, as they should under the principle of equivalence, 0.87 seconds, and not 1.75.

Do the Eclipse Photographs Prove General Relativity?

As we noted earlier, Einstein desperately needed some physical proof that gravity bent light in the exact proportion his General Relativity theory predicted so that he could give credence to the idea that gravity and acceleration were equivalent phenomena. In a letter to Ernst Mach he stated that the eclipse results would determine “whether the basic and fundamental assumption of the equivalence of the acceleration of the reference frame and of the gravitational field really holds.” Although a bending of light by gravity would not necessarily prove General Relativity (since non-Relativistic theories could also explain it), it would at least give it enough plausibility to pass the muster of an adoring public. But the physical evidence supporting General Relativity was one of the more biased campaigns of human advertisement the world has witnessed. As one author writes: “In 1911 Einstein predicted how much the sun’s gravity would deflect nearby starlight and got it wrong by half.” Another from the same magazine writes:

His second prediction, that light from distant stars would be deflected by the warped space-time around the sun, catapulted him to world fame in 1919, when observations of a solar eclipse seemed to confirm his prediction. But as historians have since shown, the 1919 measurements were equivocal at best.

Paul Marmet adds:

“…all the experiments claiming the deflection of light and radio waves by the Sun are subjected to very large systematic errors, which render the results highly unreliable and proving nothing” and concluding in

102 Karen Wright, Discover magazine contributing editor, “The Master’s Mistakes,” September 2004, p. 50. This would be no surprise to many today.
Einstein, however, regarded the solar eclipse results of 1919 as irrefutable evidence for his General Theory of Relativity, for it was reputed to prove that gravity bent starlight by precisely the amount predicted by the theory. In his 1920 book *Relativity: The Special and the General Theory*, he wrote:

The relative discrepancies to be expected between the stellar photographs obtained during the eclipse and the comparison photographs amounted to a few hundredths of a millimetre only. Thus great accuracy was necessary in making the adjustments required for the taking of the photographs, and in their subsequent measurement... The results of the measurements confirmed the theory in a thoroughly satisfactory manner.”

Previous to this, in 1913 Einstein employed Erwin Freundlich to detect a bending of starlight near the sun, but his photographs failed to provide any such evidence. After this failure, Einstein confided to Freundlich: “If the speed of light is in the least bit affected by the speed of the light source, then my whole theory of relativity and theory of gravity is false.” Perhaps this is why in March 1914 Einstein seemed a bit more unconcerned in a letter to his best friend, Michael Besso, stating: “Now I am fully satisfied, and I do not doubt any more the correctness of the whole system, may the observation of the eclipse succeed or not. The sense of the thing is too evident.”

When asked what he would do if the eclipse results were not in his favor, Einstein retorted with one of his more famous quips: “Then I would have been sorry for the dear Lord – the theory is correct.” Unless Einstein was joking, this statement shows he had already set in his mind that Relativity was correct before the 1919 eclipse experiments were performed. Eddington also caught this fever. As Stephen Brush states: “Eddington...was already convinced of the truth of Einstein’s theory before making the [eclipse] observations.” Clark reports much the same:

Eddington’s enthusiasm for the General Theory was illustrated when Cottingham asked, in Dyson’s study: “What will it mean if we get double the Einstein deflection?” “Then,” said Dyson, “Eddington will go mad and you will have to come home alone.”

According to C. W. F. Everitt, a detailed reading of the reports on the 1919 eclipse observations

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106 *Einstein: The Life and Times*, p. 207.
108 Einstein’s answer to the question from doctoral student Ilse Rosenthal-Schneider, in 1919. Quoted in Rosenthal-Schneider, *Reality and Scientific Truth*, p. 74, as cited in *The Expanded Quotable Einstein*, p. 238. Ilse was one of Einstein’s love interests prior to his divorce from Mileva Marić. He eventually married Ilse, only after giving the brush off to Ilse’s daughter, Elsa. See Volume II, pp. 39-48.
leads only to the conclusion that this was a model of how not to do an experiment... It is impossible to avoid the impression – indeed Eddington virtually says so... that the experimenters approached their work with a determination to prove Einstein right. Only Eddington’s disarming way of spinning a yarn could convince anyone that here was a good check of General Relativity. The results of later eclipse expeditions have been equally disappointing."111

Although Einstein and Eddington were so self-assured, many anomalies and suspicions revolve around May 29, 1919’s eclipse photographs. Along with Eddington were three other celebrated British astronomers: Andrew Crommelin, E. T. Cottingham and C. R. Davidson. Eddington and Cottingham did their observations on Principe Island in West Africa, while Crommelin and Davidson did theirs at Sobral, Brazil. Charles Lane Poor offers some sobering comments:

The mathematical formula, by which Einstein calculated his deflection of 1.75 seconds for light rays passing the edge of the sun, is a well known and simple formula of physical optics. Not a single one of the concepts of varying time, or warped or twisted space, of simultaneity, or of the relativity of motion is in any way involved in Einstein’s prediction of, or formulas for, the deflection of light. The many and elaborate eclipse expeditions have, therefore, been given a fictitious importance. Their results can neither prove nor disprove relativity theory....The actual stellar displacements, if real, do not show the slightest resemblance to the predicted Einstein deflections: they do not agree in direction, in size, or the rate of decrease with distance from the sun."112

Einstein had referred to 1.7 seconds of arc in his book on Relativity:

...according to the general theory of relativity, a ray of light will experience a curvature of its path when passing through a gravitational field, this curvature being similar to that experienced by the path of a body which is projected through a gravitational field. As a result of this theory, we should expect that a ray of light which is passing close to a heavenly body would be deviated towards the latter. For a ray of light which passes the sun at a distance of $\Delta$ sun-radii from its center, the angle of deflection ($\alpha$) should amount to $1.7''/\Delta$. It may be added that, according to the theory, half of this deflection is produced by the Newtonian field of attraction of the sun, and the other half by the geometrical modification (“curvature”) of space caused by the sun.113

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113 Albert Einstein, *Relativity: The Special and the General Theory*, 1961, Appendix III, p. 145. Johann Georg von Soldner (d. 1833) had already predicted a bending of light around the sun of 0.875 arc seconds, all without the use of Relativity. Einstein doubled Soldner’s figure to 1.75”, claiming that 0.875 was attributable to Newtonian physics, but the remaining 0.875 was attributable only to Relativity’s “space curvature.” Paul Marmet adds: “This amount [1.75"] is twice the one predicted by Einstein in 1908 [A. Einstein, “Jahrbuch der Radioaktivität und Elektronik,” 4, 411, 1908] and in 1911 [A. Einstein, “Über den Einfluss der Schwerkraft auf die Ausbreitung des Lichtes,” *Annalen der Physik*, 35, 898, 1911] using Newton’s gravitational law. In 1911, Einstein wrote: ‘A ray of light going past the Sun would accordingly undergo deflexion to an amount of $4 \times 10^{-6} = 0.83$ seconds of arc. Let us note that Einstein did not clearly explain which fundamental principle of physics used in the 1911 paper and giving the erroneous deflection of 0.83 seconds of arc was wrong, so that he had to change his mind and predict a deflection twice as large in 1916” (“Relativistic Deflection of Light Near the Sun Using Radio Signals and Visible Light,” Physics Dept. University of Ottawa, www.newtonphysics, p. 15).
Although Einstein predicted the deflection of starlight at the surface of the sun should be 1.75 seconds of arc, what the reports do not readily reveal is that evidence from the 1919 expedition showing deflections greater or less than 1.75 seconds were rejected as “spurious.” Even though Einstein insisted “…great accuracy was necessary in making the adjustments required for the taking of the photographs, and in their subsequent measurement,” Poor discovered that Eddington discarded 85% of the data from the eclipse photographs taken at Sobral, Brazil, due to “accidental error.” The truth is that the displacements of the stars were in every conceivable direction, some in the exact opposite position predicted by Relativity. At a meeting of the Royal Astronomical Society in 1919, Ludwik Silberstein revealed that the displacements were not radial as Einstein’s theory claims, often deflecting from the radial direction by as much as 35º, leading Silberstein to conclude: “If we had not the prejudice of Einstein’s theory we should not say that the figures strongly indicated a radial law of displacement.”

As noted, only 15% of the displacements were consistent with Einstein’s prediction. After providing the reader with Table III from the official Report of the expeditions, Poor reveals the numerous discrepancies:

This table shows that, on the average, the observed deflection, as given by the British astronomers, differs by 19% from the calculated Einstein value [1.75”]. In the cases of two stars, the agreement between theory and observation is very nearly perfect, the observed value being only 3% in error: in other cases, however, the differences range from 11% to 60% [and] the rate of decrease from star to star is radically different from that predicted. The difference between the deflection of the star nearest the sun and that of the farthest star should be, according to Einstein, 0.56”; while the observed or measured difference was 0.82”, practically 50% out of the way. The diagrams...show clearly that the observed displacements of the stars do not agree in direction with the predicted Einstein effect. This point was nowhere [sic] mentioned in the Report, which took up only the amount of the radial component of the actual displacement. But, after the measurements of the plates became available for study, several investigators called attention to this fact of a radial disagreement in direction between the observed and predicted displacements...in the case of the star furthest from the sun to 37º. Thus, even the seven best plates out of

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\[115\] Under the title: “Radial Displacement of Individual Stars,” the following information was given in the “Report” authored by Dyson, Eddington and Davidson and presented to the Royal Astronomical Society:

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<tr>
<th>Star</th>
<th>Calculation</th>
<th>Observation</th>
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<tbody>
<tr>
<td>11</td>
<td>0.32”</td>
<td>0.20”</td>
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<tr>
<td>10</td>
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<td>4</td>
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<td>2</td>
<td>0.85”</td>
<td>0.97”</td>
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<td>3</td>
<td>0.88”</td>
<td>1.02”</td>
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thirty-three, which showed star images, give inconsistent results: the observed shifts in the star images, if real, do not coincide with the Einstein effect either in amount or direction.116

It has been claimed by many that the differences between the observed and predicted shifts are no greater than should be expected...Now this very question was investigated by Dr. Henry Norris Russell, of Princeton University, a most ardent upholder of relativity theory. He studied these star displacements with a view of determining whether the departures from Einstein’s predicted effects are real or not, and, if real, of finding some possible explanation for them. As a result of an exhaustive examination of them, he concludes that these differences between the observed and predicted displacements, these non-Einstein displacements, as he calls them, are real, and cannot be attributed to mere accidental errors of observation and measurement...Dr. Russell assumes that the most probable source of these proved non-Einstein deflections is to be found in instrumental errors: in an alteration in the shape of the mirror, caused by the heat of the sun...But one point is perfectly clear. If it be admitted that the heat of the sun so distorted the mirror of the apparatus as to cause errors of 20%, in some cases of 50%, of the measured displacement, then the entire set of plates is worthless for proving the existence or non-existence of the “Einstein effect.”117

After providing the reader with the results of the photographic plates at both Sobral and Principe,118 Poor offers the following analysis:

These results, in each case, are the means [average] of the radial components only; nothing whatever being given as to the directions in which the actual displacements took place. The Einstein theory requires a deflection, not only of a certain definite amount, but also in a certain observed direction. To discuss the amount of the observed deflection is to discuss only one-half of the whole question, and the less important half at that. The observed deflection might agree exactly with the predicted amount; but, if it were in the wrong direction, it would disprove, not prove, the relativity theory....Now, the diagrams...of the seven best plates, the seven taken at Sobral with the 4-inch camera, show clearly and definitely that the observed deflections are not in the directions required by the Einstein theory...not only that, but every one of the seven plates shows the star deflected in the same direction from that called for by the relativity theory. Similarly for star No. 11, every dot again lies on the same side of the Einstein arrow, and the mean deflection differs by 37° from the predicted. In this case two of the individual plates give deflections practically in the reverse direction to that called for by the theory. The best agreement between theory and observation is given by star No. 4, where the mean difference amounts to about a single degree: but, even in this case, the individual results differ by as much as 30°. The relativist either totally disregards these discordances in the directions of the observed deflections, or invokes the heating effect of the sun to distort the mirror by just the proper amount to explain them away!119

Again, disregarding directions entirely, and taking into account only the size of the deflection, it is noted that the disagreement between the three mean results, as given in the Report, is over 100%; the largest value being well over twice that of the smallest. The actual amount of the deflection as obtained with the
When the deflections of light, as actually observed, are considered both in direction and in amount, the discordances with the predicted Einstein effect become marked, and the plates present little or no evidence to support the relativity theory. Further, if these deflections are real, and not due to instrumental errors (so readily called upon by the relativist to explain everything that the relativity theory cannot account for) then it has not yet been shown that the relativity theory is the only possible explanation. As a matter of fact there are other perfectly possible explanations of a deflection of a ray of light; explanations based on every-day, common-place grounds. Abnormal refraction in the Earth’s atmosphere is one; refraction in the solar envelope is another. The atmospheric conditions under which the eclipse plates were taken were necessarily abnormal; and the plates, themselves, clearly show that the rays of light passed through a mass of matter in the vicinity of the sun; a mass of density sufficient to clearly imprint its picture upon the photographic plates. Such is the evidence, and are the observations, which, according to Einstein, “confirm the theory in a thoroughly satisfactory manner.”

In his 1970 book, Leon Brillouin made a similar critique:

These were very inaccurate experiments with individual errors of 100% and averaged errors of 30%. The theory is not safe because it assumes an ideal vacuum near the sun’s surface, while we can observe very powerful explosions of matter and radiations from the sun.

Einstein predicts the deflection of a light ray passing near the surface of the sun, but we obtain a similar result if we consider a light ray as a beam of photons $hv$ with masses $hv/c^2$. Only the numerical coefficient is different, and Einstein’s prediction is twice as large as that in the computation with photons. Here the experimental results are actually very poor with errors of 100% magnitude…looking candidly at these observations, one feels that very large sources of error are obviously playing a substantial role, and our present knowledge of the turbulent flow in the solar atmosphere yields the most probable explanation. The Shapiro experiment is certainly safer than the deflection of light rays.

Poor’s explanation is even more detailed, showing from the science of optics what is a perfectly logical explanation to the many and varied deflections obtained in Eddington’s series of photographs:

The Sobral photographs show clearly that the rays of light, in their course from the distant stars, passed through masses of matter near the sun. This matter was sufficiently dense and reflected enough sunlight to imprint its image upon the photographic plates, and there can be no question as to its existence and its presence in the paths of the light rays. Further, whenever a ray of light passes from free space into, or through a medium of any kind of density, such ray is refracted, or bent out of its straight course. The path of such a ray becomes curved, and the amount of refraction, or curvature, depends on the density of the medium into which the ray passes and the angle at which it meets the surface. This is the fundamental law of physics: upon the refractive effects of different media are based our optical instruments and experiments: eye-glasses, cameras, microscopes, telescopes; all depend upon the refractive effect of glass upon the ray of light. It is certain, therefore, that the rays of light, in passing through the solar envelope, suffered a refraction, or bending, of some kind and amount. This fact is as well established as the sun

120 *Gravitation versus Relativity*, p. 225.
121 *Gravitation versus Relativity*, p. 226.
itself. The sole question is whether this refraction was sufficient in amount and in direction to account for the observed displacements of the star images. This possibility of accounting, in a perfectly normal way, for the observed light deflections has been dismissed by the relativist in a few words as a matter scarcely worth mentioning.\textsuperscript{124}

While it is certain that the rays suffer some refraction in passing through the solar envelope, it is claimed by most astro-physicists that the effect is so small as to be negligible in comparison with the observed deflections. This idea is so firmly fixed that the possibility of explaining any portion of the deflections by refraction was dismissed by the British astronomers in their Report with a scant phrase or two. The entire question depends upon the possibility of the solar envelope having density large enough to bend a ray of light by the required amount, and this in turn upon what that density really is. It can readily be shown by the ordinary formulas of optics that a lens of matter of a density of about 1/140\textsuperscript{th} that of air at standard pressure and temperature would deflect a ray of light by about 1", the amount observed in the case of the star nearest the sun.\textsuperscript{125}

While, thus, there is a very open question as to the amount of refraction which would be caused by a medium of varying density, there is on the other hand practically no question as to the direction in which the bending will take place. This is purely a matter of geometry, and depends upon the fundamental law, that the incident ray, the normal to the surface, and the refracted ray, all lie in the same plane....In the case of the photographs taken at Sobral during the eclipse of May 29, 1919...an approximate solution can be made with great simplicity. For, assuming the solar envelope to be an ellipsoid of revolution with its axis coinciding with that of the sun, the axis of figure would be practically at right angles to the line of sight.\textsuperscript{126}

In light of Poor’s devastating analysis, Sir John Maddox, editor of \textit{Nature}, wrote: “They [Crommelin and Eddington] were bent on measuring the deflection of light....What is not so well documented is that the measurements in 1919 were not particularly accurate.”\textsuperscript{127} G. Burniston Brown adds:

Initially stars did appear to bend as they should, as required by Einstein, but then the unexpected happened: several stars were then observed to bend in a direction transverse to the expected direction and still others to bend in a direction opposite to that predicted by relativity.\textsuperscript{128}

\textit{Scientific American}, obtaining their report directly from Crommelin’s own words, shows that even the photograph used for the tally had a significant margin of error:

\textsuperscript{124} \textit{Gravitation versus Relativity}, p. 240.
\textsuperscript{125} \textit{Ibid.}, pp. 240-241.
\textsuperscript{126} \textit{Ibid.}, pp. 247-248. Poor then adds three tables which show the contrasting results between Einstein’s relativity and Poor’s refractive index of the solar envelope and residual matter. Regarding Table IV of the perihelia of Mercury, Venus, Earth and Mars, using the sum of squares to gauge the accuracy of the results, Einstein’s theory comes in at a whopping 473 off the observed values, while Poor’s is only 14 (\textit{ibid.}, p. 234). Regarding Table VI of the stars’ Computed Departures from Radiality, Einstein’s theory deviates by 2,489 from observed values, while Poor’s only by 410 (\textit{ibid.}, p. 251). In regard to Longitude of Node and Inclination, Poor’s results come within 84% and 80%, respectively, when compared to Newcomb’s observational figures published in 1895 (\textit{ibid.}, p. 253). As N. Martin Gwynne notes: “The reader will doubtless not be surprised to learn that the predictions resulting from Poor’s formula were many, many times more accurate than those produced by Relativity Theory. Moreover the same explanation (the assumption of the self-same solar atmosphere), enabled him also to predict correctly the perihelion of Mercury and without, incidentally, being thrown into confusion by the perihelia of the other planets. The same assumption, in other words, gave as satisfactory an answer as could be desired in two radically different investigations” (private paper).
The resulting shift at the limb is 1.98'', with a probable error of 0.12''. It will be seen that this result agrees very closely with Einstein’s predicted value of 1.75''.

Eddington’s experimental results from Principe Island, West Africa are dubious at best. On the day of the eclipse, May 29, 1919, the team was greeted with heavy rain. According to Clark, events occurred with a lick and a promise:

Not until 1:30 P.M., when the eclipse had already begun, did the party get its first glimpse of the sun. “We had to carry out our programme of photographs on faith,” wrote Eddington in his diary. “I did not see the eclipse, being too busy changing plates, except for one glance to make sure it had begun and another halfway through to see how much cloud there was. We took sixteen photographs. They are all good of the sun, showing a very remarkable prominence; but the cloud has interfered with the star images. The last six photographs show a few images which I hope will give us what we need…”

One might think that the mission would have been aborted, considering the minimal number of samples Eddington managed to put together. Of the six salvageable photographs, Eddington admits, seemingly without the slightest shame, that he based his conclusion on only one of the six salvageable photographic plates, while he rejected the other plates that did not give the results he expected. As he records it: “But one plate that I measured gave a result agreeing with Einstein,” from which he then exclaims, “it was the greatest moment of [my] life.” But even Relativists admit: “…it is absolutely crucial to obtain as many photographs with as many star images as possible. To this end, of course, it helps to have a clear sky.”

When compared to a June 30, 1973 expedition led by Burton F. Jones that “hoped to gather over 1,000 star images,” this makes Eddington’s adventure into a virtual sham. Incidentally, Will reveals that the results of the 1973 eclipse showed 0.95 ± 0.11 arc seconds times Einstein’s figure of 1.75, thus offering what he says is only a “modest improvement.” With such a wide deviation, not surprisingly, the 1973 expedition was called the “swan song for this type of measurement.” That the public could be bamboozled in 1919 into believing that Relativity was proven by one mere photograph, which in itself was interpreted with obvious bias, and in the midst of five others that clearly nullified the theory, shows the influence Eddington carried in that day, as well as the utter mystique of the Relativity theory.

The questionable tactics that occurred in the 1919 eclipse expeditions also occurred in 1922 efforts in Australia. After putting the evidence of their photographs on a graph, the results show 44 data points below the curve and only 25 points above, which means that whoever created the graph did not choose

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131 Einstein: Life and Times, pp. 285-286. The photographic plate considered as successful measured a displacement of 1.61'' ± 0.30''. So even in the plate he depended on to “prove” Relativity, it is only the margin of error (0.30'') Eddington granted to himself for the final calculations that brought the result within respectable range of Einstein’s 1.75'' prediction. If Eddington had taken the minus side of the margin of error, the result would have been a dismal 1.31'' and no confirmation of Relativity could be extracted from it. In any case, the other five plates that Eddington discarded measured 0.93'' or less. In proper scientific procedure, it is the five measuring 0.93'' or less which would serve as the control and the 1.61'' as the anomaly, but Eddington conveniently reversed that protocol. It just so happens that a deflection of 0.93'' is almost identical to the prediction of Newtonian physics and astronomically far from Einsteinian physics.
133 Was Einstein Right? p. 80.
134 Ibid., p. 80. B. F. Jones’ paper, “Gravitational deflection of light: solar eclipse of 30 June 1973. Plate reductions, says “About 160 stars were measured on each plate.” But the paper reveals that, no matter how careful the experiments were conducted, they were not able to get the Einstein figure of 1.75. Jones shows low readings from a PDS microphotometer of 1.49 ± 0.20 to a high of 1.89 ± 0.18, concluding at the end of the paper that a “1.66 ± 0.18 arcsec” is the final averaged result (The Astronomical Journal, Vol. 81, No. 6, June 1976, pp. 455-463).
the proper median curve, apparently in order to give the impression that the results conformed with Relativity theory. As Arthur Lynch writes:

The results of the observations are shown on a chart, by a series of dots, and by tracing connections between these dots it is possible to obtain a “curve” from which the law of deviation is inferred. But the actual charts show only an irregular group of dots, through which, if it be possible to draw a curve that seems to confirm the theory of Relativity, it is equally possible to draw a curve which runs counter to the theory. Neither curve has any justification.135

Sir Edmund Whittaker, who wrote one of the more popular yet comprehensive volumes on the history of physics, and who was no enemy of Relativity, nevertheless stated in 1952:

While it must not be regarded as impossible that the consequences of Einstein’s theory may ultimately be reconciled with the results of observations, it must be said that at the present time there is a discordance.136

Despite these discrepancies, American astronomer W. W. Campbell made an announcement in 1923 that Einstein’s predictions had been confirmed by the 1922 results.

Astronomer Robert Dicke (who, contra Relativity, revealed that Mercury’s perihelion was due in part to the sun’s oblateness), writes:

Owing to the short duration of the eclipse and the consequent absence of repetitions of the observation, there has always been considerable doubt about the freedom of the final results from systematic errors. Furthermore, the results derived from past solar eclipses...have scattered a great deal. The accuracy of the gravitational deflection of light determined from total eclipses is probably no better than 20 per cent.”137

Dicke’s chart shows six eclipse tests between 1919 and 1952, each with several results. Beginning with the 1919 eclipse, the results are as follows in seconds of arc:

Trial 1: 1.87 - 2.12
Trial 2: 2.00 - 2.25
Trial 3: 2.05 - 2.30
Trial 4: 1.87 - 2.05
Trial 5: 1.27 - 1.87

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137 “Solar Oblateness and Gravitation,” Gravitation and the Universe, p. 27. In addition to Eddington’s poor photography, his calculation of the deflections is contingent upon determining the star’s distance from the limb of the sun. For example, a star which is close to the limb will be deflected about 1.75", but a star twice the distance from the limb will be deflected half as much. Hence, determining how close a star is to the limb of the sun is absolutely crucial. Obviously, Eddington did not have nearly enough evidence to begin a calculation as sensitive as this one.
Only Trial 5 comes within range of Einstein’s 1.75 prediction, and that is only because 1.75 comes between the lower and upper limit of the actual deflections. As Guggenheimer stated in 1925:

An examination of the various tables of the deflections observed shows that many of them are far away from the quantities predicted. The quantity approximating the predicted one [1.75 sec.] is obtained by averaging a selected few of the observations.

The 1922 eclipse (Australia):

Trial 1: 1.37 - 2.17
Trial 2: 1.62 - 1.80
Trial 3: 1.15 - 2.37
Trial 4: 1.95 - 2.35
Trial 5: 1.62 - 2.05

The 1929 eclipse (Sumatra):

Trial 1: 1.62 - 1.87 and 2.12 - 2.37
Trial 2: 1.80 - 2.20
Trial 3: 1.85 - 2.05

The 1936 eclipse (One in USSR and two in Japan):

Trial 1: 2.40 - 2.95
Trial 2: 2.30 - 3.10
Trial 3: 1.25 - 2.30

\[138\] It is interesting to note that supporters of General Relativity will record the results of these eclipse photographs in such a way as to make them appear to be very close to Einstein’s prediction of 1.75”. For example, in Trial 1 from Australia, the data shows a range from 1.37” to 2.17”, which means that there were many data points, some above and some below the median line. But when the same event is recorded in Relativity textbooks the figure given is 1.77” ± 0.40”, since 1.77 is between 1.37 and 2.17. In other words, there may have been no results showing a 1.77” deflection, but the author merely took the average of the high (2.17”) and low (1.37”) data and recorded it as 1.77”, since that figure is close to Einstein’s prediction of 1.75”. In addition, the reader is expected to assume that the ± 0.40” margin of error has no effect on the conclusion.
The 1947 eclipse (Brazil):

Trial 1: 1.70 - 2.25
Trial 2: 1.85 - 2.60

The 1952 eclipse (Sudan):

Trial 1: 1.60 - 1.80
Trial 2: 1.20 - 1.50

Misner, Thorne and Wheeler quote Dicke’s results as follows:

The analyses [of the experimental data] scatter from a deflection at the limb of the sun of 1.43 seconds of arc to 2.7 seconds [compared to a general relativistic value of 1.75 seconds]. The scatter would not be too bad if one could believe that the technique was free of systematic errors. It appears that one must consider this observation uncertain to at least 10 percent, and perhaps as much as 20 percent.” This result corresponds to an uncertainty in $\gamma$ of 20 to 40 percent.\textsuperscript{139}

In brief, no one has obtained 1.75, not even Arthur Eddington. As we will discover in the precession of Mercury, however, for a given radius of the star from the sun (viz., $6.956 \times 10^{10}$ cm), General Relativity is locked into one precise numerical value, 1.75 seconds of arc. If it is higher or lower, General Relativity is disqualified. In 1960, H. Von Klüber had already outlined why such tests were futile for Relativity. Among the difficulties are the refraction of light in the sun’s corona; distortions in the optics caused by temperature changes during the eclipse; changes in scale between the eclipse and the control photographs; distortions in photographic emulsion while drying; and errors in measuring the images on the photographs.\textsuperscript{140} By a series of graphs showing plots of the eclipse data, von Klüber shows how tenuous Eddington’s claims really are.

For example, in the 1936 Sternberg graph it shows eleven star rays bent away from the sun and fifteen towards it, thus revealing 42% of the deflections were in the opposite direction of Einstein’s prediction. In addition, the three points on the upper left show a much sharper upturn to the deflection pattern than what is represented by the dotted line. Similarly, in the 1936 Sendai graph, there are no points of less than four solar radii that would justify drawing the hyperbola with a sharp upward slope. Other eclipse results show the same problems. In the 1947 Yerkes I graph, nineteen light rays are bent away from the sun and twenty-eight toward, showing the same ~ 41% deviating from Einstein’s prediction. In addition, the hyperbola of the graph is deceptive, since there are in reality only fourteen points above the line and twenty-four below, and thus it is not representative of the mean curve.

\textsuperscript{139} Gravitation, p. 1104.
Undaunted, modern scientists were still determined to “prove” Relativity. Another eclipse test was performed in 1973 but with even more dismal results. In this graph, the General Relativity prediction represented by the sharp rise in the hyperbola is hardly justifiable, since the two shaded points indicate the largest errors on the graph. On a statistical basis, a straight line intersecting the sun’s limb at ~ .7 arc seconds is more likely.\(^{141}\)

We should not be surprised at these inaccuracies. As Alan MacRobert, senior editor of *Sky and Telescope*, notes:

> Rare is the night (at most sites) when any telescope, no matter how large its aperture or perfect its optics, can resolve details finer than 1 second of arc. More typical at ordinary locations is 2 or 3 arc-second seeing, or worse.\(^{142}\)

\(^{141}\) Graph taken from J. B. Zirker, *Total Eclipse of the Sun*, 1995, p. 179. As Zirker notes: “As you can see, the scatter is fairly large at large distances, and the position of the curve depends strongly on one or two point close to the sun” (*ibid.*, p. 178).

While the eclipse experiments were fading, Relativists then began a series of experiments using light from quasars and radio waves near the sun. But again, “the primary factor limiting the accuracy was the solar corona, the hot, turbulent gas of ionized hydrogen at 2 million degrees that extends out to several solar radii from the sun.” Regarding the sun’s corona, other physicists address the additional claim by Relativists concerning the Viking space probe. In words that disclose the evidential poverty of General Relativity to explain the results, Marmet and Couture conclude:

143 *Was Einstein Right?* p. 85.
…all the experiments claiming the deflection of light and radio waves by the sun are subjected to very large systematic errors, which render the results highly unreliable and apparently incorrect…. There is a desperate situation among scientists for not being able to show, with the most sophisticated technology, what is considered to be the basic principle of general relativity on which rely most of modern science, while this was claimed to be demonstrated by Eddington in 1919 using a simple four inch amateur size telescope.”

Added to this is the fact that even if General Relativity comes close to the proper value of light deflection near the sun, still, other physicists claim that the same phenomenon can be explained just as easily from the Newtonian perspective, and thus leaves General Relativity without one of its most famous proofs. As physicist Stan Gibilisco puts it:

The amount of change in the positions of stars near the sun was very close to the function predicted by the general theory of relativity. Scientists who supported this theory considered the experiment a great triumph. But other evidence had to be found to provide more conclusive proof of the theory. Newton’s theory also would predict the same effect, and while the deviation in stellar positions predicted by Newton was only half the observed amount, and only half the amount predicted by general relativity, the error could be traced to a simple miscalculation by Newton concerning the intensity of the sun’s gravitational field. Some effect had to be observed that would agree with the general theory of relativity, but was entirely neglected by the physics of Newton. The orbit of the planet Mercury proved to be the answer to this search.

The Strange “2” Factor

Suffice it to say, Mercury’s perihelion does not offer any proof for General Relativity, as we will discover in the next Appendix. Be that as it may, the history of the analysis of light deflection near the sun is by far one of the more confusing assortment of claims and counter-claims that have filled the landscape of theoretical physics. The story starts in 1801 with Johann von Soldner’s attempt at calculating the deflection of starlight near the sun. Based on the corpuscular theory of light, Soldner understood light to have mass, and mass is subject to Newton’s law of gravitation. The orbit of the planet Mercury proved to be the answer to this search.

\[ 2gr^2 \]

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145 Stan Gibilisco, “Understanding Einstein’s Theories of Relativity,” 1983, p. 146. Peter Rowlands says much the same: “In fact, all the standard experimental results which are used as tests of the general theory can be derived by using nothing more complicated than Newtonian gravity and special relativity” (“A simple approach to the experimental consequences of general relativity,” *Space Physics*, June 13, 1996, p. 50). L. I. Schiff adds: “Since the first two of the three ‘crucial tests’ can be derived from the equivalence principle and special relativity without reference to the geodesic equation or the field equations of general relativity, it follows that only the orbit precession really provides a test of general relativity” (“On Experimental Tests of the General Theory of Relativity,” Institute of Theoretical Physics, Stanford University, October 6, 1959, p. 343).

The factor 2 has no justification and should be omitted. Designating by $\omega$ the angular deflection of light from a star at infinity until it reaches the surface of the attracting body Soldner derived the formula

$$\alpha = \tan \omega = \frac{2g}{v \sqrt{v^2 - 4g}}$$

where $v =$ speed of light

which he applied to the earth and the sun. On account of the mistake mentioned his result for the sun (half deflection) $\omega = 0".84$ is twice too large. Correcting Soldner’s formula and using modern constants a ray of light just grazing the sun’s surface is deviated from infinity to infinity by the angle $\alpha = 0".87$ if the corpuscular theory of light and Newton’s law of gravitation are adopted.147

H. von Klüber reiterates Trumpler’s words in his 1960 paper:

Soldner (1801) investigated the behavior of a light-ray in a gravitational field of the classical Newtonian type, assuming the corpuscular theory. Unfortunately, his formula contains the erroneous factor 2. Correcting for this, and using modern constants, it can be shown that light coming from a star, and just grazing the limb of the sun before reaching an observer on the Earth, should be deviated by an angle of $0".87$.148

In his original 1801 paper, Soldner seems to defend the two-factor:

If one were to investigate by means of the given formula how much the moon would deviate a light ray when it goes by the moon and comes to earth, then one must, after substituting the corresponding magnitudes and taking the radius of the moon for unity, double the value found through the formula, because a light ray, which goes by the moon and comes to the earth describes two arms of a hyperbola.149

Soldner’s reasoning is true even in General Relativity, since the angle of deflection should be the difference in the direction of the two asymptotes. Hence, Soldner’s results could be interpreted such that $\omega = 0".87$ is half of the deflection caused by the sun, and thus a full deflection would amount to $1".74$. Or if we use Soldner’s original figure of $\omega = 0".84$, it is about half of $1".70$.150

Interestingly enough, in 1911 Einstein published an article in *Annalen der Physik*151 based on an entirely different approach than Soldner’s, which included the idea that the speed of light changes near the sun due to varying strengths of gravity depending on where the light is passing. Using the Huygens principle of a light ray’s path, Einstein used the equation:

$$\alpha = \int_{\theta = -1/2 \pi}^{\theta = 1/2 \pi} \frac{kM}{r^2} \cos \theta \, ds$$

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150 Richard de Villamil, in a letter to Arvid Reuterdahl, argues that Soldner made the simple mistake of not differentiating the original equation properly (August 24, 1925/1926, Department of Special Collections, O’Shaughnessy-Frey Library, University of St. Thomas, MN, pp. 2-3, letter on file).
\[ \alpha = 2kM/c^2 \Delta \]

where

\( k \) = constant of gravitation

\( M \) = mass of attracting body

\( \Delta \) = distance of light ray from attracting body

\( c \) = speed of light

In this equation Einstein obtains \( \alpha = 4 \times 10^{-6} \) or 0.83 seconds of arc, but, like Soldner’s, can be also adjusted to 0.87 based on a more accurate mass for the sun. In remarking on this value, Einstein wrote to Erwin Freundlich in 1913:

That the idea of a bending of light rays was bound to emerge at the time of the emission theory is quite natural, as is the fact that the numerical result is exactly the same as that according to the equivalence hypothesis.\(^{152}\)

The first question that arises here is one of priority. Since Soldner was the first to calculate how light would bend around the sun, it requires a citation to Soldner’s work, but no such reference appears in the 1911 *Annalen* article. This is similar to the same failure Einstein demonstrated when he did not give any credit in his 1905 paper to the work of Henrick Lorentz or Henri Poincaré in the area of Relativity theory. Other scientists were well aware of Soldner’s work. For example, Franz Johann Müller wrote a paper on Soldner’s work in 1914.\(^{153}\) Arthur Eddington, gravity in an article in the *London Times* of 1919, even recognized Newton’s priority regarding at least the query of how light would behave around the sun.\(^{154}\)

The second question concerns why Einstein’s prediction of "0.83, which is based on the “equivalence” principle of Relativity theory, is identical to Soldner’s value. If Einstein had access to Soldner’s "0.84 when he wrote his 1911 paper (and not noticed Soldner’s “two-factor” error), it seems he would have done whatever he could to make an “equivalence” calculation commensurate with "0.84. He could do this by matching the initial integral equation, which results in: \( \alpha = 2kM/c^2 \Delta \), to Soldner’s algebraic expression

\[ \alpha = 2g/v\sqrt{v^2 - 4g} \]


\(^{153}\) F. J. Müller, *Johann Georg von Soldner*, Geolä, Kastner and Callwey, München, 1914. Yet in defense of Einstein, Abraham Pais says: “In 1911 Einstein did not know of Soldner’s work. The latter’s paper was in fact entirely unknown in the physics community until 1921,” although Pais admits that “Soldner, who in 1801 became the first to answer Newton’s query on the bending of light” (Subtle is the Lord, p. 200). Von Klüber says only that Einstein “probably” didn’t know anything of Soldner’s work (op. cit., p. 47).

\(^{154}\) The article was titled: “Einstein’s Theory of Space and Time,” and stated: “The deflection of the star images means a bending of the ray of light as it passes near the sun, just as though the light had weight which caused it to drop towards the sun. But it is not the bending of light that threatens the downfall of Newton. On the contrary, were Newton alive he would be congratulating himself on his foresight. In his ‘Optiks’ we read: -- ‘Query 1. Do not bodies act upon light at a distance, and by their action bend its rays, and is not this action strongest at the least distance?’ Weight of light seemed less strange to Newton than to us, because he believed light to consist of minute corpuscles, whereas for us the bending of a wave of light is a much more difficult conception.”
In his 1915 paper, however, Einstein would change this equation so that it doubled the 0.83 value to 1.7. But by now, those who cared to study the issue probably knew that Soldner had only calculated half the deflection, and that a full deflection would equal 1.7. Nevertheless, Robert Trumpler defended Einstein’s doubling of the value by saying:

The increase of this value over that in Einstein’s 1911 paper is not due to any mistake in calculation in the earlier paper but is an effect of the difference between Einstein’s and Newton’s law of gravitation, as the 1916 deflection is essentially based on the principles: (1) Light is subject to gravitation. (2) Gravitation follows Einstein’s law instead of Newton’s.155

But Einstein’s sudden doubling of the light-bending angle did not escape the scrutiny of other physicists. Arvid Reuterdahl remarked:

In *Science* (August 31, 1923), Dr. Robert Trumpler calls attention to the error in Soldner’s work. Note that it is Soldner that is wrong despite the fact that Einstein’s 1911 formula is identical with that of Soldner. It is also curious that when Einstein tried again in 1916 to produce a formula it did not agree with his first effort, in fact, the 1916 formula gives a value twice as large as the one in 1911. Both are right according to the Einsteinians: – two equals one.156

Subsequent studies on this problem are confusing, at best. In 1959, L. I. Schiff accounted for Einstein’s doubling of the angle by saying that the 1911 value was based only on time dilation whereas the 1916 value was based on both time dilation and length contraction.157 As such, he also claimed that the angle for the bending of light is derivable from the equivalence principle as opposed to the field equations from General Relativity. In 1968, Sacks and Ball criticized the solution because Schiff used the equivalence postulate improperly by extending it to include the Lorentz contraction. In the same year, Tangherlini derived the 1916 value by adding the 1911 Einstein deflection to the Soldner deflection.158 In 1978, Comer and Lathrop also dismissed Schiff’s attempt by saying he incorrectly used the local equivalence principle, which they replaced with a combination of the equivalence principle and infinitely fast particles in a geodesic, requiring the full use of the field equations of General Relativity.159 In 1984, M. Strandberg asserted that Special Relativity and the local equivalence principle are the only equations needed to get the 1916 value since the former has “unexploited” properties that allow it to predict global effects that were once thought to be the sole domain of General Relativity.160 In 1989, Tian and Li claimed to have found the rest mass of a photon and thus derive its speed and deflection in a gravitational field.161

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156 A. Reuterdahl, “The Einstein Film and the Debacle of Einsteinism,” *The Dearborn Independent*, March 22, 1924, p. 15, cited in Bjerknes, pp. 2144-45. Bjerknes says Reuterdahl is relying on Philipp Lenard’s “confusing analysis” of Soldner’s paper and concludes: “Reuterdahl…mistakenly believed that Soldner’s result matched Einstein’s 1911 prediction, when in fact it comes closer to Einstein’s revised 1915 prediction.” (Abraham Pais [Subtle is the Lord, pp. 199-200] and many others have made the same mistake Reuterdahl made” (*The Manufacture of St. Einstein*, p. 2145).
158 As noted in M. W. P. Strandberg’s “Special relativity completed: The source of some 2s in the magnitude of physical phenomena,” Massachusetts Institute of Technology, March 29, 1985, p. 323.
P. Rowlands posited that Newtonian physics combined with Special Relativity could explain the light deflection and thus produce the 1916 value.  

A less confusing attempt at accounting for the doubling of Einstein’s light-bending value is that offered by Misner, Thorne and Wheeler, at least from the perspective of General Relativity. These authors offer two distinct views of the situation: (a) the linear view that analyzes light bending from the sun to the outskirts of the solar system, and (b) the post-post-Newtonian (PPN) view from the sun to earth. The latter case is relevant to this discussion because it may explain the “2” factor. In this scenario, the authors show that the Earth observer intercepts the light deflection half-way through its course, the total course not being accomplished until well outside the gravitational potential, i.e., outside the solar system. The equation for finding…..

\[ \delta \alpha = \frac{(1 + \gamma)M_*}{b} \left(1 + \cos \alpha \right) \]

which, “ranges from zero when the ray comes in opposite to the sun’s direction…to the ‘classical value’ of \( \frac{1}{2}(1 + \gamma) \times 1" \) when the ray comes in grazing the sun’s limb.”

But if that is the case, then the equation Einstein used in 1915 to arrive at "1.7, namely:

\[ \alpha = \frac{4kM}{c^2r} \]

must be adjusted for an Earth observer, and the adjustment results in precisely half of the total deflection, that is, half of 1.7 is \( \sim 0.84 \). Of course, this would make the sighting on Earth of anything near the accepted value of 1".75 (including Eddington’s) either fictitious or the mere result of an already-programmed doubling adjustment in the calculations. This is why von Klüber can say:

“….and using modern constants, it can be shown that light coming from a star, and just grazing the limb of the Sun before reaching an observer on the Earth, should be deviated by an angle of 0".87.”

It is, perhaps, the same reason that Misner, Thorne and Wheeler can say that the maximum deflection of a light ray from a star that just grazes the sun, as seen by an observer on Earth, will be:

\[ \frac{1}{2}(1 + \gamma) \times 1" \]

wherein the coefficient “\( \frac{1}{2} \)” would be numerically equivalent to a half-deflection. The same authors more or less confirm this reasoning for us since in their linear calculation of the bending of light (a calculation that has the light beam passing the sun and proceeding to beyond the solar system), the final equation is:

\[ \frac{1}{2}(1 + \gamma) \times 1" \]

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164 Gravitation, p. 1103.
165 Op cit., p. 47.
“For the sun…

\[
\frac{4M}{\ell}
\]

…For light grazing the sun, \( \ell = R_\odot \), this gives \( \Delta \phi = \frac{4M_\odot}{R_\odot} \) radians = 1\(^\circ\).75, which is also the prediction of general relativity, and is consistent with the observations.”\textsuperscript{166}

So it appears that Soldner’s original value was correct, and that General Relativity confirms this by its own PPN analysis of the situation.

Interestingly enough, the difference in the linear analysis and the PPN analysis of light bending near the sun brings up an interesting anomaly in the theory of General Relativity. As it stands, the theory uses an Earth-based observer for its PPN analysis, but by its own admission the velocity of light on Earth is less than \( c \). According to General Relativity, the true value of \( c \) can only be demonstrated outside the solar system where there is no gravitational potential. Consequently, the varying positions throughout the year of the sun, the moon and the planets relative to the Earth should cause periodic fluctuations in the velocity of light on Earth. Although these fluctuations would be small, nevertheless, modern instruments boast of knowing the speed of light to at least eight significant figures, if not more. Yet the fact is, no one has shown evidence of these periodic fluctuations; no one seems concerned about not finding them; and the most important fact of all is that General Relativity does not even predict that there will be such fluctuations.

\textsuperscript{166} Gravitation, p. 185.
Appendix 2: Newtonian, Machian and Lagrangian analysis of the Geocentric System

Vector Analysis of a Rotating Universe

Our purpose here is to show through vector analysis both the kinematic and dynamic dimensions of the universe rotating around a fixed Earth on a daily basis. Perhaps the best place to start the analysis is by observing how the National Weather Service calculates the Coriolis force. We will then use a similar means to calculate the inertial forces of a rotating universe.

The following diagram and analysis for deriving the Coriolis and centrifugal forces appears on the National Weather Service website.

The explanation from NWS is as follows:

The derivation of the Coriolis force begins by simplifying the problem the most general problem, a transformation of a vector (the wind velocity) between a fixed and a rotating frame of reference the Earth rotating with an angular velocity.

The derivation starts with this figure. Here R is the vector distance from the center of the Earth to the wind, and omega is the rotation vector of the Earth; it lies on the axis and points to the North Pole.

Over a time period (Delta T) the distance Delta R is the velocity of the Earth plus the velocity of the wind relative to the Earth. The velocity of anything is defined as the first derivative of its position.

\[ \vec{v} \equiv \frac{d\vec{R}}{dt} \]  \hspace{1cm} (1)

so the wind velocity as viewed from space is simply the wind velocity as viewed from Earth plus the velocity of Earth as viewed from space.

\[ \frac{d\vec{R}}{dt_{Space}} = \frac{d\vec{R}}{dt_{Earth}} + \vec{\omega} \times \vec{R} \]  \hspace{1cm} (2)

Here, omega is the rotation rate of the Earth, once per day. To find the acceleration, we differentiate again following the normal rules of calculus like this,
\[
\frac{d^2 \vec{R}}{dt^2}_{\text{Space}} = \frac{d}{dt} \left( \frac{d\vec{R}}{dt}_{\text{Earth}} \right) + \left( \frac{d(\vec{\omega} \times \vec{R})}{dt} \right)_{\text{Coriolis}}
\]

Doing the differentiation and collecting terms we arrive at

\[
\frac{d^2 \vec{R}}{dt^2}_{\text{Space}} = \frac{d^2 \vec{R}}{dt^2}_{\text{Earth}} + 2(\vec{\omega} \times \vec{v})_{\text{Coriolis}} + \left( \vec{\omega} \times (\vec{\omega} \times \vec{R}) \right)_{\text{Centripetal}} + \frac{d\vec{\omega}}{dt} \times \vec{R}_{\text{Day length}} [\text{Euler term}]
\]

There are three terms on the right which we must add when we are looking at the winds from the ground. The first is the Coriolis term, the second is the Centripetal term and the third is the effect of a changing rotation rate on the winds if the Earth's rotation rate changed. Fortunately, for studying the weather, only the Coriolis term is important, the other two can be neglected. So the problem reduces to

\[
\vec{a}_{\text{Space}} = \vec{a}_{\text{Earth}} + 2(\vec{\omega} \times \vec{v})_{\text{Coriolis}} \cdot \text{acceleration}
\]

Since force is mass times acceleration, when calculating the forces from the ground, we add the Coriolis term to correct for our view from the rotating coordinate system.

\[
\frac{\vec{F}}{m_{\text{Space}}} = \frac{\vec{F}}{m_{\text{Earth}}} + 2(\vec{\omega} \times \vec{v})_{\text{Coriolis}} \cdot \text{force}
\]

Normally, we assume the mass of the fluid we are looking at is 1 kilogram. If you want it out of vectors assuming you are looking at the horizontal component of the wind with respect to the Earth's turning surface, you have, for any latitude lambda,

\[
\vec{F}_{\text{Space}} = \vec{F}_{\text{Earth}} + 2 \left| \vec{\omega} \right| \sin(\lambda)
\]

We will now take these principles and calculations and apply them to a rotating Universe around a fixed Earth. In order to demonstrate the rotation of the Universe we will use a single star since its coordinates are fixed to the sphere of the Universe which carries the star. A star's location is calculated by its ascension and declination. See Figure 1:

\[\text{http://www.nws.noaa.gov/om/wind/deriv.shtml}\]
We will now derive the equations for the daily rotation of the Universe around a fixed Earth. The following terms will be used:

- $F$ is the Universe’s gravitational force exerted on the star
- $a$ is the acceleration of the star as it revolves around the Earth
- $R$ is the radius of the star’s orbit around the Universe’s axis
- $v$ is the velocity of the star revolving around the Universe’s axis
- $D$ is the distance from the Earth to the star
- $m$ is the star’s mass
- $\delta$ is the star’s declination as measured from the Earth’s equator
- $\omega$ is the rotation rate of the Universe in degrees per second

Acceleration is the change in velocity over time, and is mathematically described as

$$a = \frac{d^2R}{dt^2}$$

where $R$ is the distance to the star and $t$ is the elapsed time the star has moved, which can also be expressed as

$$a = \frac{d}{dt} \frac{dR}{dt}$$

where $dR/dt$ is the velocity ($v$) of the star. Since the velocity of the star follows the equation
\[ v = \frac{dR}{dt} = -\omega \times R \]  

(3)

where \( \omega \) is the angular velocity in degrees per second and \( R \) is the distance of the star from the Universe’s axis of rotation, thus we must rewrite equation 2 as

\[ a = \frac{d}{dt} (-\omega \times R) \]  

(4)

Now we use the calculus differentiation of the derivative \( \frac{d}{dt} \) through all the terms and arrive at

\[ a = -\frac{d\omega}{dt} \times R - 2\omega \times v - \omega \times (\omega \times R) \]  

(5)

As in the National Weather Service equations,

- \( 2\omega \times v \) is the Coriolis force
- \( \omega \times (\omega \times R) \) is the centrifugal force
- \( \frac{d\omega}{dt} \times R \) is the Euler force (which doesn’t apply since there is no variation in the length of day)

In the geocentric system, the centrifugal and Coriolis forces are the main forces that move the sun, stars and planets, and thus we will eliminate the Euler force. This reduces equation 5 to:

\[ a = -2\omega \times v - \omega \times (\omega \times R) \]  

(6)

where \( v \) is the velocity of the star revolving around the Universe’s axis. Since the Universe is rotating as opposed to the Earth, the velocity is in the opposite direction of the heliocentric system, and thus the velocity is given a negative sign.

Since the velocity \( (v) \) in equation 6 is \( -(\omega \times R) \), equation 6 becomes

\[ a = 2\omega \times (\omega \times R) - \omega \times (\omega \times R) \]  

(7)

which is simplified to

\[ a = \omega \times (\omega \times R) \]  

(8)

Distributing the cross-product through the terms yields

\[ a = \omega (\omega \cdot R) - R(\omega \cdot \omega) \]  

(9)

Since the star is located at declination \( \delta \), then \( (\omega \times R) \) equals \( D\omega \sin(\delta) \), which yields

\[ a = -\omega^2 (R - D\omega \sin(\delta)) \]  

(10)

where \( \omega \) is a vector of the rotation axis in the direction of \( \omega \), which is in the plane of the star’s orbit, as in Figure 1. The \( \omega \) maintains the star’s acceleration at the star’s presumed declination that is determined by \( R \).
Equation 10 has two acceleration vectors which are depicted below. After multiplying both vectors by the mass of the star, the sine term \(\omega^2 D \sin \delta\) shows what keeps the star’s plane of rotation stable in the vertical frame (i.e., not going up or down), while the cosine term \(\omega^2 D \cos \delta\) shows what pulls the star toward the Universe’s axis of rotation. The net result of the two vector accelerations is to maintain the star in its position within the inertial field created by the gravitation of the Universe.

Since Equation 10 is kinematic (dealing with motion) as opposed to dynamic (dealing with forces), we will make the equation dynamic in order to show that the geocentric universe is dynamically consistent. Before we do so, it is necessary to show how modern physicists do the same with common kinematic equations. For example, the velocity of a body in circular motion is understood as:

\[ v = \omega \times R \]

But this is a kinematic equation, since it only describes the motion, not the forces causing the motion. To make it dynamic we can multiply both sides by the mass \((m)\) to get:

\[ mv = m\omega \times R \]

In this case, modern physics will replace \(mv\) with \(p\), which is called the “momentum,” so that:

\[ p = m\omega \times R \]

We will now do the same procedure for producing the dynamic version of the geocentric universe. To do so, we multiply each side of Equation 10 \([a = -\omega^2 (R - D\omega \sin(\delta))]\) by the star’s mass \((m)\), to get:

\[ ma = -m\omega^2 (R - D\omega \sin(\delta)) \]

and since \(ma = F\), then the Force which keeps each celestial object in its designated place in a rotating Universe is:

\[ F = -m\omega^2 (R - D\omega \sin(\delta)) \]

Not only will each celestial object be held in place by this equation, light itself will also obey this equation. In the geocentric Universe light can assume any speed since (a) limitations to light speed do not apply to rotating frames, and (b) inertial forces can accelerate or decelerate light’s speed.\(^{168}\)

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\(^{168}\) My thanks to Dr. Gerry Bouw for his help in arriving at this vector analysis and his permission to use it.
A Newtonian-Machian Mathematical Analysis of Neo-tychonian Model of Planetary Motions

The calculation of the trajectories in the Sun-Earth-Mars system will be performed in two different models, both in the framework of Newtonian mechanics. First model is the well-known Copernican system, which assumes the Sun is at rest and all the planets orbit around it. Second one is less known model developed by Tycho Brahe (1546-1601), according to which the Earth stands still, the Sun orbits around the Earth, and other planets orbit around the Sun. The term “Neo-tychonian system” refers to the assumption that orbits of distant masses around the Earth are synchronized with the Sun’s orbit. It is the aim of this paper to show the kinematical and dynamical equivalence of these systems, under the assumption of Mach’s principle.

The discussion of motion of celestial bodies is one of the most interesting episodes in the history of science. There are two diametrically opposite schools of thought: one that assumes that the Sun stands still, and Earth and other planets orbit around it; and another that assumes that the Earth stands still, and Sun and other planets in some manner orbit around the Earth. The first school of thought comes from Aristarchus (310-230 BC) and is generally addressed as heliocentrism, another from Ptolemy (90-168 BC) and is generally known as geocentrism. Since Aristotle, the ultimate authority in science for more than two millennia, accepted the geocentric assumption, it became dominant viewpoint among scientists of the time. The turnover came with Copernicus (so-called “Copernican revolution”) who in his work *De Revolutionibus* proposed a hypothesis that the Sun stands in the middle of the known Universe, and that Earth orbits around it, together with other planets. Copernicus’ system was merely better than Ptolemy’s, because Copernicus assumed the trajectories of the planets are perfect circles, and required the same number of epicycles (sometimes even more) as Ptolemy’s model. The accuracy of Ptolemy’s model is still a subject of vivid debates among historians of science.

The next episode in this controversy is Kepler’s system with elliptical orbits of planets around the Sun. That system did not require epicycles, it was precise and elegant. It is therefore general view that Kepler’s work finally settled the question whether it is the Sun or the Earth that moves. But what is less known is that Tycho Brahe, Kepler’s tutor, developed a geostatic system that was just as accurate and elegant as Kepler’s: the Sun orbits around the Earth, and all the other planets orbit around the Sun. The trajectories are ellipses, and all the Kepler’s laws are satisfied. In that moment of history, the Kepler’s and Brahe’s models were completely equivalent and equally elegant, since neither of them could explain the mechanism and reason why the orbits are the way they are. It had to wait for Newton.

Sir Isaac Newton, as it is generally considered, gave ultimate explanation of planetary motions that was in accord with Kepler’s model, and excluded Brahe’s one. The laws of motions and the inverse square law

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of gravity could reproduce all the observed data only with the assumption that the Sun (i.e. the center of mass of the system, which can be very well approximated by the center of the Sun) stands still, and all planets move around it. According to Newton’s laws, it is impossible for the small Earth to keep the big Sun in its orbit: the gravitational pull is just too weak. This argument is very strong, and it seems to settle the question for good.

But in the end of 19th century, the famous physicist and philosopher Ernst Mach (1839-1916) came with the principle which states the equivalence of non-inertial frames. Using the famous “Newton’s bucket” argument, Mach argues that all so-called pseudo-forces (forces which results from accelerated motion of the reference frame) are in fact real forces originating from the accelerated motion of distant masses in the Universe, as observed by the observer in the non-inertial frame. Some even go further, stating that “every single physical property and behavioral aspect of isolated systems is determined by the whole Universe.” According to Mach’s principle, the Earth could be considered as the “pivot point” of the Universe: the fact that the Universe is orbiting around the Earth will create the exact same forces that we usually ascribe to the motion of the Earth.

Mach’s principle played a major role in the development of Einstein’s general theory of relativity, as well as other developments in gravitational theory, and has inspired some interesting experiments. This principle still serves as a guide for some physicists who attempt to reformulate (“Machianize”) Newtonian dynamics, or try to construct new theories of mechanics. Some arguments against and critiques of Mach’s principle have also been raised. Since the time of its original appearance, Mach’s principle has been reformulated in a number of different ways. For the purpose of this paper, we will focus on only one of the consequences of Mach’s principle: that the inertial forces can be seen as resulting from real interactions with distant matter in the Universe, as was for example shown by Zylbersztajn.

The only question that remains is: are these forces by themselves enough to explain all translational motions that we observe from Earth, and can they reproduce the Tycho Brahe’s model? The discussion in this paper will show that the answer to this question is positive. In order to demonstrate it, we will consider the Sun-Earth-Mars system.

The paper is organized as follows. In section 2 an overview of two-body problem in the central potential and Kepler’s problem is given. In section 3 the calculations of Earth’s and Mars’ trajectories are performed in the heliocentric system, both analytically (by applying the results from previous section) and numerically. In section 4 the calculations of Sun’s and Mars’ trajectories are performed in geocentric

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system, due to the presence of pseudo-potential originating from the fact of accelerated motion of the Universe. Finally, the conclusion of the analysis is given.

2. Two-Body Problem in the Central Potential

2.1 General overview

We start with the overview of two body problem in Newtonian mechanics. Although there are alternative and simpler ways to solve this problem,\(^\text{182}\) we will follow the usual textbook approach.\(^\text{183}\) The Lagrangian of the system reads:

\[
L = \frac{1}{2}m_1\dot{r}_1^2 + \frac{1}{2}m_2\dot{r}_2^2 - U(|\mathbf{r}_1 - \mathbf{r}_2|),
\]

(2.1)

where \(U\) is potential energy that depends only on the magnitude of the difference of radii vectors (so-called central potential). We can easily rewrite this equation in terms of relative position vector \(\mathbf{r} = \mathbf{r}_1 - \mathbf{r}_2\), and let the origin be at the center of mass, \(i.e., m_1\mathbf{r}_1 + m_2\mathbf{r}_2 \equiv 0\). The solution of these equations is:

\[
\mathbf{r}_1 = \frac{m_2}{m_1 + m_2} \mathbf{r}, \quad \mathbf{r}_2 = -\frac{m_2}{m_1 + m_2} \mathbf{r}.
\]

(2.2)

The Lagrangian (2.1) so becomes

\[
L = \frac{1}{2}\mu \dot{r}^2 - U(r),
\]

(2.3)

where \(r \equiv |\mathbf{r}|\) and \(\mu\) is the reduced mass,

\[
\frac{1}{\mu} = \frac{1}{m_1} + \frac{1}{m_2}
\]

(2.4)

In that manner, the two-body problem is reduced to one body problem of particle with coordinate \(r\) and mass \(\mu\) in the potential \(U(r)\).

Using polar coordinates, the Lagrangian (3) can be written as:

\[
L = \frac{1}{2}\mu(r^2 + \dot{\phi}^2) - U(r)
\]

(2.5)

One can immediately notice that variable \(\phi\) is cyclic (it does not appear in the Lagrangian explicitly). Consequence of that fact is momentum conservation law, since \((\partial/\partial t) (\partial L/\partial \dot{\phi}) = \partial L/\partial \phi = 0\). Therefore,

\[
\ell \equiv \frac{\partial}{\partial \phi} = \mu r^2 \dot{\phi} = \text{const.}
\]

(2.6)

is the integral of motion.

In order to find a solution for the trajectory of a particle, it is not necessary to explicitly write down the Euler-Lagrange equations. Instead, one can use the energy conservation law,


\[ E = \frac{1}{2} \mu (\dot{r}^2 + r^2 \dot{\phi}^2) + U(r) = \frac{1}{2} \mu \dot{r}^2 + \frac{\ell^2}{2 \mu r^2} + U(r) \] \hspace{1cm} (2.7)

Straightforward integration of (2.7) gives the equation for the trajectory,
\[ \phi(r) = \int \frac{\ell \, dr / r^2}{\sqrt{2m[E - U(r) - \ell^2/r^2]}} \] \hspace{1cm} (2.8)

2.2 Kepler’s problem

Let us now consider the particle in the potential
\[ U(r) = -\frac{k}{r} \] \hspace{1cm} (2.9)

generally known as Kepler’s problem. Since our primary interest is in the planetary motions under the influence of gravity, we will take \( k > 0 \). Solution of eq. (8) for that potential is:
\[ \frac{\ell}{r} = 1 + e \cos \phi, \] \hspace{1cm} (2.10)

where \( 2p \) is called the \textit{lactus rectum} of the orbit, and \( e \) is the eccentricity. These quantities are given by
\[ p = \frac{2\ell^2}{\mu k}, \quad e = \sqrt{1 + \frac{2\ell^2}{\mu k^2}} \] \hspace{1cm} (2.11)

Expression (2.10) is the equation of a conic section with one focus in the origin. For \( E < 0 \) and \( e < 1 \) the orbit is an ellipse.

One can also determine minimal and maximal distances from the source of the potential, called perihelion and aphelion, respectively:
\[ r_{\text{min}} = \frac{p}{1+e}, \quad r_{\text{max}} = \frac{p}{1-e} \] \hspace{1cm} (2.12)

These parameters can be directly observed, and often are used to test a model or a theory regarding planetary motions.

3. Earth and Mars in the Heliocentric Perspective

According to Newton’s law of gravity, the force between two massive objects reads:
\[ \mathbf{F} = \frac{G m_1 m_2}{|\mathbf{r}_1 - \mathbf{r}_2|^3} (\mathbf{r}_1 - \mathbf{r}_2) \] \hspace{1cm} (3.1)

Which leads to a potential (\( \mathbf{F} = -\nabla U \))
\[ U(|\mathbf{r}_1 - \mathbf{r}_2|) = -\frac{G m_1 m_2}{|\mathbf{r}_1 - \mathbf{r}_2|} \] \hspace{1cm} (3.2)
This is obviously Kepler’s potential (2.9) with \( k = G m_1 m_2 \), where \( G \) is Newton’s gravitational constant.

Since the Sun is more than 5 orders of magnitude more massive than Earth and Mars, we will in all future analysis use the approximation

\[
\mu \approx m_i \quad (3.3)
\]

where \( m_i \) is mass of the observed planet. For the same reason, gravitational interaction between Earth and Mars can be neglected, since it is negligible compared with the interaction between Mars and the Sun. Using these assumptions, we can write down corresponding Lagrangians,

\[
L_{ES} = \frac{1}{2} m_E \dot{r}_{ES}^2 + \frac{G m_E m_S}{r_{ES}},
\]

\[
L_{MS} = \frac{1}{2} m_M \dot{r}_{MS}^2 + \frac{G m_M m_S}{r_{MS}} \quad (3.4)
\]

where \( m_E \) and \( m_M \) are masses of Earth and Mars, respectively. Subscripts \( ES \) (\( MS \)) correspond to the motion of Earth (Mars) with respect to the Sun. These trajectories can be calculated using the exact solution (2.10) with appropriate strength constants \( k \) and initial conditions which determine \( E \) and \( \ell \). Another way is to solve the Euler-Lagrange equations numerically, using astronomical parameters\(^{184}\) (e.g., aphelion and perihelion of Earth/Mars) to choose the initial conditions that fit the observed data. The former has been done using Wolfram Mathematica package. The result is shown on Fig. 1.

![Fig. 1: Trajectories of Earth and Mars in heliocentric system over the period of 2 years. Blue and red lines represent Earth’s and Mars’ orbits, respectively.](image)

For the later comparison, one could write out the expressions for the \( e \) and \( p \) parameters for the Earth. Putting the expressions for energy (2.7) and momentum (2.6) into eqs. (2.11) it is straightforward to obtain

\[ p = \frac{\dot{\phi}^2 r^4}{GM_S} \]
\[ e = \sqrt{1 - \frac{2GM_S \dot{\phi}^2 r^3 - \ddot{r}^2 \dot{\phi}^2 r^4 - \dot{\phi}^4 r^6}{c^2 M_S^2}} \] (3.5)

where \( \dot{\phi}, \dot{r} \) and \( r \) are angular velocity, radial velocity and distance respectively, taken in the same moment of time (e.g. in \( t = 0 \)).

Fig. 2 displays motion of the Mars as viewed from the Earth, gained by trivial coordinate transformation

\[ r_{EM}(t) = -r_{ES}(t) + r_{MS}(t), \] (3.6)

where \( r_{ES}(t) \) and \( r_{MS}(t) \) are solutions of Euler-Lagrange equations for the Lagrangians (3.4). Equation (3.6) is just the mathematical expression of the Tycho Brahe’s claim. The retrograde motion of Mars can be useful in the attempt to understand and determine orbital parameters, as was shown qualitatively and quantitatively by Thompson.\(^{185}\)

The acceleration that Earth experiences due to the gravitational force of the Sun is usually referred as centripetal acceleration and is given by

\[ a_c = \frac{F_c}{m_E} = \frac{GM_S}{r_{ES}^2} \hat{r}_{ES} \] (3.7)

where \( \hat{r} \) is the unit vector in the direction of vector \( r \), \( r_{ES}(t) \) is radius vector describing motion of Earth around the Sun, and \( F_c \) is centripetal force, i.e. the force that causes the motion.

FIG. 2: Trajectory of the Mars as seen from the Earth over the period of 7 years. Calculation of this trajectory is done numerically in the heliocentric system.

4. Sun and Mars in the Geocentric Perspective

4.1 The pseudo-potential

From the heliocentric perspective, the fact that the Earth moves around the Sun results with centrifugal pseudo-force, observed only by the observer on the Earth. But if we apply Mach’s principle to the geocentric viewpoint, one is obliged to speak about the real forces resulting from the fact that the Universe as a whole moves around the observer on the stationary Earth. Although these forces will further be considered as the real forces, we well keep the usual terminology and call them pseudo-forces, for the sake of convenience. Our focus here will be on the annual orbits, not on diurnal rotation which requires some additional physical assumptions\(^\text{186}\) that are beyond the scope of this paper.

The Universe is regarded as an \((N + 1)\)–particle system \((N\) celestial bodies plus planet Earth). From the point of a stationary Earth, one can write down the Lagrangian that describes the motions of celestial bodies:

\[
L = \frac{1}{2} \sum_{i=1}^{N} m_i \dot{r}_i^2 - \frac{1}{2} \sum_{i=1}^{N} \frac{G m_i m_j}{r_{ij}} - \sum_{i=1}^{N} \frac{G m_i m_j}{r_i} - U_{ps},
\]

where \(r_{ij} \equiv |r_i - r_j|\), \(U_{ps}\) stands for the pseudo-potential, satisfying \(F_{ps} = -\nabla U_{ps}\). \(F_{ps}\) is the pseudo-force given by

\[
F_{ps} = -m \sum_{i=1}^{N} a_{cp,i},
\]

where \(a_{cp,i}\) is centripetal acceleration for given celestial body (with respect to the Earth) and \(m\) is a mass of the object that is subjected to this force. It’s easy to notice that the dominant contribution in these sums comes from the Sun. The close objects (planets, moons, etc.) are much less massive than the Sun, and massive objects are much farther distant. The same approximation is implicitly used in section 3.

In the Machian picture, the centripetal acceleration is a mere relative quantity, describing the rate of change of relative velocity. Therefore, centripetal acceleration of the Sun with respect to Earth is given by Equation 3.7, with \(r_{ES} = -r_{SE}\). All that considered, Equation 4.2 becomes

\[
F_{ps} = \frac{G m S}{r_{SE}^2} \mathbf{r}_{SE}
\]

where \(r_{SE}(t)\) describes the motion of the Sun around the Earth.

We can now finally write down the pseudo-potential which influences every body observed by the fixed observer on Earth:

\[
U_{ps}(\mathbf{r}) = \frac{G m S}{r_{SE}^2} \mathbf{r}_{SE} \cdot \mathbf{r}
\]

where \( \mathbf{r}(t) \) describes motion of particle of mass \( m \) with respect to the Earth. Notice that this is not a central potential.

### 4.2 The Sun in Earth’s pseudo-potential

In order to determine Sun’s orbit in Earth’s pseudo-potential, one needs to take the dominant contributions of the Lagrangian (4.1), as was explained earlier. Taking into account the expression for pseudo-potential given in Equation 4.4, one ends up with

\[
L_{SE} = \frac{1}{2} M_S \dot{\mathbf{r}}_{SE}^2 - \frac{G M_S^2}{r_{SE}} \tag{4.5}
\]

This Lagrangian has the exact same form as the reduced Lagrangian (2.3). That means that we can immediately determine the orbit by means of Equation (2.11) by substituting \( \mu = M_S \) and \( k = GM_S^2 \). This leads to the following result (subscript \( SE \) will be omitted):

\[
p = \frac{\dot{\phi}^2 r^4}{G M_S}
\]

\[
e = \sqrt{1 - \frac{2G M_S \dot{\phi}^2 r^3 - r^2 \dot{\phi}^4 - \dot{\phi}^6 r^6}{G^2 M_S^2}} \tag{4.6}
\]

which is the exact equivalent of the previous result given in Equations (3.5), since \( \dot{\phi} \), \( \dot{r} \) and \( r \) are relative quantities, by definition equivalent in both models. We can therefore conclude that the Sun’s orbit in the Earth’s pseudo-potential is equivalent as one observed from the Earth in the heliocentric system. It remains to show the same thing for Mars’ orbit.

### 4.3 Mars in Earth’s pseudo-potential

In the similar way as before, we take the dominant contributions of Lagrangian (4.1) together with Equation (4.4) and form the Lagrangian:

\[
L_{ME} = \frac{1}{2} m_M \dot{\mathbf{r}}_{ME}^2 + \frac{G m_M M_S}{|r_{ME} - r_{SE}|} \frac{G m_M M_S}{r_{SE}^2} \mathbf{r}_{SE} \cdot \mathbf{r}_{ME} \tag{4.7}
\]

where subscript \( ME \) refers to the motion of Mars with respect to Earth, and \( \mathbf{r}_{SE}(t) \) is solution of the Euler-Lagrange equations for the Lagrangian (4.5).

The Euler-Lagrange equations for \( \mathbf{r}_{ME}(t) \) Lagrangian (4.7) are too complicated to be solved analytically, but can easily be solved numerically. The numerical solutions for equations of motion for both the Sun and Mars are displayed in Fig. 3. The equivalence of trajectories gained in two different ways is obvious, justifying the model proposed by Tycho Brahe.
FIG. 3: Trajectories of the Sun (dark, blue) and the Mars (light, red) moving in Earth’s pseudo-potential over the period of 7 years. Calculation of this trajectory is performed numerically in the geocentric system.

5. Conclusion

The analysis of planetary motions has been performed in the Newtonian framework with the assumption of Mach’s principle. The kinematical equivalence of the Copernican (heliocentric) and the Neo-tychonian (geocentric) systems is shown to be a consequence of the presence of a pseudo-potential (4.4) in the geocentric system, which, according to Mach, must be regarded as the real potential originating from the fact of the simultaneous acceleration of the Universe. This analysis can be done on any other celestial body observed from the Earth. Since Sun and Mars are chosen arbitrarily, and there is nothing special about Mars, one can expect to come up with the same general conclusion.

There is another interesting remark that follows from this analysis. If one could put the whole Universe in accelerated motion around the Earth, the pseudo-potential corresponding to the pseudo-force (4.2) will immediately be generated. That same pseudo-potential then causes the Universe to stay in that very state of motion, without any need of exterior forces acting on it. See the following.

Newtonian/Machian Analysis of the Geocentric Universe

Using Mach’s principle, we will show that the observed diurnal and annual motion of the Earth can just as well be accounted as the diurnal rotation and annual revolution of the Universe around the fixed and centered Earth. This can be performed by postulating the existence of vector and scalar potentials caused by the simultaneous motion of the masses in the universe, including the distant stars.
1. Introduction

The modern day use of the word relativity in physics is usually connected with Galilean and special relativity, i.e., the equivalence of the systems performing the uniform rectilinear motion, so-called inertial frames. Nevertheless, the physicists and philosophers never ceased to debate the various topics under the heading of Mach’s principle, which essentially claims the equivalence of all co-moving frames, including non-inertial frames as well.

Historically, this issue was first brought out by Sir Isaac Newton in his famous rotating bucket argument. As Newton saw it, the bucket is rotating in the absolute space and that motion produces the centrifugal forces manifested by the concave shape of the surface of the water in the bucket. The motion of the water is therefore to be considered as “true and absolute,” clearly distinguished from the relative motion of the water with respect to the vessel.\(^\text{187}\)

Mach, on the other hand, called the concept of absolute space a “monstrous conception,”\(^\text{188}\) and claimed that the centrifugal force in the bucket is the result only of the relative motion of the water with respect to the masses in the Universe. Mach argued that if one could rotate the whole Universe around the bucket, the centrifugal forces would be generated, and the concave-shaped surface of the water in the bucket would be identical as in the case of rotating bucket in the fixed Universe. Mach extended this principle to the once famous debate between geocentrists and heliocentrists, claiming that both systems can equally be considered correct.\(^\text{189}\)

His arguments, however, remained mostly of a philosophical nature. Since he was a convinced empiricist, he believed that science should be operating only with observable facts, and the only thing we can observe is relative motion. Therefore, every notion of absolute motion or a preferred inertial frame, whether inertial or non-inertial, is not a scientific one but rather a mathematical or philosophical preference.

As Hartman and Nissim-Sabat correctly point out,\(^\text{190}\) Mach never formulated the mathematical model or an alternative set of physical laws which can explain the motions of the stars, the planets, the Sun and the Moon in a Tychonian or Ptolemaic geocentric systems. For that reason, some physicists in modern times have tried to “Machianize” the Newtonian mechanics in various ways\(^\text{191, 192}\) or even try to construct new theories of mechanics.\(^\text{193}\) There have also been attempts to reconcile Mach’s principle with the General Theory of Relativity, some of which were profoundly analyzed in the paper by Raine.\(^\text{194}\)

In the recent paper\(^\text{195}\) we have used the concept of the so-called pseudo-force and derived the expression for the potential which is responsible for it. This potential can be considered as a real potential (as shown by Zylbersztajn,\(^\text{196}\) which can easily explain the annual motion of the Sun and planets in the Neo-


\(^{189}\) Ibid., pp. 279, 284.


Tychonian system. In the same manner, one can explain the annual motion of the stars and the observation of the stellar parallax.\textsuperscript{197}

It is the aim of this paper to use the same approach to give the dynamical explanation of the diurnal motion of the celestial bodies as seen from the Earth, and thus give the mathematical justification for the validity of Mach’s arguments regarding the equivalence of the Copernican and geocentric systems. The paper is organized as follows. In section 2 the vector potential is introduced in general terms. This formalism is then applied to analyze the motions of the celestial bodies as seen from the Earth in section 3. Finally, the conclusion of the analysis is given.

2. Vector potential formalism

Following Mach’s line of thought, one can say that the simultaneously rotating Universe generates some kind of gravito-magnetic vector potential, $\mathbf{A}$. By the analogy with the classical theory of fields\textsuperscript{198} one can write down the Lagrangian which includes the vector potential,

\begin{equation}
L = \frac{1}{2}m\dot{\mathbf{r}}^2 + m\mathbf{r} \cdot \mathbf{A} + \frac{1}{2}m\mathbf{A}^2 - mU_{\text{ext}} \tag{2.1}
\end{equation}

where $m$ is the mass of the particle under consideration, and $U_{\text{ext}}$ is some external scalar potential imposed on the particle, for example, the gravitational interaction.

We know, as an observed fact, that every body in the rotational frame of reference undergoes the equations of motion given by\textsuperscript{199}

\begin{equation}
m\ddot{\mathbf{r}} = \mathbf{F}_{\text{ext}} - 2m(\omega_{\text{rel}} \times \dot{\mathbf{r}}) - m[\omega_{\text{rel}} \times (\omega_{\text{rel}} \times \mathbf{r})] \tag{2.2}
\end{equation}

where $\omega_{\text{rel}}$ is the relative angular velocity between the given frame of reference and the distant masses in the Universe, and $\mathbf{F}_{\text{ext}} = -\nabla U_{\text{ext}}$ some external force acting on a particle.

It can be easily demonstrated that one can derive Equation (2.2) by applying the Euler-Lagrange equations on the following “observed” Lagrangian

\begin{equation}
L_{\text{obs}} = \frac{1}{2}m\dot{\mathbf{r}}^2 + m\mathbf{r} \cdot (\omega_{\text{rel}} \times \mathbf{r}) + \frac{1}{2}m(\omega_{\text{rel}} \times \mathbf{r})^2 - mU_{\text{ext}} \tag{2.3}
\end{equation}

By comparison of the general Lagrangian (2.1) and the “observed” Lagrangian (2.3) one can write down the expression for the vector potential $\mathbf{A}$,

\begin{equation}
\mathbf{A} = \omega_{\text{rel}} \times \mathbf{r} \tag{2.4}
\end{equation}

It is important to notice that there is no notion of the absolute rotation in this formalism. The observer sitting on the edge of the Newton’s rotating bucket can only observe and measure the relative angular velocity between him or her and the distant stars $\omega_{\text{rel}}$, incapable of determining whether it is the bucket or the stars that is rotating.

3. Trajectories of the celestial bodies around the fixed Earth

3.1. Diurnal motion

It is one thing to postulate that rotating masses in the Universe generate the vector potential given by (2.4), but quite another to claim that this same potential can be used to explain and understand the very motion of these distant masses. We will now demonstrate that this is indeed the case.

The observer sitting on the surface of the Earth makes several observations. First, he or she notices that there is a preferred axis (say z) around which all the Universe rotates with the period of approximately 24 hours. Then, according to the formalism given in Section 2, he or she concludes that the Earth must be immersed in the vector potential given by

\[ \mathbf{A} = \Omega \mathbf{\hat{z}} \times \mathbf{r} \]  

(3.1)

where \( \Omega \approx \frac{2\pi}{24h} \) is the observed angular velocity of the celestial bodies.\(^{200}\)

One can now re-write the Lagrangian (2.1) together with the Equation (3.1) and focus only on the contributions coming from the vector potential \( \mathbf{A} \),

\[ L_{\text{rot}} = \frac{1}{2} m \dot{\mathbf{r}}^2 + m \Omega \mathbf{\hat{r}} \cdot (\mathbf{\hat{z}} \times \mathbf{r}) + \frac{1}{2} m \Omega^2 (\mathbf{\hat{z}} \times \mathbf{r})^2 \]  

(3.2)

The Euler-Lagrange equations for this Lagrangian, written for each component of the Cartesian coordinates, are given by

\[ \begin{align*}
\dot{x} &= -2\Omega \dot{y} + \Omega^2 x \\
\dot{y} &= 2\Omega \dot{x} + \Omega^2 y \\
\dot{z} &= 0
\end{align*} \]  

(3.3)

The solution of this system of differential equations reads

\[ \begin{align*}
x(t) &= r \cos \Omega t \\
y(t) &= r \sin \Omega t \\
z(t) &= 0
\end{align*} \]  

(3.4)

where \( r \) is the initial distance of the star from the \( z \) axis. The observer can therefore conclude that the celestial bodies perform real circular orbits around the static Earth due to the existence of the vector potential \( \mathbf{A} \) given by Equation (3.1). This conclusion is equivalent to the one that claims that the Earth rotates around the \( z \) axis and the celestial bodies do not.

3.2. Annual motion

The second thing the observer on the Earth notices is the periodical annual motion of the celestial bodies around the \( z' \) axis which is inclined form the axis of diurnal rotation \( z \) by the angle of approximately

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\(^{200}\) The period of the relative rotation between the Earth and the distant stars is called sidereal day and it equals 23 h 56' 4.0916". Common time on a typical clock measures a slightly longer cycle, accounting not only for the Sun’s diurnal rotation but also for the Sun’s annual revolution around the Earth (as seen from the geocentric perspective) of slightly less than 1 degree per day (Wikipedia, 26 Apr. 2013, Sidereal time http://http://en.wikipedia.org/wiki/Sidereal_time).
23.5°. This motion can be explained if one assumes that the Earth is immersed in the so-called pseudo-potential

\[ U_{ps}(\mathbf{r}) = \frac{G M_S}{r_{SE}} \mathbf{r}_{SE} \cdot \mathbf{r} \]  

(3.5)

Here \( G \) stands for Newton’s constant, \( M_S \) stands for the mass of the Sun and \( r_{SE}(t) \) describes the motion of the Sun as seen from the Earth. The Sun’s trajectory \( r_{SE}(t) \) is shown to be an ellipse in \( x'-y' \) plane (defined by the \( z' \) axis from the above). Using this potential alone one can reproduce the observed retrograde motion of the Mars or explain the effect of the stellar parallax as the real motion of the distant stars in the \( x'-y' \) plane. All this was demonstrated in the previous communications [9, 11].

3.3. Total account

One can finally conclude that all celestial bodies in the Universe perform the twofold motion around the Earth:

i. circular motion in the \( x-y \) plane due to the vector potential \( \mathbf{A} \) (3.1) with the period of approximately 24 hours, and

ii. elliptical orbital motion in the \( x'-y' \) plane due to the scalar potential \( U_{ps} \) (3.5) with the period of approximately one year.

Using Equations (2.1), (3.1) and (3.5) one can write down the complete classical Lagrangian of the geocentric Universe,

\[ L = \frac{1}{2} \mathbf{r}^2 + m\Omega \mathbf{r} \cdot (\mathbf{\ddot{z}} \times \mathbf{r}) + \frac{1}{2} m\Omega^2 (\mathbf{\ddot{z}} \times \mathbf{r})^2 - m \frac{G M_S}{r_{SE}^2} \mathbf{r}_{SE} \cdot \mathbf{r} - mU_{loc} \]  

(3.6)

where \( U_{loc} \) describes some local interaction, e.g., between the planet and its moon. It is a matter of trivial exercise to show that these potentials can easily account for the popular “proofs” of Earth’s rotation like the Foucault’s Pendulum or the existence of the geostationary orbits.

4. Conclusion

We have presented the mathematical formalism which can justify Mach’s statement that both geocentric and Copernican modes of view are “equally actual” and “equally correct.” This is performed by introducing two potentials: (1) a vector potential that accounts for the diurnal rotations and (2) a scalar potential that accounts for the annual revolutions of the celestial bodies around the fixed Earth. These motions can be seen as real and self-sustained. If one could put the whole Universe in accelerated motion around the Earth, the potentials (3.1) and (3.5) would immediately be generated and would keep the Universe in that very same state of motion \( ad \ infinitum \).

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