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Cover: Turis Babel, by Athanasius Kircher, 1679.

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EDITORIAL

This is the tenth anniversary of the *Biblical Astronomer*. Prior to that, the name of this publication was *The Bulletin of the Tychonian Society*. The *Bulletin* ran for 54 issues, and the issue numbers continued with the *Astronomer*. For those curious, the first issue was printed in 1967 under a different name. The Tychonian Society was not founded until 1972, which was also when first issue of the *Bulletins of the Tychonian Society* was issued. It was, as I recall, about issue number 5.

Faith in ET, seventeenth century style

For years your editor has hoped to do a series of articles on extraterrestrial (ET) life and belief in extraterrestrials. From time to time mention has been made of angels as extraterrestrials, but there's not been a survey article forthcoming. Mention was made that belief in extraterrestrials was an early "proof" advocated against the veracity of the Holy Writ. Now, in this issue, a university student in the United Kingdom, Bartholomew Dobson, has kindly allowed me to reprint a paper he wrote for one of his classes. He entitled it "How Important in Seventeenth Century Astronomy was Belief in Extraterrestrials?" Mr. Dobson documents that, to the followers of science at least, if not the leaders, faith in extraterrestrials did play a role in promoting the new ideas, particularly, the concepts of a large universe and heliocentrism.

Is the universe big or little?

In this issue we resume our recent look at the big versus little universe debate. Two articles appertain to the matter, both by yours truly. The first one continues the review of how astronomers arrived at the currently accepted distance scale of the universe. The second hearkens back to an earlier paper which was also the first paper in the distance scale review. It examines one particular issue with parallax determinations and that is the existence of negative parallaxes.

Some small-universe advocates see in negative parallaxes a fatal flaw, not only in modern astronomy, but also in its determination of distances to stars and thus the distance scale of the universe. A negative parallax occurs when the reference stars used to measure the position of the star whose parallax is being measured, are actually closer to earth than is the target star. If all stars were very far away, or if all stars are centered on the earth, then there should be no detectable parallax. Indeed, if all stars were at exactly the same distance from earth, or were geocentrically distributed, or were infinitely far away, then the number of negative and positive parallaxes should be the same. In other words, 50 percent of the stars should have small negative parallaxes, and the rest should exhibit equally small positive parallaxes. In this case one measures no true parallax at all, but one merely measures observational errors.

In the article the number of negative parallaxes is compared to the number of positive ones over a range of parallax values. The analysis is consistent with real parallaxes and inconsistent with false parallaxes; that is, it is inconsistent with the premise that all parallaxes are observational errors.

What is flat space?

A reader commenting on the past issues of the *Astronomer* made this statement: "What? We have a 'flat universe' now, not just a 'flat earth?' That's a little too 'far out flat' for me to grasp yet, but I'll listen."

In a flat universe, light travels in a straight line unless otherwise perturbed (such as by a gravitational field or refractive medium). Also, in a flat universe a triangle consisting of straight lines has its angles sum to 180 degrees. On the surface of the earth, which is curved, a triangle that is large enough will have its angles sum to more than 180 degrees. For example, the triangle which runs from the equator to the north pole along the date line, then runs back to the equator at 90 degrees west longitude and has the equator for its third side, actually has three angles, each 90 degrees. The sum of the angles of that triangle is 270 degrees. If the earth were flat, the angles would sum to 180 degrees.

In the above illustration, if the earth were perfectly transparent and we took a laser with detector and two mirrors, and send a beam from the laser to the first mirror (at the pole in the illustration) and that mirror reflected it to a second mirror (at the 90 W - equator intercept) which sent it back to the starting point, in a flat universe the angles sum to 180 degrees. In a non-flat universe the angles would some to more or less than 180 degrees.

SPATIAL MEASUREMENTS THE HERTZSPRUNG-RUSSEL DIAGRAM

This is the fifth article of a series on the size of the heaven, the firmament. The first article, by David Lifschultz, appeared in issue 90 of the *Biblical Astronomer*[1] and laid the foundation for the discussion.

The second article appeared in the next issue.[2] That article reviewed the various geocentric models for both a large and a small universe. It also reviewed the evidence for parallax, stressing the reality and repeatability of the evidence.

The third article was a response by Mr. Lifschultz in which he emphasized that all parallax had to be based on the diameter of the earth or it was all guesswork.[3] He concluded the article with these words: "Once again, the point of these papers is to demonstrate that the size of the universe is unprovable, and it could be small as well as large. And the weight of Scriptural references to the sun as the chief heavenly light (Ps. 84:11[4]) could be both in size as well as brightness." This last is the cause of disagreement. I maintain that the use of the term "great lights" in Genesis 1:14-18[5] does not require them to be the greatest lights; that they need only be great in the geocentric purpose stated in that passage in context. As pointed out in the second article, the parallax can be real in a geocentric universe if one assumes the modified Tychonic model (see figure on the next page where the sun is in the middle of the starry circle and the earth is in the middle of the circle whose circumference runs through the sun. Also see the article on the geocentric orrery on page 5 of *B. A.* no. 94, Fall 2000).

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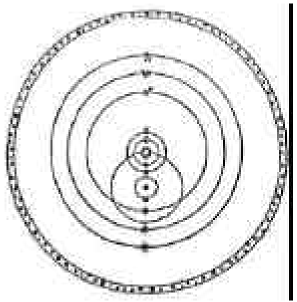
[1] Lifshultz, David, 1999. "Spatial Measurement and Modern Science," *Biblical Astronomer*, **9**(90):3.
[2] Bouw, G. D., 2000. "Spatial Measurement and Modern Science: A Reply," *ibid*., **10**(91):10.
[3] Lifschultz, David, 2000. "Spatial Measurement and Modern Science: Part II," *ibid*. **10**(92):5.
[4] Psalm 84:11 — "For the LORD God *is* a sun and shield: the LORD will give grace and glory: no good *thing* will he withhold from them that walk uprightly."
[5] 14 And God said, Let there be lights in the firmament of the heaven to divide the day from the night; and let them be for signs, and for seasons, and for days, and years:
15 And let them be for lights in the firmament of the heaven to give light upon the earth: and it was so.
16 And God made two great lights; the greater light to rule the day, and the lesser light to rule the night: *he made* the stars also.
17 And God set them in the firmament of the heaven to give light upon the earth,
18 And to rule over the day and over the night, and to divide the light from the darkness: and God saw that *it was* good.

The fourth article, by Dr. John Byl, dealt with the absurdity of an infinite, created universe.[6] On this absurdity Mr. Lifschultz, Dr. Byl, and I agree.



We now come to this, the fifth article, where we shall examine the second stage in the distance scale: the Hertsprung-Russel diagram.

Spectral classification

We have all seen a rainbow, or sunlight shining through glass prism broken into the colors of the rainbow. If one does this shining the sunlight through a slit before passing it through a prism, one sees the *spectrum* of the sun. The color will appear spread out as in a rainbow, going through the sequence "ROY G. BIV" (red, orange, yellow, green, blue, indigo, and violet), but one will also see dark lines, some very narrow, and some very broad, interspersed throughout the color band.

The central band in the picture above shows the spectrum obtained by spreading out the light of the star Epsilon Geminorum. The picture is a negative, which is to say that the light regions are black. Above and below the picture are the spectra of an electric arc between two iron electrodes. The iron lines are called "emission lines," which are bright lines (remember, it's a negative so they look black here), and the coincidence of many of the emission lines with the "absorption lines" in the star's spectrum (absorption lines are dark but show up white in the photo), proves that iron vapor is present in the star's atmosphere. The amount of iron can be calculated from the width of the absorption lines.

The absorption (dark) lines in a spectrum are produced as follows. As white light passes through a gas, the electrons of the gas can draw energy from the light. As they do so, they "jump" to a higher "orbit" or energy level. The energy levels corresponding to the electron orbits are always the same for that gas. As energy is absorbed from the light, light of that energy is removed from the light beam. Thus at that particular wavelength there will be no light, and so there is a dark line seen

[6] Byl, John, 2000. "God, Space and Time," *Biblical Astronomer*, **10**(94):10.

in the spectrum (remember, these dark lines appear as light lines in the above picture). Likewise, when the gas is excited (heated), it emits light of the same set of wavelengths as it absorbs when "cold." Since each element and even each type of molecule has a distinct combinations of lines (or bands of lines in the case of molecules), the elements making up the gas through which light passes can be identified by the absorption lines. (For those who wonder how astronomers "know" about these lines, they know it from experiments with elements in laboratories here on earth. The same lines show up in stars as in the lab.)

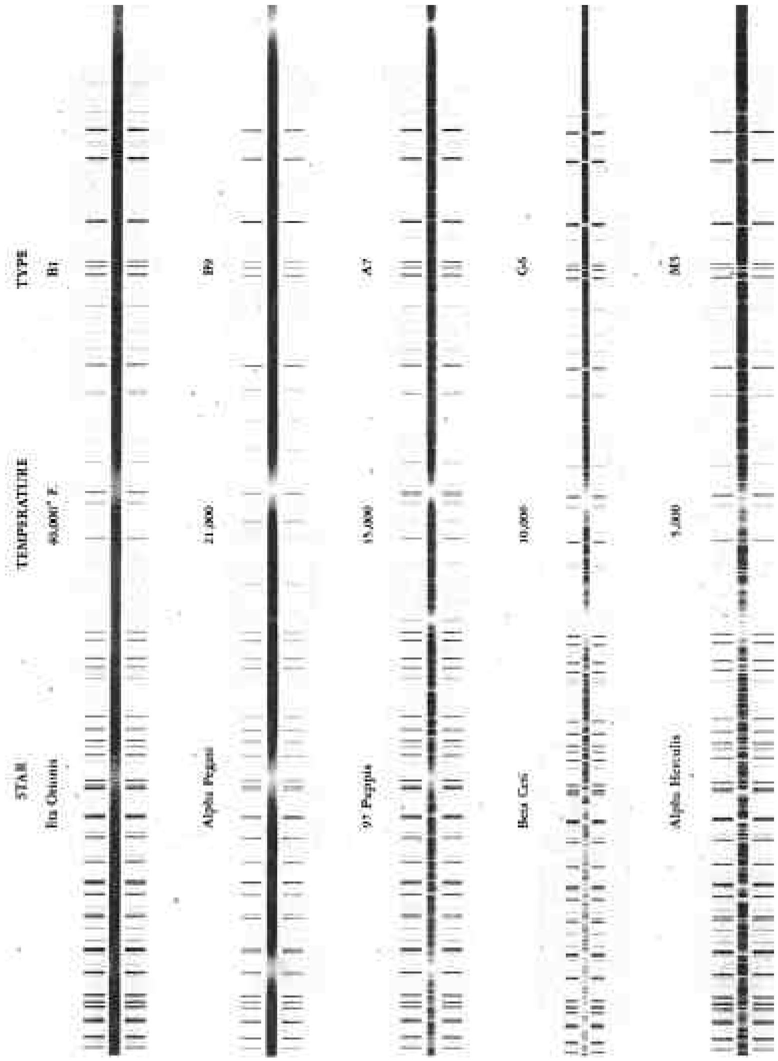
Spectral lines give information about the conditions in which they are formed, too. One such property is called "Zeeman splitting," where the lines occur in pairs. This indicates that the lines were emitted or absorbed in the presence of a strong magnetic field. There are two things which determine the width of a line. The first is abundance, the amount of the element present in the gas. The second is the turbulence of the gas, the amount of temperature-induced motion. The more the turbulence, the wider the line. To distinguish between the two effects, astronomers look at the depth of the line, that is, how dark is its center relative to its width. The lines also give the temperature of the gas.

Temperature classes

The hotter a gas, the more electrons are kicked free of their atoms. These can no longer change orbits and absorb photons. Thus only very abundant elements, particularly hydrogen which is the most abundant element we see, have a chance of leaving their "signatures" on the spectrum. Because of the heat, these lines would be extremely broad, and because free electrons can recombine with ionized atoms, one can find emission lines in such spectra. As a result, astronomers have grouped stars into seven temperature classes. These are called O, B, A, F, G, K, and M. Each type is subdivided into as many as ten subgroups. The subgroup is denoted by a digit. O-type stars are the hottest, and M-types are the coldest. Some O-type stars (called Wolf-Rayet stars) can reach surface temperatures of 100,000 degrees. The spectra on the next page show some representative spectral types and their temperatures.

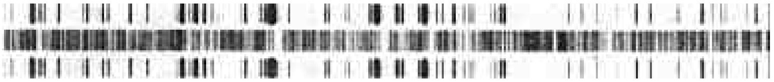
Luminosity types

Besides temperature, the pressure of the star's atmosphere also contributes to the broadness of a spectral line. The lower the pressure, the sharper the line. Based on this, stars have also been grouped by their brightness at a given temperature. Large, massive stars emit much light than their “dwarf” counterparts at a given temperature. The luminosity type is denoted by a Roman numeral, with I being most luminous and V being least luminous. Beyond that there are the categories of white dwarfs and brown dwarfs.



A star’s spectrum can also reveal one more thing about a star, and that is its speed and direction along the line of sight. This is the famous Doppler effect which is commonly identified with the red shift of distant galaxies. But for stars it is not always a red shift. It could just as well be a blue shift.

The way it works is that waves emitted by a star moving away from us are lengthened by the star's motion during the time it takes the wave to go forth. Likewise, waves emitted by stars moving toward the earth are shortened by the star's motion. The former is called a red shift, and the latter a blue shift. The picture below shows the spectrum of the star Phi^2 Orionis (pronounced *fye-two*). In the picture the iron-arc comparison lines are a bit overexposed, but the corresponding absorption lines can be seen in the star. In this case, though, the lines are about an eighth of an inch to the right (the red) of the comparison spectrum. This is because the star is moving away from us at about 50 miles per second.

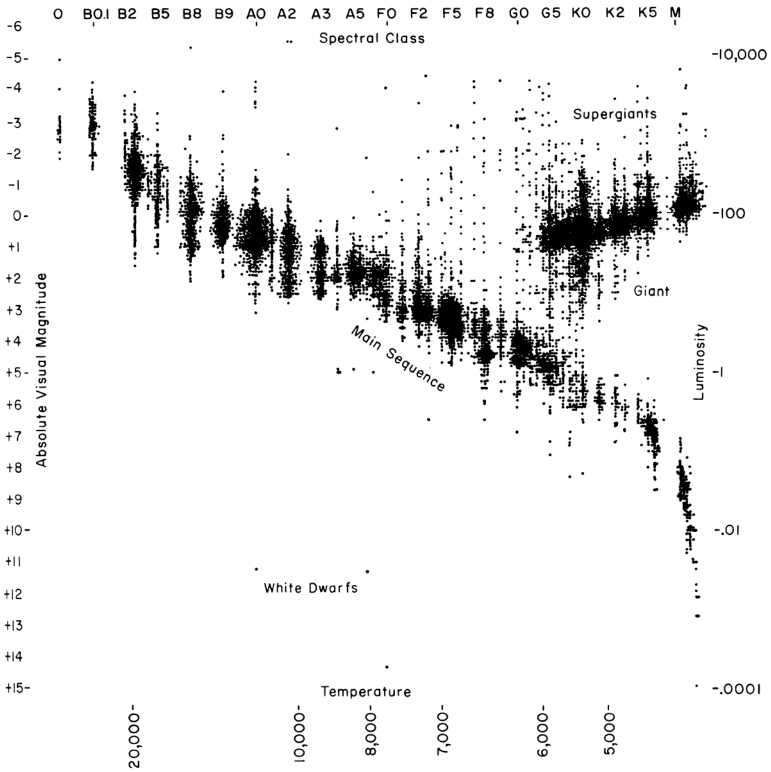


The Hertzsprung-Russell Diagram

What would happen if one were to plot the intrinsic brightness of a star against its spectral (temperature) class? There is a problem to overcome before that can be done. In order to do so, we need to know the intrinsic brightness of a star. To do that we need to know its distance.

When speaking of the intrinsic brightness of a star, astronomers speak of something called the "absolute magnitude." The absolute magnitude is the magnitude (brightness) of a star when placed 32.6 light years from earth (10 parsecs). The sun's absolute magnitude is roughly 4.5. This is about as bright as the faintest stars most people can see with the unaided eye. Absolute magnitude comes in two varieties: visual and bolometric. The bolometric absolute magnitude is the brightness of a star taken at all wavelengths, the sum of all wavelengths. The absolute visual magnitude is the brightness it would have when seen by the naked eye.

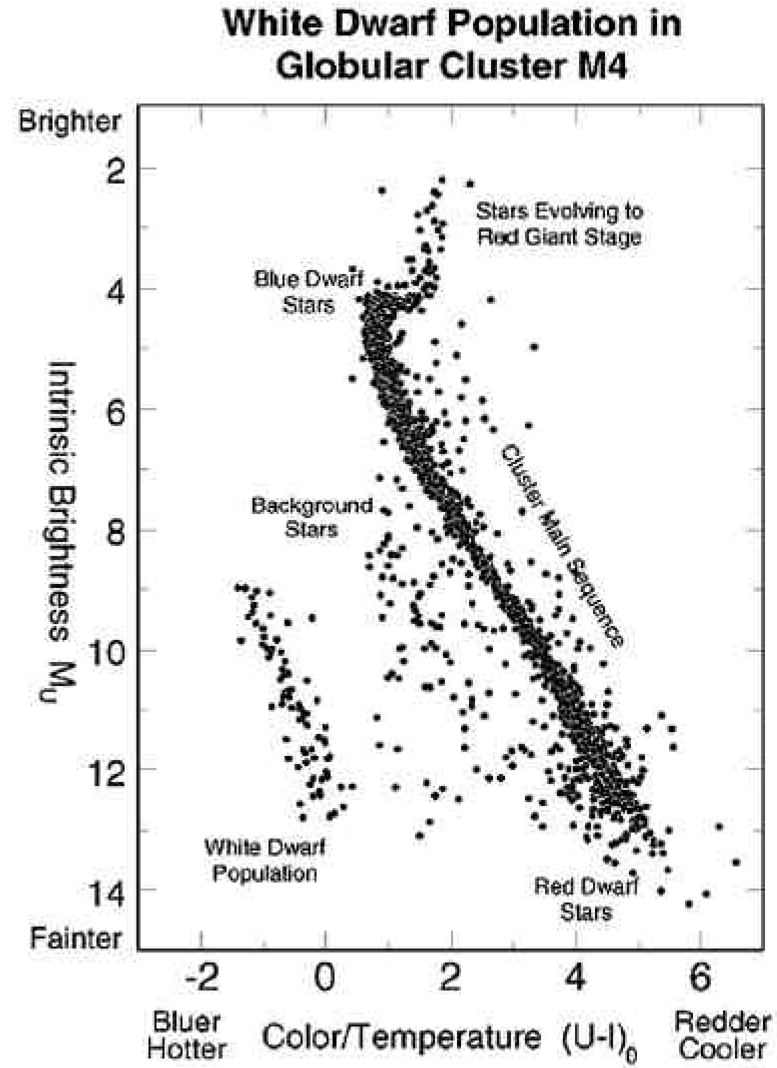
This still leaves us with the need to find the distance to particular stars. In a previous article we reviewed the determination of parallax. So it is upon parallax that the absolute magnitude is based. But there's more to the story than that. Clusters of stars, such as the Hyades (which make up the head of Taurus, the bull), and the Pleiades have hundreds of stars in them. For all practical purposes the stars are all at the same distance, well, most of them anyhow. There will be some stars between the cluster and us, and other stars in the background which shine through the cluster. Both can look like they belong to the



cluster. The figure on the next page is the Hertzsprung-Russell diagram of thousands of stars of "known" distance. Most of these distances are determined by parallax and by fitting the diagram for a cluster to the parallax-based curve. The sun is a G2-type star (scale along the top of the diagram), and by definition is at position 1 in luminosity (scale along right the of the diagram).

On the next page is another form of a Hertzsprung-Russell diagram called a color-magnitude diagram. In a color-magnitude diagram the temperature or spectral class is replaced by a "color," meaning, the difference in brightness measured in two color bands, usually blue and visual or yellow, (B-V), but in this diagram it is the difference between ultra-violet and infrared. This color-magnitude diagram is of the globular cluster Messier 4. Globular clusters are spherical clusters of stars containing hundreds of thousands of stars.

The bottom curve in both types of diagrams is called the "main sequence." Most stars, including the sun, fall into this group. Astronomers assume that the main sequence stars of the sun's spectral



type or redder can be lined up when adjusted for distance. Evolutionarily speaking the more luminous stars are *younger* than the fainter stars. That's why the sequences are always aligned along the bottom right of the H-R diagram, because the slowest "evolving" stars are located there.

When astronomers talk about the "evolution" of stars, by the way, they generally mean the aging process of a star. How quickly a star ages depends on the speed of light. Therefore, if the speed of light were very much higher than now during the creation week, these stars would have aged “millions” to “billions” of years in a matter of days, weeks, or months. There is no way known that we could tell the difference today except by the wavelength of the arriving photons, assuming energy is conserved (first law of thermodynamics). If the speed of light was higher in the past, photons emitted in the past would have a longer wavelength, that is, would be red-shifted.[7]

ZAMS fitting

As can be seen from the former two figures, there is a considerable amount of scatter among the main sequence stars. Part of that scatter is assumed to be due to the “age” of the star. In general, it is theorized that young stars age onto the main sequence from the lower right, stay on the main sequence for most of their lives, and then age to the upper right from the main sequence. As such, astronomers focus on the bottom edge of the main sequence, particularly from type G0 (6,000 degrees) on down to cooler temperatures. This imaginary line is called the *Zero-age Main Sequence* or ZAMS for short. As star clusters have their color-magnitude diagrams determined, the lower right portion of the diagram is fitted to the ZAMS. The difference between the observed main sequence apparent magnitude and the absolute magnitude scale fitting the parallax-determined ZAMS (bottom edge of the main sequence) gives the distance to the cluster.

Now the solar-type stars in the furthest clusters may not be detectable, so in that case the red giant branch, if present, is fitted. The red giant branch runs off the main sequence to the upper right, centered at a luminosity value about 100 times as bright as the sun. The gap between the main sequence and the branch seems empty of stars because stars “age” rapidly through that portion of the diagram, so they don’t spend much time there, and so there are few found there.[8] Note that in the diagram on page 8 the main sequence continues to the upper left from the red giant turn-off, whereas in the color-magnitude diagram on page 9 the stars turn off and there are none extending beyond the turn-off. The reason is that in the latter case we are dealing with a particular cluster where all stars are presumably the same “age.” Thus the faster aging hot young stars will already have turned off into the red giant or

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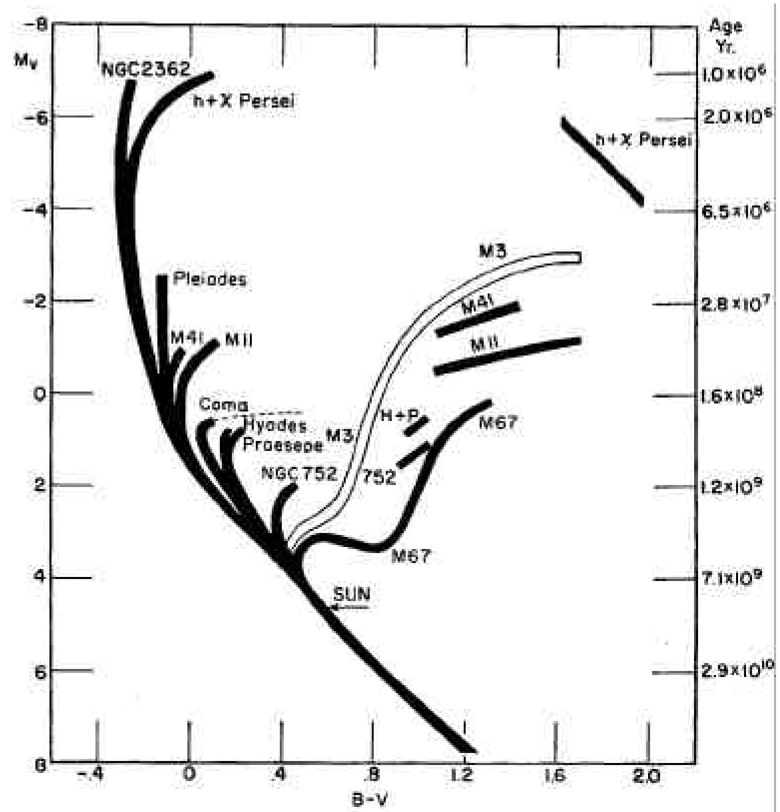
[7] $E=hc/\lambda$, therefore, if energy (E) is conserved, any increase in the speed of light, c, must be matched by an increase in wavelength, λ, that is, the spectral line is redshifted.

[8] Please don’t write me and tell me that evolution never happened. I know that. Remember, I think that early on, during the creation week, when God stretched out the heaven, that the speed of light was much higher and that stars aged very rapidly that week.

white dwarf branches. In the former, we are dealing with stars of all "ages."

The figure[9] below shows the ZAMS fitting for several star clusters. One of the clusters is a globular cluster (M3), and others are open clusters (also called galactic clusters because they fall on the plane of the Milky Way). These clusters have no particular shape and are rather loosely thrown together such as the Hyades, Pleiades, h and χ Persei. Galactic clusters appear younger than globular clusters and also are richer in metals.

The reader will note that the argument is not about whether or not there is any turn-off from the main sequence. There is, and it is different for each cluster. One may question whether the turn-off is truly age



related or may be caused by some other factor. In the early decades of the twentieth century astronomers believed that stars aged by "sliding" down the main sequence. Starting about the 1930s the theory of stellar

[9] Sandage, A., 1957. *Astrophysical Journal*, **125**:436.

structure suggested that wouldn't work, that stars curved off in the path you see in the upper region of the color-magnitude diagram on page 9.

Trigonometric parallax is not the only foundation on which the second stage of cosmic distance determination is set. There is a class of double stars which are so close together that the only way we can see them is by their superimposed spectrum. As they orbit one another, their spectral lines show their Doppler shifts going opposite to one another. In other words, while one star's lines show it approaching us, the other star's lines show it receding from us. It was found that certain spectral lines are weak in large proper motion stars and strong in small proper motion stars and conversely. By using strength ratios of these lines it was shown that the ratios corresponded to absolute magnitudes which corresponded to those measured by direct parallax.

Summary

In this paper we assumed that parallax was determined on the basis of an earth-sun distance baseline when the star is observed six months apart. Although it's been suggested that the only valid geocentric parallactic base line is the diameter of the earth, doing so places the nearest star about half way between Saturn and Uranus, namely 1.2 billion miles. Several space craft have surpassed that distance. The furthest out is approaching 10 billion miles. There is no hint from its navigational system that any stars have moved significantly from the positions they had when the spacecraft left earth.

When differences in the brightness of areas of different color in a star's spectrum are matched with their parallaxes so that they are plotted as if they are the same distance from earth, the stars mostly fall in certain narrow bands forming what is called the main sequence of stars. Stars in clusters also show the same tendency when their color-magnitude diagrams are drawn. This gives astronomers some confidence that the distance to the clusters can be more or less accurately determined by fitting the cluster's main sequence to the parallactically determined one.

The third stage

In the next article we shall consider the distance indicators based on the color-magnitude diagram. (The position of a star on the color-magnitude diagram is empirically measured whereas the position of a star on the H-R diagram is based on someone's judgment of spectral and luminosity type. This latter is more subjective.)

How Important in 17th Century Astronomy was Belief in Extra-Terrestrials?

I. Bartholomew P. Dobson

Whenever arguments of science arose in the Middle Ages, the learned men of Europe would generally debate the philosophies of the Ancients, particularly those of Aristotle. Aristotle had taught (amongst other things) that everything in the cosmos – the stars, planets, sun and moon – all orbited the earth as a natural property inherent in them. Thus to the Medieval mind, the existence of extra terrestrials required there to be other worlds, complete with their own planets, sun and fixed stars. Hence, the debate about the "plurality of worlds" was actually about the "plurality of cosmoses." However, with the coming of the Renaissance, this debate metamorphosed into an argument about whether there could be more worlds in this *one* cosmos.

This rather abrupt change in the nature of the debate came less than fifty years after the publishing of a book, which for the first time since the Ancient Greeks, had seriously postulated that the earth did not inhabit a central position in the cosmos – Copernicus' *De Revolutionibus*. Now, although Copernicus held to his position for merely metaphysical reasons (the observations were equally explicable by Ptolemy's model, which, unlike his, was not at odds with various Aristotelian beliefs), it was never-the-less rather attractive to some, and crucial to the argument of plurality of worlds. If the earth was just one of the planets, moving around the sun, then why couldn't the other planets, the moon, sun and stars all have been inhabited; and if the earth was not special as regards motion, why should it have been special as regards life? Despite such logical conclusions, however, Copernicus refused to engage in such discussion. To him, his model was physical reality; it was up to others to ponder its significance.

The ending of the 16th Century witnessed the execution of the first major advocate of such a new idea of the plurality of worlds. On February 16, 1600, Giordano Bruno, an advocate of an infinite universe with many worlds and inhabitants, was burned at the stake by the Roman Catholic Inquisition. He had argued that without an absolute centre to the universe, the Aristotelian objection to other worlds (that there could be no ordered motion about more than one centre) was invalid (which indeed it was). However, he did not convince many of his peers, and was eventually executed – although probably more for his denial of the deity of Christ and "magical" view of the earth than his pluralism.[10] Still, Bruno's ideas did not die with him. A mathematician by the name of Johannes Kepler, although rejecting the idea of infinite worlds, was soon to accept the idea of life on the moon, planets and even stars; though unlike Bruno, empirical evidence was to play a key role in his ideas.

Kepler's earliest theories in this respect regarded the moon, the most easily observed body in the night sky. In his book, *Astronomiae Pars Optica*, he included a section "On the spots of the moon." These dark spots, he thought, were the lunar land; the bright ones the seas.[11] Although some had claimed they were merely optical illusions, Kepler showed by use of a *camera obscura* that they were present no matter which way they were looked upon. Thus Kepler's belief in lunar-life caused him to theorise the existence of the lunar "mares," and so conclusively was it thought that these showed the existence of water, that they are still called this today.

Kepler also thought the brilliant nova of 1572 evidenced the existence of extra-terrestrials, for why, he reasoned, would it happen just for us? Concluding that there was no satisfactory answer to this question, he resolved that it must have happened for the benefit of other people, who lived amongst the stars. However, his mentor, Tycho Brahe, who had made a meticulous study of that same nova, did not agree. Rather, arguing from what he considered the "fact" that there was no life anywhere but the earth, he reasoned that the stars couldn't be as large or as distant as the Copernican theory implied – for then the largest parts of creation would be of no use to anyone. However, as the Copernican view grew in popularity, the opposite argument began to overtake men with minds like Kepler's. Still, though the idea of extra-terrestrial life was growing into the "general knowledge" of some (as a consequence of heliocentrism), the most famous of all heliocentrics was of a quite different disposition.

Galileo Galilei's life and work were not, so far as we can tell, inspired by belief in other worlds, but for more pragmatic reasons. Galileo soon discovered the financial gains he could receive from the creation of the telescope, and he made his observations in the hope of securing a healthy patronage – for in his days this was the only way a scientist like him could make a living. Galileo turned his telescope toward the moon in order to find something that would earn him money, which it did. In his *Sidereus Muncius*, Galileo mentioned that the surface of the moon was "not unlike the face of the earth," and that

[10] S. J. Dick, *Plurality of Worlds*, 1982, p.69

[11] This was Kepler's original view. Later Kepler reversed this view, thus falling in line with Galileo whose telescope, showed mountains ranges and shadows on the bright areas.

"if anyone wished to revive the old Pythagorean opinion that the moon is like another earth, its brighter part might very fitly represent the surface of the land and its darker region that of the water."[12] Now, Kepler originally suggested that the dark regions were the land and the light ones water, but he eventually changed his mind, falling in line with Galileo because of his mathematical arguments. However, unlike Galileo, he used these new discoveries to try to prove his idea of extra-terrestrial life; a concept Galileo later referred to as "damnable."[13]

Thus Kepler's pluralist arguments had more force than ever. Why was there observed such a remarkable circular cavity on the moon?[14] Obviously, earthmen could not have built it, so he concluded that it was the work of moon-men, designed to protect then from the great heat of the long lunar day. But how did they survive the long night? After doing an experiment in which he (wrongly) thought that he had felt heat from moon-light collected by a mirror, he reasoned that earth-light would keep the moon-people warm during the night. Also, Galileo observed mountains, which made the satellite seem more like home, as did his already identified "seas" and the reportedly observed lunar atmosphere. However, Kepler's evidences lay with more than just the moon, and his conclusions probably lay more in his beliefs in astrology than his astronomical work. Why, he reasoned, would Jupiter have moons, if not for the benefit of Jovians? For, argued the astrologer who had cast many horoscopes for Rudolf II, the motions of these moons would only have any astrological significance to people on Jupiter – hence they must exist.

Such characterised Kepler's arguments. However, there was one big challenge that all heliocentrics in general, and pluralists in particular, would have to face: the testimony of the Bible. The Roman Church's treatment of Galileo is perhaps the best known (and misrepresented) cases of this, but the general problem extended to all those who called themselves Christian, for the book they said they believed served as a testimony against them. For example, the Bible is rather specific in its assertion that the sun moves, not the earth. Numerous examples could be quoted, but a few will suffice:

> Who laid the foundations of the earth, that it should not be removed forever.[15]
> …the world also is stablished, that it cannot be moved.[16]

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[12] *Ibid.* p.75.
[13] *Ibid*. p.61.
[14] Mare Crisium, for example: the Sea of Crises.
[15] Psalm 104:5.
[16] Psalm 93:1.

> The sun also ariseth, and the sun goeth down, and hasteth to his place where he arose.[17]

There was also one massive problem (and other smaller problems) for pluralism, regarding the salvation of these extra-terrestrials. Were they saved? If not, why not? If so, how? Did Jesus go to die on their planets, or did they not fall? If not, then why bother sending God's Son for men? All these were valid questions that the non-Copernicans and anti-pluralists used to justify their cause. Thus, in 1638, a young man by the name of John Wilkins tried to deal with them.

Wilkins was later to become the bishop of Chester, and spent much time trying to dismiss these arguments in order to allow his Copernican model (complete with men on the moon and sun) to coexist with the Bible. His commentary on Psalm 19 is particularly notable in this respect, for the passage declares that the sun moves throughout the course of the day as a strong man running a race. The section ends with, "and there is nothing hid from the heat thereof,"[18] and it is Wilkins' treatment of this verse that is noteworthy, for he writes:

> "…speaking still in reference to the common mistake, as if the sun were actually hot in itself; and as if the heat of the weather were not generated by reflection, but did immediately proceed from the body of the sun."[19]

So we see Wilkins' augment: one cannot take the Bible literally, since doing so would require the sun to be hot. But Wilkins could not allow this, for it would have prevented extra-terrestrials from living

[17] Ecclesiastes 1:5, A.V.
[18] Psalm 19:6, A.V.
[19] J. Wilkins, *Discourse of the Possibility of a Passage thither, That it is probable our Earth is one of the Planets*, p.153

there. We now know that Wilkins' objection was invalid, but the fact that it had been made allowed Christians to ignore the plain teaching of Scripture. This, then, helped pave the way for the rejection of the ancient Biblical cosmology and its replacement with Copernicanism.

With the rejection of some of the teachings of the Bible, more and more men came to a belief in the heliocentric model and of men on other worlds. Descartes helped with this idea by claiming that all stars were themselves suns, allowing many to postulate the existence of people elsewhere. Fontenelle constructed a pluralist cosmology along Cartesian lines, with men of different characters on the different planets. Although these were based partially upon astronomical evidences of the distances of their home planets from the sun (and hence temperatures), they were more like the works of fiction produced by earlier authors, which had stirred the public imagination. It is notable that amongst all these years, pluralism was often the foundation upon which astronomy was interpreted, only rarely anyone doing astronomy because of it. Nor was any of Newton's work apparently connected with the extra-terrestrial life debate, although some of the Dutch scientist Huygens' was. The latter, by assuming that all stars were as bright as the sun, provided us with one of the first calculations of stellar distance. This was all done in light of his belief that they were indeed suns, and had planets encircling them, each with men like our own.

Thus we reach the conclusion of the matter: It appears that many of the philosophers and astronomers of the 17th century postulated their astronomy for reasons quite divorced from extra-terrestrials – for Copernicus, Galileo, Descartes and Newton this was clearly a side issue. However, many others would take it upon themselves to expand these astronomical ideas and postulate other worlds. Pluralism did serve as the basis for a little astronomy and also, in the case of Wilkins above, helped throw out the Biblical view of the universe, and so it remains now. Whilst money will be spent when Mars rocks appear to have fossils, and radio telescopes will scan the skies for coded messages, still, as ever, astronomy will mainly be conducted for the sake of astronomy. However, as long as men live in their heliocentric universe, it will stand to reason that there *ought* to be life out there. Still, if Tycho or Aristotle were around now, there could be nothing shown to him to render his view of aliens, at least, false.

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Quotable Quote

The number of children taught at home has increased from a miniscule 15,000 in 1978 to 1.5 million today. Academic resources are better than ever, with Web pages offering information about good textbooks, teaching aids and supplemental materials. But mostly home schooling forges a special bond between parents and their children. It communicates to children how important they are that parents invest so much time in them. It also earns dividends for parents who are able to shape their own children's intellectual and moral development and not turn that responsibility over to an agent of the state, who, no matter how good a teacher, will always be required to teach the state's values and the state's perspective on subjects from sex to history and biology. Children educated at home are some of the friendliest, most articulate and socially comfortable people I've met. They look you in the eye. They speak in complete sentences, eschewing the verbal crutches such as "you know" and "she goes." They aren't robots, but neither are they freaks. They are, I suspect, the way most parents would like their children to be: smart, kind, courteous, respectful and seeking to live a moral life.

– Cal Thomas

HIPPARCHOS ON PARALLAXES

Two e-mails received in the past month added new fuel to the debate about the relevance of parallaxes in the geocentric debate. The first to arrive was a claim by a physicist that parallaxes detected by the Hipparchos astronomical satellite disprove geocentricity once and for all. The second is also based on the Hipparchos results but this time the claim is that 917 *negative* parallaxes implies a small universe.

History of Hipparchos

In June of 1989, the European Space Agency launched its astronomy satellite aboard an Ariane rocket. The acronym stands for HIgh-Precision PARallax COllecting Satellite. The name puns with that of the ancient Greek astronomer Hipparchus. From its planned orbit beyond the interference of Earth's atmosphere, the satellite was designed for precise mapping of the stars. It measured luminosity, angular momentum, proper motion of stars, and parallax.

The original plan was for Hipparchos to enter a geo-stationary orbit. However, an engine failure resulted in the satellite achieving an elliptical earth-orbit instead. Exhaustive efforts by ground controllers enabled Hipparchos to carry out its mission, relaying some 1,000 gigabytes of observational data over an approximate three-year period until failure of the satellite's solar panel in June 1993. Because Hipparchos was not able to achieve its originally intended geo-stationary orbit, reducing the observations is extremely complex, requiring a great deal of time and expense. Nevertheless, a portion of this analyzed data became available in August 1997.

Hipparchus-measured parallaxes

The easiest way to visualize parallax is to hold one’s finger about a foot in front of one’s eye. Close the right eye and note where on this page the finger appears; then close the left eye and open the right and the finger will now appear to the left of where it appeared when the right eye was closed. Heliocentrically, the left and right eye are the positions of the earth about the sun six months apart. Astronomers measure the angle from the amount of shift on the book (distant stars) and so can determine the distance to the finger. The angle from left eye to finger to right eye equals the parallax.

There are two parts to the claim that Hipparchos parallaxes disprove geocentricity. First, in the course of a year, Hipparchos covers a base line greater than the 186,000 miles of the earth's orbit (rather like using the distance between the ears instead of the eyes in the above illustration). This allows more accurate parallax determination which, in turn, allows distance determination to more distant stars, that is, stars which are further away. Second, since we have decent data on the relative motion of the sun and its neighboring stars (proper motions and radial velocities), over the years Hipparchos traced a spiral path relative to those stars which moved a straight-line distance of some 3×10^{15} miles (compared with the 2×10^{8} miles about the sun). However, so far no one seems to have looked for those parallaxes yet, so only the first argument will be addressed.

Hipparchos's parallax

If, as in some small universe models, the stars are centered on the earth, then Hipparchos gives a base line roughly 45,000 miles compared with earth's diameter of 7900 miles. This larger baseline was expected to show the parallax for stars if the universe is some 90 light-days in diameter. This was not the case, and this is the grounds for the claim that the geocentric model is disproven by the Hipparchos satellite.

But a small universe, with the stars centered on the earth is not the only geocentric model, nor is it the most capable in explaining the observed motions of the stars. The modified Tychonic model (see the "Spatial Measurements" article on page 3 of this issue) is better at explaining these, and the modified Tychonic model is not in the least disproved by the Hipparchos data.

Negative parallaxes

The problem of negative parallaxes is one that is relevant only to geocentrists, and then only to those who advocate a small universe. For the rest of the world it's only a matter of statistics. Here is a quote from Amnon Goldberg, taken from an e-mail to yours truly.

> I did a search on all objects with parallaxes between -2.0 and -1.0 mas and found 917 hits. I didn't do other negative ranges, but I am reasonably sure there are many more negative parallaxes. Now I am curious. Why are there so many negative parallaxes. I figure an occasional foreground star could create systematic errors. But 917 from an arbitrary search range? Makes me suspect that Harald [Heinze] may be correct. There, I said it.

The search Mr. Goldberg refers to is available on a world-wide web site at http://astro.estec.esa.nl/hipparcos_scripts/hipMultiSearch.pl, which returns data on stars located within certain ranges of position, magnitude, or, in particular, parallaxes. Mr. Goldberg thinks that 917 parallaxes is too many to be by accident.

How, one may ask, does one get a negative parallax? There are two ways a negative parallax could arise. The first is that there is an error in the measurement. Indeed, if all the stars were located at exactly the same distance from us, then all parallax measurements would be nothing more than errors. That means that 50 percent of the parallaxes would be positive, and 50 percent would be negative. Likewise, measurements at the limit of our capabilities to detect parallax would also give an equal mixture of positive and negative values.

The second way to get a negative parallax is to measure a star that is located further away than the reference stars. In that case, the reference stars would show a larger parallax than the more distant stars and the latter's position relative to the background stars is reversed.

Consider our finger example of earlier. Now put the fingers of the other hand behind the original finger (about a foot further away would be fine). Close your right eye and note the position of the finger against your other hand's fingers. Now, without moving your hands, close the left eye and open the right. You'll note that your finger **jumps to the right** against the background fingers.

Now reverse the position of your two hands so that the hand with the fingers is nearer to you than the hand with the lone finger held up. Again, close your right eye and note the position of the lone finger through the fingers. Then open your right eye and close the left. This time the finger **jumps to the left**, the opposite direction of when it was in front of the other fingers. This is a negative parallax.

In the early decades of the twentieth century, astronomers thought negative parallaxes an embarrassment, and would not publish them. But in the middle of the century, astronomers started to use a technique called "statistical parallaxes" for stars too distant to have measurable true parallaxes. At that time it was pointed out that the absence of published negative parallaxes was skewing the statistics, making statistical parallaxes less accurate. As a result, negative parallax results were collected and have been published ever since. Note that it is in astronomers' best interest to publish negative parallaxes, so there is no incentive to hide them.

To check out the significance of Amnon Goldberg's report, I connected to the Hipparchos site and finished the analysis he started. First of all, he ran his search for the range of -0.0010 to -0.0020 seconds of arc, that is, from –1.0 to –2.0 milli-arc-seconds (mas). (There are 3600 arc seconds in a degree, so there are 3,600,000 mill-arc-seconds in a degree. For comparison, the full moon as seen from earth is about half a degree in diameter.) The astute reader of past issues about the parallax debate will recognize that I have consistently claimed the accuracy of a parallax determination to be ±0.001 second or worse. Thus Amnon's search area is right above the detection limit of a parallax. So it is not surprising to see many negative parallaxes.

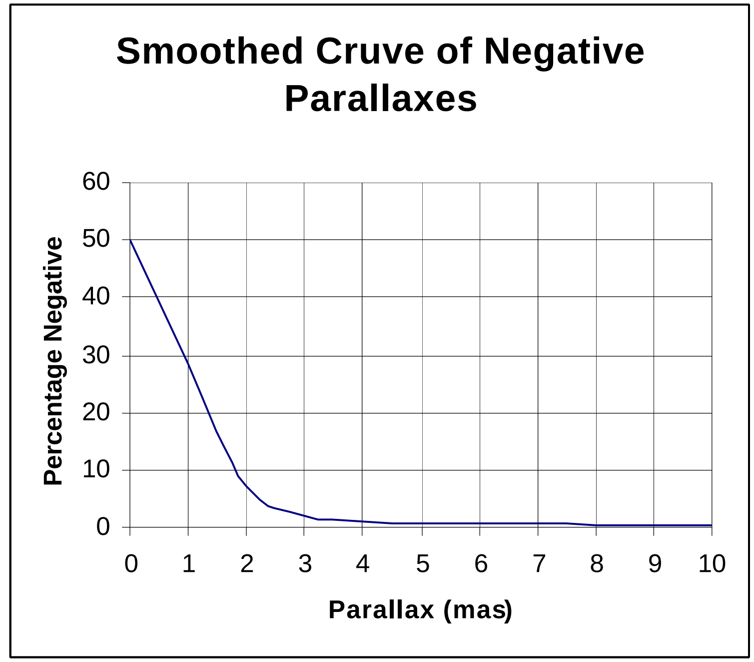
The first range I checked was the +1.0 to +2.0 mas and found 11,628 parallaxes in that range. I was surprised at how *few negative* parallaxes there actually were in that absolute range! The table below shows the results for both negative and positive parallaxes in the total range from 0".000 to 0".010. The reader will note that the number of negative parallaxes drops off quickly for larger parallaxes.

RANGE (mas)	$\mathbf{N}_{negative}$	$\mathbf{N}_{positive}$	$\mathbf{N}_{Total}$	**Percent < 0**
0-1	2,577	6,471	9,048	28.5
1-2	917	11,628	12,545	7.3
2-3	322	14,950	15,272	2.2
3-4	148	14,632	14,780	1.0
4-5	87	11,944	12,031	0.7
5-6	43	9,607	9,650	0.6
6-7	48	7,658	7,706	0.8
7-8	22	6,046	6,068	0.4
8-9	17	4,881	4,898	0.3
9-10	13	3,840	3,853	0.3

The columns of the table are as follows: Range is the range of parallax values in milli-arc-seconds, $N_{negative}$ is the number of negative parallaxes in that range. $N_{positive}$ is the number of positive parallaxes in that range. N_{Total} is the total number of parallaxes, positive and negative, and Percent is the percentage of all parallaxes which are negative.

As expected, the percentage of negative parallaxes increases as we approach the detection limit on parallaxes. At 0".001 and under, roughly 30 percent of the parallax determinations are negative. Between 0".0000 and 0".0001 there are 914 published parallaxes, of which 433 are negative. This is well below the practical limit and, indeed, the results give 47.3 percent negative parallaxes, which might as well be the 50 percent expected if parallaxes could not be measured. The chart above is a plot of the percentages in the table. It shows how rapidly negative parallaxes fall off as parallax increases.

At the other extreme, the largest parallaxes which are those be-



tween 0''.100 and 0''.500, there are 178 parallaxes reported of which not a single one is negative. Between 0''.010 (the right-hand end of the above chart) and 0''.015, 0.38 percent are negative. Between 0''.015 to 0''.020, 0.4 percent are negative.

Conclusions drawn from the physical evidence

From analysis of the Hipparchos parallax determinations, we conclude that the typical error of a parallax measurement is ±0''.0015 or 1.5 mas. This is about the same error as reported by ground-based observatories. Parallax determinations below¦ 0.1¦ mas are indistinguishable from noise.

The existence of these parallaxes by both ground-based and satellite observatories confirms the not just the heliocentric model, but also the modified Tychonic geocentric model. By itself, the existence of stellar parallaxes provides no support for either the large or small universe models. It is when parallaxes are coupled with other observed correlations, such as the luminosity function among stars, color-magnitude diagrams (see article on page 5 of this issue), proper motions, the two-period sine curve in radial velocities of stars around the sky, etc. that the small universe model runs into trouble.

What does the Bible say?

Of course, the final authority for the Biblical Astronomer is the Holy Bible. We have considered this before, but for our new readers it bears repeating. There are three key issues or passages in the small versus large universe debate.

1. The "great lights" of Genesis 1:16[20] and Psalm 136:7-9[21] are called great in the context of their purpose, to rule the day and night. Day and night in the context is day and night on earth. The moon does not rule the night on Mars, for example. The lights are called "great" in a geocentric context. To interpret that statement to mean the largest objects in the universe is to add to the word of God, for the scripture says "great," not "greatest."
2. The references to the stars falling from heaven (Isaiah 34:4,[22] Revelation 6:13,[23] 12:4[24]) is taken to imply that the stars are fairly small. There are various interpretations of these passages. Some say that they all describe exactly the same event, some say there are two events, that Isa. 34:4 and Rev. 6:13 are one event and that Rev. 12:4 happens subsequently. Some think that these are three events. In the Revelation, 1:20[25] stars are defined as angels. This reflects the "host of heaven" allusion of Isa. 34:4. Interpreting Revelation 12:4 in this light gives the tradition that a third of the angels are fallen angels, servants of the Devil. Perhaps we need look for no further interpretation, but if we do want to look for a physical fulfillment, the, given the limits of physical nature, a meteor shower looks most promising of all events. For if the luminous stars are meant, then

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[20] Gen. 1:16 – And God made two great lights; the greater light to rule the day, and the lesser light to rule the night: *he made* the stars also.

[21] Psa. 136:7-9 – To him that made great lights: for his mercy *endureth* for ever: The sun to rule by day: for his mercy *endureth* for ever: The moon and stars to rule by night: for his mercy *endureth* for ever.

[22] Isa. 34:4 – And all the host of heaven shall be dissolved, and the heavens shall be rolled together as a scroll: and all their host shall fall down, as the leaf falleth off from the vine, and as a falling *fig* from the fig tree.

[23] Rev. 6:13 – And the stars of heaven fell unto the earth, even as a fig tree casteth her untimely figs, when she is shaken of a mighty wind.

[24] Rev. 12:4 – And his tail drew the third part of the stars of heaven, and did cast them to the earth: and the dragon stood before the woman which was ready to be delivered, for to devour her child as soon as it was born.

[25] Rev. 1:20 – The mystery of the seven stars which thou sawest in my right hand, and the seven golden candlesticks. The seven stars are the angels of the seven churches: and the seven candlesticks which thou sawest are the seven churches.

they must be both very small and cold. Even if the stars were 40 light days away, each would typically be the size of the earth given their angular diameters. The passage can be taken to suggest that each "star" that fell is about the size of a fig. This suggests a meteor shower of stony or iron meteoroids. It certainly does not allow for a hot ball of gas or plasma which would dissipate upon hitting the atmosphere. I believe a meteor storm is the most realistic *physical* interpretation of the aforementioned verses, and I find it intriguing that major meteor showers are possible near 2033, the 2000th anniversary of the crucifixion, and again near 2066, around the 2000th anniversary of the fall of Jerusalem.

3. The third consideration is offered by Jeremiah 31:37[26] which suggests that the heaven cannot be measured. Some have suggested that this means that space is infinite, but compare Proverbs 25:3[27] where, if the same logic is applied, the depth of the earth should be infinite, too. Others, thinking the heaven referred to is the atmosphere, have pointed out that the atmosphere has no discernable boundary and thus cannot be measured. This is allowed since the earth is mentioned in context. And still others note that we have yet to find the edge of the universe and if we ever did we could still not span it, let alone measure it. Still others suggest that the "heaven above" refers to the heaven beyond the firmament which, possibly, could be infinite. In any case, we cannot measure the heaven, even though the firmament (outer space wherein the stars) has an edge as attested to by there being waters above it.

In conclusion, the abundance of negative parallaxes for small parallax values does not provide support for a small universe but is entirely attributable to errors of measurement. For larger parallax values, the presence of negative parallaxes is statistically consistent with the occasional parallax determination of a star further away than the reference stars. Negative parallaxes do not support or favor small universe models.

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[26] Thus saith the LORD; If heaven above can be measured, and the foundations of the earth searched out beneath, I will also cast off all the seed of Israel for all that they have done, saith the LORD.

[27] Prov. 25:3 – The heaven for height, and the earth for depth, and the heart of kings *is* unsearchable.

PANORAMA

Were some ships sunk by a North Sea bubble?[28]

Giant bubbles of methane gas could be responsible for the mysterious disappearance of ships in the Bermuda Triangle and the North Sea. Some scientists believe that if large quantities of methane come to the surface from the sea floor, the density of the water is lowered to such an extent that ships plunge to the bottom without warning.

The first hard evidence of this phenomenon has been found in the North Sea, where a wrecked trawler lies several hundred feet down right over a reservoir of the gas. Scientists believe that the ship sank several decades ago after running into a methane bubble.

Running into a pocket of methane would be a terrifying experience. “When the gas bubbles up from the surface, it lowers the density of the water, and therefore its buoyancy,” said marine geologist Alan Judd from the University of Sunderland. “Any ship caught above would sink as if it were in a lift shaft.” He added that people jumping overboard in lifejackets would sink too. No trace of boat or passengers would remain on the surface.

Methane gas can be generated by rotting animal and plant remains on the ocean floor, that gradually get covered in mud and silt. Eventually, after thousands of years, this gets compressed into high-pressure gas reservoirs. When the pressure gets too much the gas explodes, sending a huge bubble of methane to the surface.

Gas below the surface is a known hazard for oil rigs. If they hit a gas pocket while drilling, the resulting blow-out can sink the rig. Dr Judd examined sonar surveys of an area of sea about 100 miles north east of Aberdeen. The seabed is riddled with pockmarks from escaping gas. The surveys showed one unusually large mark called Witch's Hole.

A follow-up survey discovered a wrecked trawler on the seabed, right over Witch's Hole. It was lying undamaged, on its keel, on the ocean floor. “The boat didn't go in either end first, it went down flat,” Judd told New Scientist magazine. “This meant that we could rule out a collision or hole in the hull, because then it would have sunk end first, like the Titanic.” He says the fact that the wreck, which is of an 80ft trawler built sometime between 1890 and 1930, sits right over a huge gas deposit is strong evidence that methane is the culprit. “For a boat to have randomly

[28] Hanlon, Michael, 2000. “Were some ships sunk by a North Sea bubble?” http://www.dailyexpress.co.uk/00/11/30/news/n0520.shtml

landed within Witch's Hole would be an amazing coincidence," said Judd.

The scientists will now examine shipping reports from the first half of the 20th century to try to pin down the date of the wreck and the name of the trawler.

The Bermuda Triangle is an area of sea between Bermuda, Puerto Rico and Miami where an unusually high number of ships have disappeared. Some people have blamed paranormal forces for the disappearances; others point out that this part of the Atlantic is subject to a large number of tropical storms. But some scientists believe that methane might again be to blame.

Leeds University geologist Ben Clennell says that submarine landslides off the Florida coast could expose an unusual form of ice called a gas hydrate, a mixture of water, ice and methane. When exposed to the water, this ice will fizz and pop, releasing huge quantities of methane, which could be responsible for the sinking of ships.

More Leonid mysteries

In the last issue we presented a review article on the Leonid meteor shower, tracing its history over the past millennium. Because so much research has gone into the study of the shower, it is not surprising that some results will be unexpected. For example, conventional wisdom has it that meteors should start glowing where the air is thickest, at lower altitudes.

A recent report[29] compares the beginning heights of meteors taken by photography versus TV cameras. The observations were made by a multinational group in Red China. By placing two or more cameras some miles apart, a stereo effect against the background stars can be used to compute the height of the meteor's start and finish. In other words, the parallax of the meteor can be observed.

Both sets of cameras recorded the same final burn heights, but the starting heights were different for the cameras. Pavel et al. report on their most startling result:

> The highest observed Leonid meteor with initial mass of about 1 kg [two pounds –*Ed*.] started radiating at an altitude of almost 200 km [120 miles –*Ed*.]. The origin of meteor radiation at such high altitudes is still not well understood and more detailed observations will be needed, including near-infrared spectroscopy.

[29] Pavel, Spurny, et al., 2000. "Atmospheric behavior and extreme beginning heights of the thirteen brightest photographic Leonid meteors...," *Meteoritics and Planetary Science*, **35**:243.

By contrast, the photographic meteor tracks began to burn below 130 km [80 miles –*Ed*.]. The perceived problem is why meteors would begin to burn and vaporize while still in a vacuum.

Although the researchers offer no explanation, I can offer one. Television cameras are much more sensitive to the near infrared than is film. For example, one can see the emission of remote control units in the viewfinder of a camcorder. This means that one would see the meteor first in a TV recorder, and have to wait a while longer before it would glow hot enough to be seen visually or on film. As for both terminating at the same height, well, at that point there is nothing left of the meteor except maybe some dust-pieces. These would not fall fast enough to register a different height, nor would they stay hot for very long as their heat will quickly be absorbed by ambient air molecules.

Pulsars may be younger than theory predicts[30]

For several decades the only pulsar — a stellar object left over from a supernova explosion — clearly associated with an observed supernova explosion was the pulsar in the Crab Nebula which exploded in 1054. Several others were suspected, but ran into trouble with their ages and could not be confirmed. Now a second pulsar has been definitely associated with a recorded, well-dated supernova.

Images taken with the Chandra X-Ray Observatory have confirmed 1997 observations with Japan's ASCA satellite that associated a 0.065-second pulsar with the A.D. 386 supernova remnant G11.2-0.3. Chandra showed the pulsar to be located dead center of the remnant.

Prior to this, the age of the pulsar was set at 24,000 years. That is, astronomers thought the explosion happened 24,000 years ago, long before recorded history.

In a 1980 paper,[31] it was noted that:

> Morehouse[32] interpolates the Aquila supernova as having occurred between those associated with the Crab Nebula and the Vela pulsars. The latter has been associated with an apparent supernova reported in an ancient Summerian tablet, reputedly dated

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[30] From the 2001 San Diego meeting of the American Astronomical Society. "Pulsar ages may need refiguring," *Science News*, **159**:56, Jan. 27.

[31] Bouw, G. D., 1980. "On the Star of Bethlehem," ***Creation Research Society Quarterly*, 17**, 174-181, footnote 12. The paper is reproduced starting on page 79 of *The Geocentric Papers*; (see the back cover of this issue for availability), but footnote number 12 was omitted from it as too far afield for that reprint.

[32] Morehouse, A. J., 1978. "The Christmas Star as a supernova in Aquila," *Journal of the Royal Astronomical Society of Canada*, **72**:65-68.

6,000 years old. The Crab Nebula pulsar has a period of 0.033 second; PSR 1913+16b has a period of 0.089 second. If we assume that the three pulsars are similar and correctly identified with their supernovae, and if we assume that t_o is the initial period and r is the slow-down rate, then we can date the Summerian tablet. We find that for 1978:

for the Crab Nebula $t_o + 924\ r = 0.033$
for the Aquila object $t_o + 1981\ r = 0.059$
for the Vela pulsar $t_o + t\ r = 0.089$.

Solving for t we find that the tablet may actually be as recent as 1200 B.C.

Given that the Aquila and Vela pulsars have been divorced from their historic evidence in order to preserve the theoretical decay rates, why is this not done for G11.2-0.3 in Sagittarius? For one, if 24,000 years had really elapsed since the explosion, the pulsar would have wandered far out of the core of the nebula, the "puff of smoke" thrown off by the supernova. The second reason is that a similar age discrepancy was also found for another pulsar. Another team, other than the Chandra group, reported this difference.

The results are said to make true age determination for pulsars more difficult. Nevertheless, the observed pulsar decay rates are themselves variable. Pulsar periods seem, on the whole, to lengthen; but they are also subject to sudden jumps, not just to longer periods, but also to shorter periods. The obvious approach is to use observed associations between pulsars and historical supernovae to check for average rates in much the same way as was done above to revise the age of the Vela pulsar. The Vela pulsar's age could not be reliably determined from the Summerian tablet, and was a theoretical one that satisfied the discoverer of its association with the supernova at the time. It was used to date the tablet, not vice-versa.

Dark matter and the missing mass

In the mid-1990s a team of astronomers reported detecting twinkling stars. Now this hardly seems news since we have all seen stars twinkle at night, but that's not what this group was referring to. They had found stars which flashed due to the focussing of light by matter between us and the star. They proposed that the flashing was caused by concentrations of matter swarming around the visible disk of the Milky Way.

The theory is that as chunks of this matter occasionally passed between stars and telescopes, the star's light will be seen to brighten and dim several times during the passing. (Technically this is due to optical interference.) A couple of years later, the same group caught the start of another sequence and notified other astronomers of its happening. Ten days later telescopes in South Africa, Australia, and Chile captured a flicker of brightness in a star in the Small Magellanic Cloud. The duration of the phenomenon (a total of 40 days after discovery) was not consistent with the lensing object (mass concentration) being in the Milky Way's halo. Instead, it was another star in the Small Magellanic Cloud. This cast doubt on any flashings being due to dark matter, the candidate for the missing mass.

The Lense-Thirring effect measured[33]

The Lense-Thirring effect is a tiny perturbation of the orbit of a satellite which change is caused by the spin of the attracting body. The effect was accurately measured with the use of two laser-ranged satellites, LAGEOS and LAGEOS II. The parameter which measures the Lense-Thirring effect (in earth gravitational model EGM-96) was found to be 1.1 ± 0.2. General Relativity predicts a value of 1.

The result is consistent with the effect derived by the physicists Lense and Thirring in 1916, that, as the authors put it, "the spin of a body changes the geometry of the universe by generating space-time curvature." Geocentrically this confirms the claim made by geocentrists in the past 25 years that a rotating universe will create inside itself a gravitational field which will induce not only Newton's $F = ma$, but also the centrifugal force, Coriolis force, and Euler force.

In other words, though the authors of the paper see this as confirming Einstein, the experiment also confirms the basis for physical geocentricity, *viz.* Mach's principle.

[33] Ciufolini, I., et al. 1998. "Test of General Relativity and measurement of the Lense-Thirring effect with two earth satellites," *Science*, **279**:2100-2103, (27 March).

CREDO

The Biblical Astronomer was founded in 1971 as the Tychonian Society. It is based on the premise that the only absolutely trustworthy information about the origin and purpose of all that exists and happens is given by God, our Creator and Redeemer, in his infallible, preserved word, the Holy Bible commonly called the King James Bible. All scientific endeavor which does not accept this revelation from on high without any reservations, literary, philosophical or whatever, we reject as already condemned in its unfounded first assumptions.

We believe that the creation was completed in six twenty-four hour days and that the world is not older than about six thousand years. We maintain that the Bible teaches us of an earth that neither rotates daily nor revolves yearly about the sun; that it is at rest with respect to the throne of him who called it into existence; and that hence it is absolutely at rest in the universe.

We affirm that no man is righteous and so all are in need of salvation, which is the free gift of God, given by the grace of God, and not to be obtained through any merit or works of our own. We affirm that salvation is available only through faith in the shed blood and finished work of our risen LORD and saviour, Jesus Christ.

Lastly, the reason why we deem a return to a geocentric astronomy a first apologetic necessity is that its rejection at the beginning of our Modern Age constitutes one very important, if not the most important, cause of the historical development of Bible criticism, now resulting in an increasingly anti-Christian world in which atheistic existentialism preaches a life that is really meaningless.

If you agree with the above, please consider becoming a member. Membership dues are $20 per year. Members receive a 20% discount on all items offered for sale by the *Biblical Astronomer*.

To the law and to the testimony: if they speak not according to this word, it is because there is no light in them.

\- Isaiah 8:20

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