

Faith and the Structure of the Universe¹

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Geocentrism: Aristotelian and Jewish

The metaphysical dimension of science

A contemporary work, *New Heavens and a New Earth – The Jewish Reception of Copernican Thought*² wonders why the great revolution in the history of science – from Aristotelian geocentrism (the earth-centred cosmos) to Copernican heliocentrism (the sun-centred planetary system) – has left unmoved many of the luminaries of orthodox Judaism to this day. Great authorities of Judaism from antiquity to the present have held to a geocentric model of the universe, albeit not the same as Aristotle’s version of that model. The geocentric model is the straightforward import of Scripture. It is maintained by the Sages of Talmud and the great medieval authorities (*Rishonim*), and, at their head, Maimonides³. The towering Renaissance Jewish authority, Rabbi Judah Loew, the “Maharal” of Prague explicitly repudiated Copernicanism⁴ and adhered to the traditional geocentric Torah view. Great later authorities, contemporaries of the European Enlightenment – to take an eminent example, Rabbi Schneur Zalman of Liadi – held to the geocentric model⁵. And notably, a great Rabbinical figure of our time, the seventh Lubavitcher Rebbe, Rabbi Menachem Mendel Schneerson, also upheld the geocentric

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² Jeremy Brown, *New Heavens and a New Earth – The Jewish Reception of Copernican Thought* NY: Oxford University Press, 2013.

³ *Hilchos Y’sodei HaTorah*, chapters 3-4.

⁴ *N’siv HaTorah*, Chapter 14.

⁵ *Tanya, Likkutei Amarim*, Chapter 42.

model⁶. All of these are not exceptions to, but much rather exemplars of, the Torah outlook on the structure of the universe, in their respective epochs.

The astonishment expressed seems to be that the Jewish people, a “wise and understanding people”⁷, and particularly their great luminaries, should simply repudiate the findings of “science”. Yet, even from a secular standpoint, embracing the march of worldly science as “objective truth” is philosophically naïve. For there are two criteria for the “objective truth” of a scientific theory: one, the validity of its fundamental (or *metaphysical*) assumptions and two, its empirical and experimental-practical (or *physical*) validation⁸. Let us consider these briefly in turn.

The metaphysics – philosophical or world-view assumptions and implications – of a scientific theory are as significant as the practical power of its physics or empirical science. Science is as much a view of the world, as an instrument which deals with it. Amongst those disturbed by the conflict of the world-view assumptions and implications of science with received religious teachings of ultimate, metaphysical truth, there have been two kinds of problematical responses: a mistaken metaphysical and a mistaken empirical response. The metaphysical response has been to revise or reinterpret received – in the religious case, Scriptural – interpretations to harmonize with the metaphysical frameworks of science. The empirical response has been to discredit the value of the practical science associated with the conflicting scientific world-view. Neither of these responses has been acceptable to

⁶ Rabbi Joseph Ginsburg & Professor Herman Branover *Mind over Matter - Teachings of the Lubavitcher Rebbe, Rabbi Menachem Mendel Schneerson on Science, Technology and Medicine* (transl. A. Gofryd), Shamir, 2003, pp. 75-77.

⁷ Deuteronomy 4:6.

⁸ See S. D. Cowen, *Torah and the Natural Sciences*, Melbourne: Institute for Judaism and Civilization, 2018.

mainstream orthodox Torah Judaism, certainly to the great authorities, who over the millennia have held to geocentrism. We shall deal here first with the metaphysical response and in the next sub-section with the empirical response, in the specific context of the science of the structure of the universe.

Scripture and its commentary – the “written” and the “oral” law – which were *both* given by G-d through Moses at Mt Sinai, as Maimonides writes in the Introduction to his *Mishneh Torah* – affirm a geocentric model of the universe. The oral Torah, as a living tradition, affirms it in all its stages, by leading Sages, as we have noted – from the Talmud to the present. The Torah is the source not only of objective ethics, what *ought to be* – symbolized by the Ten Commandments. It is also the source of all true metaphysics: it teaches us *what ultimately it is* – symbolized in the Ten Utterances at the beginning of Genesis – that G-d created.

Since Torah is the validator of objectively true metaphysical (as well as ethical) frameworks, it follows that for science to be fully true, it would have to be metaphysically meaningful and valid from a Torah standpoint, in addition to being effective and experimentally validated (or experimentally uncontradicted) science. Since most worldly physical science has historically not fully met that metaphysical criterion of truth, Torah has always taken up a critical distance to the worldly science of the day, *even though it mandates the practical use of it, as we shall presently discuss*. The metaphysical critique of science, from the standpoint of Torah, applies, of course, *also* to the great scientific system of secular antiquity, which most resembles the Torah model of the universe, namely the Aristotelian version of the geocentric cosmos.

In the classical Torah view of the cosmos we find that the physical universe is an analogy of its inner, metaphysical structure. Whether, as explained by Maimonides (in the “Laws

of the Foundations of the Torah”) or Rabbeinu Bachya⁹, the physical cosmos has a spiritually significant design and meaning. The non-physical parts of creation, which “precede” the physical parts, in a non-spatio-temporal sense but rather a causative and transmissional sense, are spiritual “worlds”, over all of which and the physical universe G-d Himself metaphorically “rides”. The spiritual “world” of the angels, which serve as vehicles for the operation of the Divine attributes, precedes and leads to the first stage of the physical universe, namely the Heavenly spheres. In Torah, these are called the *galgalim* – “wheels” or “spheres” – in which are embedded the celestial bodies, the planets and stars. Their motion is spherical (appearing elliptical and sometimes displaying other ostensible irregularities because of their various epicentres and epicycles). Their individual motions take place “upon” or “within” the comprehensive ninth sphere, called the diurnal sphere (*galgal hayomi*), which makes a complete orbit around the earth at its centre, in 24 hours. This motion, in its unceasing continuity, appeared to Abraham as evidence of a transcendent G-d, who provided this constant motion and thereby sustainment of the entire physical creation¹⁰. In other words, even though the Divine influence is “immanently” transmitted “downwards” through the sun, the moon and a host of other heavenly bodies, and finally the “elements” of the terrestrial realm, the entire cosmos, with all its details is held and maintained in constant renewal by a transcendental G-dly power.

The mystical Torah doctrine of Kabbalah and Chassidic thought calls the entire chain of Divine influence through the structure of creation “the order of descent” – *seder his'talsbalus* – through levels, spiritual and physical, to “this world”, the

⁹ Commentary on Exodus 25:9.

¹⁰ Maimonides, *Hilchos Avoidas Cochovim* 1:3.

earth. It is the architecture both of the immanent and transcendent enlivenment of creation.

Metaphysically, the Copernican system dismantled the spiritual meaning and analogical significance of the geocentric universe. It destroyed the qualitative distinction between what the Heavenly and terrestrial realms stand for, overrunning their boundaries with a materially homogeneous, (and with Newton, infinite) spatio-temporal continuum. It removed the uniqueness of the earth, as centre and goal of creation¹¹. With the perfection of the Copernican model though the work of Isaac Newton, two new concepts were fully established – inertial motion and universal gravitation – to supply the mechanics for the new heliocentric system. What these terms, which came to replace the Divine metaphysics of creation, actually mean, has received little metaphysical reflection. This essay seeks to show how these corrupted the spiritual metaphysics of the Torah geocentric universe. Without disputing the practical and experimental power of the new science, the clash between the geocentric and the heliocentric systems was – acknowledged or not – a *metaphysical* clash.

The empirical dimension of science

As noted, from a Torah standpoint, science also requires validation, or at least non-contradiction, by empirical data and experiment. In the contemporary epoch of Torah scholarship, the Lubavitcher Rebbe, Rabbi Menachem Mendel Schneerson, apart from being a Torah giant, was also an academically trained and qualified scientist. On Torah grounds, he affirmed the geocentric model of the universe and as a scientist explained that it is *not refuted* by empirical science. On the basis

¹¹ “Copernicanism...destroyed the earth’s uniqueness, abolished the terrestrial-celestial distinction and suggested the infinity of the universe” *The Copernican Revolution - Planetary Astronomy in the Development of Western Thought*, Cambridge: Harvard University Press, 1957, p. 237.

of relativity, he pointed out, one cannot prove what moves: whether the earth is stationary and the heavens (including the sun) move (as the geocentric model states) or that the earth both spins and orbits the sun. There is accordingly no conflict of “scientific evidence” with the verses of Torah and the oral Torah’s explanations of those verses, which set forth the geocentric model. It is simply a matter of alternative assumptions and perspectives, each of which can be used to explain the same empirical observations¹².

It is not only the Lubavitcher Rebbe, who, on the basis of physical relativity, has made this point, but also, from a different philosophical and historical standpoint, one of the greatest modern secular historians and philosophers of science, Thomas S. Kuhn. Kuhn, famous primarily for his book, *The Structure of Scientific Revolutions*, explained that empirical scientific research *proceeds* on the basis of an ultimately accepted and believed “paradigm”, a conceptual framework, out of which the “evidence” is interpreted and explanatory laws are found. Opposing paradigms can empirically equally “work”. As important as the empirical explanatory and predictive power of a paradigm, is the fact of its *historical acceptance* as a scientific world-view. Thus, in his magisterial work, *The Copernican Revolution*, Kuhn writes, comparing the Copernican and Ptolemaic (geocentric) scientific models,

Judged on purely practical grounds, Copernicus’ new planetary system was a failure; it was neither more accurate nor significantly simpler than its Ptolemaic predecessors. But historically the new system was a great success...¹³

¹² See also Hans Reichenbach, *The Philosophy of Space and Time* (to which Rabbi Schneerson refers), which also sets out the relativity of the Ptolemaic and Copernican systems, of which an extract is found in an appendix of *Mind over Matter*.

¹³ *The Copernican Revolution*, p. 171.

In other words, the replacement of the geocentric by the heliocentric model has to do with an historical and metaphysical – an ideological and world-view-centred – “paradigm shift”. The “Copernican revolution” is for Kuhn a primary exemplar of the thesis of the *Structure of Scientific Revolutions*, that science works out of an historically *dominant* paradigm, that can change, and that empirical science can proceed from opposed or relative paradigms.

Whilst Torah requires metaphysical truth to certify science as objectively true, a scientific doctrine which is metaphysically *untrue* – by the criteria the Torah – is not for that reason shunned or wholly discredited by Torah. To the contrary, as noted, Torah itself mandates the use of practical, applied science, especially where it is empirically powerful, for valid ethical purposes. There is, moreover, a reason why a science, which metaphysically is not wholly true, can and does work. This is because, as explained by the mystical Torah tradition, there is an endemic mixture of truth and falsehood in the creation – including in intellectual culture and science itself – as a result of the mystical cosmic phenomenon known as the “breaking of the vessels”¹⁴. By contrast with Torah – the *chochma p’nimis* (the “inner wisdom”), which is entirely true – worldly secular science is a *chochma chitzonis* (“external wisdom”), a mixture of truth and falsehood, which through its element of truth may nevertheless be endowed with high practical efficacy. As such, the utilization of scientific theories pragmatically for ethically valid ends is necessarily instrumental to the refinement of the world. Torah itself, however, is not

¹⁴ *Tanya, Likkutei Amarim*, Chapter 8. See discussion of the present point in S. D. Cowen, “The Torah and the Worldly Sciences” in M. Seidler (Ed.), *Rabbinic Theology and Jewish Intellectual History. The Great Rabbi Lowe of Prague*, Oxford: Routledge, 2013.

concerned with the *production* of empirical science¹⁵; its domain is that of *metaphysical* truth, which provides the ultimate criterion for the metaphysical truth of the sciences; and also of *ethical* truth, in the direction of human conduct.

Stages of the critique of Geocentrism

In the history of western science, there occurred by stages the “overthrow” of Aristotelian geocentrism. It is popularly assumed that the Aristotelian geocentric model of the universe reigned unaltered through the Middle Ages until the Renaissance when figures such Kepler, Galileo and, above all, Copernicus replaced it with a heliocentric model of the planetary system. It was, however, the achievement of the French philosopher and historian of science, Pierre Duhem¹⁶, to have demonstrated that in the Middle Ages, scholastic medieval science in fact accomplished key transitions from, and modifications of, the Aristotelian science of the universe, and furnished foundations for the subsequent Copernican “transformation”. Duhem’s work was continued in recent times by Stanley Jaki and later students, Stacey Trasancos and others. Kuhn in his *The Copernican Revolution* also absorbed this important observation of Duhem.¹⁷

Aristotle’s universe was a bounded universe, which consists of two different kinds of matter: that of the Heavenly spheres with their planets and stars in their circular motion round the earth; and the matter of the earth, composed of the four elements or foundations – fire, air, water and earth – with their

¹⁵ Though see “Torah and the Worldly Sciences” in *Torah and the Natural Sciences*, pp. 169-170.

¹⁶ See J. A. Schuster, “Pierre Duhem’s History and Philosophy of Science in Contemporary Perspective”, *Journal of Judaism and Civilization*, Vol. 12.

¹⁷ “The great new scientific theories the sixteenth and seventeenth centuries all originate from rents torn by scholastic criticism in the fabric of Aristotelian thought”, *The Copernican Revolution*, p. 122.

characteristic rectilinear (“up and down”) motion. The Aristotelian universe also contained its own immanent, internal “Prime Mover”.

We can distinguish four stages, starting with Aristotle himself, through which western science moved from complete acceptance, to the complete overthrow, of the geocentric universe. The stages of the critique and overthrow of the Aristotelian universe, which we elaborate in this essay, start *first*, in the Middle Ages with the critique of the Aristotelian physics of non-rectilinear motion – the circular motion of the spheres and the “violent” motion of a projectile on earth, preventing it (until the projecting force is spent) from falling rectilinearly to its natural rest. Each, according to Aristotle, is due to immanent, repetitive “pushing” forces. The medieval Scholastics replaced this with a concept of “impetus”, as a potentially unending (non-finite or *infinite*) force – a forerunner of the Newtonian concept of inertial motion – applicable both to the celestial and terrestrial domains. There is another related concept of the “infinite”, introduced by the Scholastics, namely the concept of *infinite* space, which the Aristotelian theory would not allow. Both of these – impetus and infinite space – are concepts preparatory for the Copernican revolution.

The next stage was the Copernican revolution itself. Whilst the scholastic developments (as we shall explain) *naturalised* “infinite” concepts – drawn initially from the “heavenly” realm – and applied them equally to the terrestrial and celestial realms, they left these realms in their serried order, with the earth at the centre of the universe. The cosmos retained the form of an overall descent from the heavenly spheres to the earth, a nominal geocentrism. Copernicus, Galileo and their cohorts knocked out this hierarchical structure which kept the Heavens above and prior to the earth. Relying (as Kuhn argues) on the concept of impetus or inertial motion, they

used these to set the earth in dual motion – on its axis and in orbit around the sun – in what was tending to become an infinite universe. Heavens and earth were joined and equalized in the one plane.

In a fourth and final stage, it was Newton who, by replacing Aristotle's theory of terrestrial rectilinear motion – which Galileo had already weakened – with universal gravitation, completed the full theoretical infrastructure of the Copernican, heliocentric model. Newton's theory of universal gravitation applies to all matter, terrestrial or celestial, and completed the paradigm reversal of the relationship of the earth and the sun. His theory of planetary motion, and of the heliocentric system in particular, comes about through the melding of the concepts of inertial motion and universal gravitation.

Judaism, as we have noted, never abandoned the geocentric model of the universe, because of its metaphysical truth, as taught by Scripture and the tradition of the Oral law; and also because it was not empirically disproved. Indeed, Jewish tradition, through its luminaries, furnished an historical critique (sometimes explicit and sometimes implicit) of Aristotelian geocentrism. This emerges progressively and in parallel with, though distinct from, the critique of Aristotelian geocentrism by Western science through the epochs.

In the following sections we seek to bring out the progressive critique by Western science of Aristotelian geocentrism, which lead to its overthrow, *alongside* the progressive critique of Aristotelian geocentrism in Torah thought, which clarifies *Torah* geocentrism as a metaphysical paradigm. Thus, in the Middle Ages, a group of great Jewish thinkers explicitly reject, as had (at least implicitly) Scripture and the Rabbinical tradition before them, the exclusively immanent deity and finite dynamics of the Aristotelian

cosmos.¹⁸ Maimonides, Rabbi Chasdai Crescas and Gersonides elaborate, within Torah geocentrism, the significance of the *transcendent* dimension of G-dliness, not found in Aristotelian geocentrism. This contrasts with the work of their contemporaries, the Scholastics, Jean Buridan and Nicole Oresme, who naturalized “infinite” concepts associated with transcendent Deity into scientific concepts of “impetus” (inertial motion) and infinite space. In the Renaissance, the work of Copernicus and Galileo, in “joining” (homogenizing) “infinite” Heavens with the earth, is paralleled by, though crucially distinguished from, the writing of the Maharal of Prague. The Maharal, within the geocentric model, shows how the infinite dimension of transcendent G-dliness and the finite dimension of immanent G-dliness (nature) “sit” paradoxically together in ways that do not compromise (homogenize) the integrity of either – unlike the Copernican homogenization of Heavens and earth. Finally, in the Enlightenment it was Newton, who finally integrated Heavens and earth, through the melding of inertial motion and universal gravitation to produce a uniformly mechanized universe. By contrast, Rabbi Schneur Zalman of Liadi shows how the transcendent and immanent G-dly powers in the cosmos are actually integrated within the Torah’s *geocentric* view. These are bare “thumbnail” descriptions – to be elaborated in following sections – of the epochal developments, whereby the metaphysics of geocentrism were overthrown, on the one hand, by general thought; and, on the other, preserved and clarified by Torah thought.

¹⁸ See S. Cowen, “Jewish Tradition and Classical Philosophy on G-d and Nature”.

The medieval critique of Aristotelian geocentrism: the Scholastics and Torah *Rishonim*

The rigorous immanence of Aristotelian geocentrism

The Aristotelian geocentric universe differs fundamentally from the Jewish geocentrism in that it represents a wholly “immanent” universe, that is, one governed entirely by an indwelling deity and finite driving forces. There was, for Aristotle, no transcendent G-d *outside* the system of the universe, which either brought it into being from, or sustained it from reverting to, nothingness. He postulated a “Prime Mover”, and a group of associated spirits, which drove the Heavenly spheres, but this was a concept of deity that existed wholly *within* the creation.

Aristotle’s universe, as we have noted, contained two distinct realms, Heavens and earth. A different kind of motion was typical of each: the stable circular movement of the Heavens and the rectilinear movement (up and down) of material objects on Earth. Yet both were immanently and finitely driven. The motion of the spheres, and with them the planets and stars, for Aristotle, was due to the reiterated “pushing” of the Prime Mover and of lesser spirits *within* the spheres. On earth, the motion of a projected (thrown) object was also explained through a reiterated pushing force, as the object continued in its course, known as “*antiperistasis*”, as explained below. But what both the motions of the Aristotelian Heavens and the earthly projectile have in common is that an reiterated application of an internal and ultimately finite force from was required to keep them going. This is as opposed to the concept of a non-finite, non-ending (in this sense, “transcending”) force which would explain the continuity of motion of the Heavenly spheres or the earthly projectile.

Nor would Aristotle adduce anything transcendent from the durability of the Heavenly spheres and bodies in contrast to

the process of generation and decay of formed entities on earth. Rather, the durability of the Heavens was due solely to the absence of contrariety¹⁹ in the distinct material of the Heavenly Spheres, as distinct from the materiality of the earth, with its decomposing and recomposing mixtures of its four elements.

The circularity of the movement of the Aristotelian Heavens – the fact that they did not fall – was attributable to their weightlessness. Moreover, circularity was characteristic of the Heavens because the Heavens were more perfect, and furthermore, in the words of M. K. Munitz, “[s]ince...the circular is considered is considered perfect, whereas the straight line [rectilinearity, typical of natural motion in the terrestrial sphere] is not, it will be naturally prior to the others”²⁰. The circular motion is peculiar to the refined substance – not the expression of an infinite or transcendent aspect of the motion – of the spheres.

Not only was the Aristotelian universe finite, Aristotle’s very concept of space was strongly wedded to his immanentist philosophy. Space is not infinite and cannot be, he argued, since a sphere with an infinite radius cannot complete as revolution in finite time. He saw, moreover, space not as the abstract coordinate system – a vacant space with abstractly extending axes – but rather as the “surface”, so to speak, of materiality, as inseparable from the finite dimensionality of objects which fill it. Space is not the external envelope but the surface of its contents. Munitz further summarizes the Aristotelian universe:

...in opposition to the doctrine of the plurality of worlds...Aristotle insists there is but one universe, i.e., one planetary system and outermost shell of fixed stars, and

¹⁹ “...contrariety does not obtain for ethereal bodies.” Milton K. Munitz, *Space, Time and Creation*, NY: Collier Books, 1961, p. 23.

²⁰ *Ibid.*, p. 23.

that this entire system contains all existent material bodies. To suppose otherwise would be to contradict the theory of matter and motion assumed, since bodies, for example, that naturally move downward to a given centre could not consistently and simultaneously move there if there were more than one centre, as would be the case if there were more than one world. A corollary of the fact that there is but one world and there is no body beyond its confines is that ‘there is also no place or void or time outside the heaven’ since all of these are connected with the existence of body. The spherical shape of the universe is established on several grounds, among them the fact that only this shape permits rotation in one place since there is no space or void outside the heavens²¹.

In other words, there is nothing at all – neither physical or spiritual – beyond the boundaries of the Aristotelian geocentric universe. Time is measured by, and a function of, the motion of its parts and space, as noted, is the surface of its parts. It has an exclusively immanent and finite logic: nothing transcends the system nor does anything “transcendental” intrude into its makeup or movement. It is to the exclusive immanence and finitude of the Aristotelian geocentric universe, that the medieval Scholastics and Jewish thought responded – though quite differently.

The Scholastics: transcendence naturalized

The work of Jean Buridan, a scientist in the culture of medieval Christendom, on the concept of “impetus” has been hailed by Stanley Jaki, writing in the tradition of Pierre Duhem, as the “most important ever penned in Western

²¹ *Ibid.*, p. 24.

intellectual history as far as science is concerned.”²² As a forerunner of the concept of inertial motion, it established a basic foundation for the Copernican (and Newtonian) scientific revolution. It came about as a critique of the Aristotelian concept of the cause of the continued motion of projectiles, mentioned above – *antiperistasis* – which is explained by Stacey Trasancos as follows:

Once the mover (the hand, for instance) throws the object and the object is no longer in contact with the mover, the air that resists the object (*anti*) is divided by the object and surrounds it (*peri*). By doing so, the air fills the vacuum in the wake thereby impelling it along (*stasis*).²³

Buridan rejected Aristotle’s concept of *antiperistasis* as a co-propellent of motion and instead propounded a concept of “impetus”, which, as mentioned, is the prototype of the Newtonian concept of inertial motion. It stipulated that a projected (propelled) body has within it an impetus, which tends to keep it in motion, until and as this is attenuated through resistance or drawn downwards towards the earth. “Impetus” accounted, in Buridan’s view also (and perhaps initially and primarily) for the constant circular movement of the Heavens – in contradistinction to the continually renewed pushing of Aristotle’s immanent deity. Trasancos quotes Buridan:

G-d, when He created the world, moved each of the celestial bodies as He pleased, and in moving them He impressed in them impetuses which moved them without His having to move them any more... And these impetuses which He impressed in the celestial bodies were not decreased nor corrupted afterwards, because there was no

²² *A Late Awakening*, Port Huron, MI: Real View Books, 2004, p. 49, quoted by Stacey Trasancos, *Science Was Born of Christianity. The Teaching of Fr Stanley L. Jaki*, The Habitation of Chimham Publishing, 2014, p. 159.

²³ Trasancos, *ibid.*, p. 151.

inclination of the celestial bodies for other movements. Nor was there resistance which would be corruptive or repressive of that *impetus*²⁴.

Buridan was writing from the standpoint of medieval Christendom and especially of the “Condemnations” (of propositions of Aristotle deemed irreconcilable with Christianity) by the Bishop of Paris in 1277 which asserted the transcendent Creator G-d of Christendom over the pantheistic, exclusively immanent character of the Aristotelian universe. Yet, Buridan had taken a Divine power, which was “infinite”, the characteristic of a transcendent Creator, and at the very same time installed – or hypostatized – it as a power *of and in* nature. G-d had, so to speak, “withdrawn” from it, leaving it as a feature of nature, which bears His “infinite” character. This was a decisive move against the purely finite and inwardly driven universe of Aristotle, but it sought to install, naturalize, something “infinite” *within* finite nature.

Contrary to the Aristotelian concept of space, Buridan’s student, Nicole Oresme, similarly sought to import an “infinite” characteristic into the physical universe. In contradistinction to Aristotle’s concept of space as the finite, outer surface of things – not an independent, infinite spatio-temporal continuum independent of its contents – Oresme determined that the

...nature of place is that beyond the world, that is, outside the last sphere, there exists an infinite void space...Oresme also speaks of the immensity which is outside the heavens and identifies this immensity – by which he undoubtedly means the extracosmic void space – with G-d Himself²⁵

²⁴ *Ibid.*, p. 156, quoting Buridan, *Super octo libros physicorum Aristotelis subtilissimae quaestiones*, paragraph 6.

²⁵ Online *Stanford International Encyclopedia of Philosophy*, “Nicole Oresme”, Section 2.2.

Similarly, and in contradistinction to Aristotle he did not connect time with the motion of physical bodies. Rather, "...the duration of things without any succession is eternity...[Indeed,] Oresme identifies eternity with G-d Himself."²⁶ Oresme repudiated Aristotelian finitude. Instead, he took the non-finite characteristic of a transcendent Creator, the Maker of the Universe, and sought to manifest it as "real" spatio-temporal infinity. For Aristotle there was no "real" infinity in nature – continuous progression does not get us beyond the finite. For Oresme there was, and he characterized it as a feature of *physical* reality. This was also a foundation for what Kuhn has called the "infinite space of the Newtonian world-machine"²⁷. Like Buridan's infinite "impetus", it was transcendence hypostatized in nature.

The *Rishonim*: transcendence non-naturalized

The Jewish contemporaries of the Scholastics, the great medieval Torah authorities known as the "*Rishonim*" (the "first" authorities), also mounted a critique against Aristotle from the standpoint of Divine transcendence., but their conclusions are philosophically opposed to the Scholastics.

In the Torah model of the geocentric universe, set out by Maimonides, the great, comprehensive sphere (which revolves once in 24 hours – the diurnal sphere, or *galgal hayom*), to speak in two-dimensional terms, is like the great turn-table, upon which all the other spheres and heavenly bodies track with their own movements. The *Tzemach Tzedek* put it in his *Sefer HaChikira*, that the latter are like a person walking on a travelling ship: the ship moves the person, as he or she walks independently on deck. Thus, the (sphere of the) sun advances on its track (orbit) at about one degree each day, but its entire

²⁶ *Ibid.*, Section 2.3.

²⁷ *The Copernican Revolution*, p. 131.

orbit is itself turned 360 degrees every day by the ninth, daily (“diurnal”) sphere. But what drives the *galgal hayomi* is a transcendent G-dly power *outside* it.

The infinite, transcendent power which drives (the ninth, and so, also the other) spheres also enables their influence to reach the earth, as we see simply that the physical earth depends on the sun and the moon (together with a host of other influences) and their movements are largely effected by the encompassing sphere. As Maimonides writes:

The change [arising in physical matter through the dynamics of the four foundations – elements of terrestrial matter –] is caused by the rotation of the [daily] sphere [together with the subsidiary spheres, which it carries]. *Through its rotation* the four foundations are [dynamically] connected and from them the matter constituting humans, animals and mineral or metals comes about. And it is G-d who gives each matter its appropriate [spiritual] form through the angel, tenth in rank [from the realm of angels], which is the spiritual entity called “*Tshim*”.²⁸

In other words, all the immanent workings of the universe depend ultimately upon a transcendental Divine power, which maintains the continuity of the “process”, just as it once brought the entire structure of creation into being from nothingness for the first time. This constant enlivenment and renewal from a transcendent “without” is epitomised in the rotation of the diurnal sphere. Moreover, it is by the transcendent Divine will, the Heavenly bodies *endure* as individuals; and on earth transient phenomena are maintained through the power of generation, as species. So too, G-d can also will the spheres to stop or change their movements²⁹. Every immanent act is transcendently enabled.

²⁸ *Mishneh Torah, Hilchos Y'sodei HaTorah* 4:6.

²⁹ “We, however, hold that all things in the Universe are the result of design and not merely of necessity; He who designed them may change

In relation to the Divine transcendent power, the Jewish critics of Aristotle, maintained, unlike their Scholastic counterparts, that this infinite power *cannot* be invested (“impressed”) in a finite body; it cannot become a property of nature *per se*. According to this, we must say, the concept of “impetus” is *metaphysically* invalid. For, as stated, an *infinite* power of continuity such as impetus or inertial motion was meant to represent – that proceeded from a transcendent (“infinite”) Creator (as Buridan said) – cannot be invested (contrary to Buridan’s claim) in *finite* natural phenomena themselves³⁰. Rabbi Levi ben Gershon (Gersonides), known by the acronym of his name RaLBaG, in his work *Wars of the L-rd* (*Milchamos HaShem*), thus sets forth concepts which contradict the metaphysical foundation of his contemporary Buridan’s notion of “impetus”. Thus, he writes in Chapters 11 and 12 of Part 1 of Book 6 of *Wars of the L-rd* that anything which has the property of quantity is inherently limited. One can go on counting indefinitely, but the fact that it is countable means that it is inherently finite. This applies to time, space, matter and motion. Specifically, he writes in Chapter 12 that the motion of the spheres, inasmuch as they are physical, cannot possess an *intrinsic* unending power of continuous motion. For the orbits are countable and express a material relationship, and what is numerable can never be infinite, as he there writes that although one can go on adding indefinitely, from this arises no actual infinity. So too, we must say, accordingly, that there is no power within them, which could

them when He changes His design”. Maimonides, *Guide for the Perplexed*, NY: Dover, 1956 (first published 1904) transl. M Friedländer, p. 184

³⁰ Cf Maimonides, “Laws of the Foundations of the Torah” 1:5: It is G-d “Who is the driver of the [diurnal] sphere, [constantly throughout time] with a power that is infinite and no knows no abatement. For the sphere turns constantly, and it is impossible that it should turn without something that turns it. It is He, be He blessed, Who turns it without hand of body”.

drive them forever, presenting itself as “impetus” (later to be known as “inertial motion”). Their constancy of motion is the action of the transcendent G-d – Who, from “without” renews and continues it, by His will, as long as He wills to do so.

Similarly, whilst Jewish medieval thought would attack the exclusive immanentism of Aristotelian geocentrism and make extensive critique of Aristotle, it did not come to Oresme conclusions. Oresme sought to manifest a transcendent, infinite Creator by making the universe infinite, to the point where he identifies a “real infinity” of space and time with the Creator Himself – something excluded and wholly impossible from a Torah point of view. The Jewish medieval philosopher Rabbi Chasdai Crescas in his work *Light of the L-rd (Or HaShem)*, also mounts an attack on Aristotle’s wholly immanent and finite metaphysics of nature, which is without a transcendent Creator. But when it comes to saying what “positively” manifests an “infinite” G-d in the physical universe, in terms of “time” and “space”, he did not install “real” infinities into the physical time and space. Rather, with regard to time, he speaks of a kind of duration “prior” to the created physical universe (where time is marked by physical movement) by referring to that which the Rabbis called a wholly different “order of times” (*sefer haʿzmanim*), “prior” to the creation of physical times³¹. When he speaks in positive terms³² of that which lies in “spatial” terms beyond the

³¹ See *Or HaShem*, Book 1, Proposition 15; Book 4, Issue 1, Issue 2. The concept of an “order of times” preceding creation is explained in Chassidic Torah philosophy by the *Tzemaḥ Tzedek* in *Derech Mitzvosecho* (NY: Kehos) in the section *Mitzvas Amanas Elokus*, Chapter 12. In general, R. Crescas rejects Aristotle’s association of time with motion and associates with a concept of “duration”, which is extended to the extra-physical “order of times”.

³² As distinct from his refutations of Aristotle, on Aristotle’s own terms.

creation, instead of referring to this as an infinitely extended physical “void” or space, he speaks of “worlds”, again in a mystical sense of *non*-physical worlds³³.

So also, Rabbi Chasdai Crescas invokes the statement of the Jewish Sages, that “G-d is the place of the world”. This he explains to mean:

...just as the dimensions of empty space enter those of a body and fill it, so does the glory of G-d enter all the parts of the world...That is, even if He is holy and set apart...His glory fills all of the earth...³⁴

The transcendent G-d is above both physical time and space and His “transcendence” and “infinitude” cannot be assimilated to physical nature. Nevertheless, G-d is present to the Creation as the transcendent, enlivening fount of its possibility and existence. This is His “glory”.

³³ See the statement of *Derech Mitzvosecho, Mitzvas Amanas Elokus*, Chapter 11 that beyond the physical universe, that is, beyond the ninth sphere (*galgal hayomi*), there is no concept of physical space, according to *all* the Jewish philosophers. R Crescas, having refuted Aristotle’s negation of the existence of worlds outside the known (Aristotelian) cosmos, in terms of Aristotle’s own reasoning, refrains from giving any physical characterization of what possible worlds might be. He concludes on this subject, “Inasmuch as the existence of many worlds is a possibility true and unimpeachable, yet as we are unable by means of mere speculation to ascertain the true nature of what is outside this world, our Sages, peace be upon them, have seen fit to warn against searching and inquiring into ‘what is above and what is below, what is before and what is behind’ [Talmud Tractate *Chagigah* 11b].” *Light of the L-rd*, Book 1, Part 2, Proposition 1, Speculation 4 in the translation of H. A. Wolfson, *Crescas’ Critique of Aristotle*, Cambridge: Harvard University Press, 1929/1971, p. 217.

³⁴ *Light of the L-rd.*, Book 1, Part 2. Translation of Roslyn Weis, *Light of the L-rd*, NY: Oxford University Press, 2018, p. 77.

The Renaissance and geocentrism: Copernicus, Galileo – and the Maharal of Prague

Copernicus and Galileo

The Scholastics had introduced highly significant conceptual changes into the geocentric model of the universe, but they had not overturned it. The Heavens still preceded and revolved around the earth. It was the work of Copernicus and Galileo, who eliminated the qualitative, material distinction of Heavens and earth, and homogenized them in the one plane.

The removal of a Divine template and purpose in the structure of the universe – which proceeded from purely spiritual realms (a G-dly and then an angelic realm) to the successive stages of the physical universe (first, the more spiritual, but yet physical, realm of the Heavens and then the earth) – to a uniform, material universe sat with the secular humanist metaphysic of the Renaissance.

So did a mathematical aesthetic of harmony and simplicity. The Ptolemaic system, which was the mathematical astronomy that clothed Aristotelian geocentrism, had a degree of complexity, which disturbed the intellectual aesthetic of the human mind, made central by the Renaissance. The task, which Copernicus set himself in his work *De Revolutionibus* – setting philosophical and theological issues aside – was to reduce the complexity of the albeit functioning Ptolemaic astronomy to a more harmonious mathematical model which happened when one took the sun as its centre, even though, as we have quoted Kuhn's words, it had "no greater power of prediction than that of the Ptolemaic system".

It was the appeal of the new *paradigm* that gave it hegemony over the theologically meaningful medieval paradigm of the

geocentric universe, even though its science had not yet been worked out³⁵. Kuhn writes:

Copernicus in the sixteenth century provided only a new mathematical description of the way the planets move; he was not successful in explaining *why* the planets moved as he said they did. Initially his mathematical astronomy *made no physical sense*, and it posed new sorts of problem for his successors. Those problems were only resolved by Newton, whose dynamics supplied the missing keystone to Copernicus' mathematical system.³⁶

Indeed, the great Renaissance figure Francis Bacon expressed his scepticism about Copernicus as “a man who thinks nothing of introducing fictions of any kind into nature, provided his calculations turn out well”.³⁷

As mentioned, the naturalization and physical hypostatization of “infinite” concepts, originally deriving from the theology of a transcendent Creator, had already been accomplished by the Scholastics in Buridan's notion of “impetus” (inertial motion) and Oresme's infinite universe. These thinkers were still, however, metaphysically committed to the theologically anchored two-staged (Heavens and earth) geocentric paradigm of the physical universe. Copernicus and

³⁵ A mistake, which has been significantly corrected by Kuhn's work, is to portray medieval science as mere *deduction* from a metaphysical (Aristotelian) system; whilst modern science which began with the Renaissance is held to be purely empirical and *inductive*. In fact, both have a metaphysical framework (a paradigm) and both sought scientifically to explain the phenomena (by means of empirical scientific laws).

³⁶ *The Copernican Revolution*, p. 121. Emphases added.

³⁷ Quoted in E. R. Hull, *Galileo: and His Condemnation*, London: Catholic Truth Society, 1913, p. 88. Kuhn speaks of Copernicus' “eye so absorbed with geometrical harmony that he could adhere to his heresy for its harmony alone.” *The Copernican Revolution*, p. 183.

Galileo, who had no such commitment, would now deploy these concepts to dismantle it and instead construct a homogenous, one-stage universe.

Thus, with Buridan's concept of "impetus" (inertial motion) the Renaissance scientists could set up a whole new system of orbits and revolutions without the earth at their centre. It could also be used to put the earth itself in dual motion – around its axis and around the sun. Indeed, Oresme had already opined, without definitively affirming it, that the earth *could* spin in its position at the centre of the Universe – and did so on the basis of the theory of impetus. Kuhn writes:

Oresme's refutation of Aristotle's central argument for the earth's immobility [i.e., that it does not turn] takes the impetus theory, or something quite like it, for granted. On the Aristotelian theory of motion, a vertically thrown stone must move along a radius fixed in space. If the earth moves while the stone is in the air, the stone (or arrow) cannot accompany it and will therefore not return to its point of departure. But if the earth's eastward motion endows the stone with an eastward impetus while the stone is still in contact with the projector, that impetus will endure and will cause the stone to pursue the moving earth even after contact is broken. The impetus theory enables the moving earth to endow terrestrial bodies with an internal propellant, and that propellant enables them to follow the earth afterward. Like his master Buridan, Oresme believed in the impetus theory, and though his refutation of Aristotle does not mention the theory explicitly, the refutation makes no sense without it. In one way or another the impetus theory is implicated in most of the arguments, both medieval and Renaissance, that make it

possible to move the earth without leaving terrestrial bodies behind.³⁸

Freed from the geocentric paradigm's qualitative distinction of Heaven and earth, Copernicus and Galileo universalized impetus theory, making it possible to “conceive the heavens as a terrestrial mechanism, a piece of clockwork.”³⁹

In the geocentric model, as set forth in Torah, the stars populate the eighth sphere. Although great, their number is finite, as is the universe.⁴⁰ The stars were remote but were not held to be incomparably vastly so. One of the most important consequences of Copernicus' reversal of perspective on the centre of the planetary system was a massive resizing of the universe: a stride towards (what we have quoted Kuhn as calling) the “infinite space of the Newtonian world-machine”. This came about through the phenomenon of “stellar parallax” occasioned through the wide orbit of the earth around the sun, posited by Copernicus.

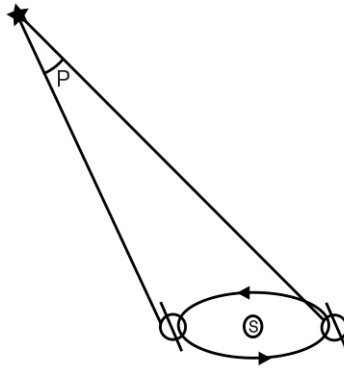


Diagram has been modified from the one which appears in Kuhn, *The Copernican Revolution*, p. 162

³⁸ *The Copernican Revolution*, p. 120.

³⁹ *Ibid.*, pp. 120-21.

⁴⁰ See Rashi on Genesis, 15:5, Psalms 147:4, *Tanya (Igros Kodesh)*, chapter 27, See footnote with sources from Rabbi M. M. Schneerson there in *Shivrim baSefer HaTanya*). Maimonides, *Laws of the Foundations of the Torah* 3:8.

According to the geocentric (and Torah) perspective a person on earth contemplates a particular, individual star in its position in the night sky at almost exactly the same angle from his or her standpoint each night of the year. The same is, of course, empirically so, with the heliocentric planetary system. The problem for the latter is that the diameter of the earth's "orbit" around the sun is about 300 million kilometres. Hence, for a person to see a particular star at almost the same angle in the sky, but from either end of that 300 million kilometre diameter (or that the angle subtended by the two ends of the diameter of the earth's "orbit" and the star come down to almost zero degrees) the star's distance has to be massively remote from the earth (something not required by the geocentric model). This would later express itself in the concept of "light years", a notion "smacking" of infinity, in a universe which Newton called actually infinite. Lost in this seeming "infinitude", the earth's uniqueness and former theological significance as centre and goal of the created universe was further relativized.

Galileo was not the originator, but a champion, of the heliocentric model of the planetary system. With his telescope he purported to have the empirical instrument which would validate the new paradigm. The mountains which he saw on the moon, and other phenomena, and the "proofs" which Galileo sort to bring from other observations (which we mention below), do not disturb the Torah concept of geocentrism. In Kuhn's words, "Though the telescope argued much, it proved nothing"⁴¹.

Galileo sought to bring proof from the movements of the tides to the Copernican positing of the dual motion of the earth on its axis and around the sun. This theory was itself rejected by subsequent science itself and was replaced by the

⁴¹ *The Copernican Revolution*, p. 226.

Newtonian theory of gravitation, which related the tides to the gravitational pulls of the moon and the earth. The second empirical proof to the Copernican model proposed by Galileo was from his study of sunspots. This was supposed to invalidate the Aristotelian concept of the sun as unflawed. To my knowledge, there is no such requirement in Jewish geocentrism. His argument from the movement of sun-spots that the sun rotated on an axis, could not prove, however, as he wanted to suggest, that the *earth* rotated on its axis. He sought to argue – from phases of Venus – that it orbited the sun, and from this he extrapolated – though this too was no proof – that the earth *also* orbited around the sun⁴². Finally, as we shall shortly note, Galileo sought to argue that the biblical miracle of Joshua’s stopping of the sun was more consistent with a heliocentric planetary system. This proof however, operates out of his own paradigm, and he did not grasp the Torah framework which makes sense of it within the geocentric model, as we shall presently see from the analysis of this miracle by the Maharal of Prague.

The Maharal of Prague

Rabbi Judah Loew, known as the Maharal of Prague, was a contemporary of Copernicus. He knew of, and explicitly repudiated, Copernican theory⁴³, upholding the Torah geocentric model as seen throughout his writings. The Copernican system had taken on the Scholastic “naturalization” of Divine transcendence: “infinity” – both as intrinsically unending “impetus” and as infinite space – had been incorporated into nature. That was done, however, without the Scholastic beholdenness to the geocentric order. Hence, the earth could be swept up into an orbit, and other

⁴² See *Galileo: and his Condemnation*, pp. 126-129.

⁴³ *N’siv HaTorah*, Chapter 14.

orbits posited, which G-d had not made, according to Jewish tradition.

In the Torah tradition, the application of such conceptions as “impetus” and infinite space, could not be metaphysically condoned. Divine transcendence (infinity) is necessarily beyond creation: as a power of G-d, it can both sustain and will creation in specific ways; by definition, however, it can never be vested in natural “laws” or natural “frameworks” themselves. So too, for the Maharal, the duality of the transcendent infinite and the immanently finite, each as the expression of distinct Divine powers, had to be kept rigorously distinct, each with its own integrity. G-d has a (delimiting finite-immanent) power *in* nature and G-d has a (infinite-transcendent) power *above* nature. The two powers are at work in the maintenance of the (geocentric) Universe as a whole. The immanent power differentiates the boundaries and forms of the Heavens and the earth as parts of a cosmic *material* nature. The transcendent power wills their very existence and continuity. Equally, it can will their (“miraculous”) alteration or cessation.

In other words, there is a finite “natural” and an infinite “non-natural” Divine power, both at work, cooperating with, but not to be assimilated to, one another – by contrast with their amalgamation worked by Copernicus and Galileo. With this we can address the position of the Maharal on the Scriptural account of the stopping of the sun which featured in the trial of Galileo. The other “proofs”, which Galileo sought to bring for the Copernican model in his trial and in his work, the *Dialogue Concerning the Two Chief World Systems*, that have been briefly discussed above.

One of the issues in the trial of Galileo was the statement of Scripture⁴⁴, that the sun was stopped miraculously in its course to enable Joshua and his army to defeat their opponents before dark set in. Aside from the miracle of the sun's stopping, Scripture stated clearly that the sun orbits – and here presently stopped orbiting for a number of hours – in contradistinction to the Copernican heliocentric model. Galileo sought here to argue that according to the Ptolemaic model the stopping of the sun would have shortened – not lengthened – the day. For the diurnal westward movement of comprehensive diurnal sphere (on which all the other spheres, including that of the sun, tracked) would not then have been countered at all by the gradual eastward movement of the sun (tracked upon or within the moving diurnal sphere)⁴⁵.

The Maharal in the “Second Introduction” to *G'vuros HaShem* (“The Powers of G-d”) explains the discussion in the Talmud as to at what point and for how long the sun stopped. Significant, however, for us here in regard to Galileo's objections to the Scripturally related occurrence, is the the Maharal's explanation of the miracle: that, whilst for Joshua and the combatants the sun stood still, for the rest of the world the sun continued in its course. Nature and the supranatural functioned *simultaneously* in the *one* plane, and did so *paradoxically*.

This was so because the quality of the transcendent power of G-d is that it is removed – *nivdal* – that is, not bounded by the categories, forms and ostensible “laws” that govern nature. Consequently, when the transcendent dimension intervenes

⁴⁴ *Joshua* 10:12, On other instances of unusual movements of the sun in Scripture and Torah tradition, see Y. Y. Gordon, “Unusual movements of the Sun as recorded in Jewish Tradition”, *Journal of Judaism and Civilization*, Vol. 13, 2018.

⁴⁵ See Blackwell, Richard. *Galileo, Bellarmine and the Bible*. London: University of Notre Dame Press, 1991.

and manifests itself within nature, it shows itself as paradox. It “breaks” the laws of logic and nature. Similarly, as the Maharal points out, amongst the miracles which occurred in Egypt, were those which occurred in the plagues of blood and darkness, that were brought upon Egypt, prior to the Jewish exodus. The waters of the Nile were turned into blood; but this was so only for the Egyptians – at the same time, they were water for the Israelites who drank from them. The plague of darkness engulfed the Egyptians; but for the Israelites, in the very same time and space, there was light. In other words, the rules of worldly logic and worldly nature – that something cannot be both blood and not-blood, dark and not-dark at one and the same time – were suspended. The greatest (continuous) miracle of transcendent G-dliness – the creation of existence out of, and the continued sustainment or prevention of its reversion to – nothingness has no parallel in nature: in nature, no thing comes from nothing. This is an “unseen” miracle. When, however, the transcendent G-dly power *shows* within nature, it makes nature do visibly “unnatural” and “illogical” things.

The same was witnessed in a continuous miracle in the Holy of Holies – the innermost sanctum, housing the Holy Ark, in which were the tablets of the Ten Commandments received from G-d by Moses – in the Temple in Jerusalem. The Holy Ark had a measured length of two and a half cubits. It was placed lengthwise across the width of the Holy of Holies, which measured 20 cubits across. When one measured from one end of the Ark to its neighbouring wall one found a length of ten cubits and similarly from the other end of the Ark to its neighbouring wall – ten cubits. In other words, the Ark *simultaneously* occupied space (it had a measure) took up *no* space (it had no measure). So also, in the courtyard of the Temple, when the assembled people stood, they were crowded, but when they prostrated themselves (each requiring

more space), there was room for everyone (it was *not* crowded). This was because G-d here joined the supernatural and the natural, with paradoxical effect.

Galileo sought to show that the stopping of the sun would not have lengthened the day on the grounds of a computation of natural movements. What in fact occurred, as explained by the Maharal, was a transcendental suspension of the laws of nature. It is only a truly omnipotent G-d, who could place “opposite predicates” in the same subject⁴⁶.

Just as a transcendent G-d wills the non-normal, so does He will the “normal” as and for as long as He likes. The meaning of the infinite transcendent Divine power is Divine *will*. The spheres and celestial bodies turn – or “orbit” – not because it is written into, or “impressed”, in their nature, as “impetus” or “inertial motion”, but because G-d repeatedly wills them to do so. Not only *is* their motion renewed by transcendent Divine will (and can be suspended by will) in every moment, but also *what* moves and *where* it moves is decreed by Divine will. The universe has a – geocentric – form that G-d specifically willed.

Hans Reisenbach would write many hundreds of years later, that which of the relative perspectives of the Copernican and Ptolemaic systems – whether the earth revolves around the sun or the sun revolves around the earth – cannot be *physically* (empirically) proven by human intellect⁴⁷. What Torah

⁴⁶ It is interesting to compare here Pope Urban VIII’s response to Galileo’s proof to heliocentrism from this theory of the tides (to be discredited by subsequent science) in the permission which he gave, as Cardinal Barberini as stated in *Galileo: and his Condemnation*, p. 45: “Finally. the book must conclude with an argument which Urban VIII himself had communicated to Galileo in 1624... This argument ran as follows: - ‘G-d is all powerful; all things are therefore possible to him. Therefore, the tides cannot be adduced as a *necessary* proof of the double motion of the earth without limiting G-d’s omnipotence – which is absurd?’”

⁴⁷ The Pope himself had also stipulated, in the permission to Galileo to print his work that (in E. R. Hull’s words) that “[t]he title must indicate

metaphysically teaches us, and this of course is the position of the Maharal, is that G-d transcendently *willed* an immanently structured universe, which is geocentric, not Copernican or Newtonian in format.

The Enlightenment and geocentrism: Newton and Rabbi Schneur Zalman of Liadi

Newton's completion of the new science

Copernicus, Galileo and their other great cohorts propounded the paradigm, which in Western science and thinking supplanted geocentrism, but they did not finalize its scientific explanation. Aristotelian geocentrism had two great typical, characteristic motions – the circular motion of the Heavens and the rectilinear (up and down) motion of objects on earth. The Scholastics had already naturalized the Heavenly circular motion into the concept of impetus, the prototype of inertial motion, and this was implicit in, and made theoretically possible, as we have noted, the whole new set of spinning and orbital motions in Renaissance heliocentrism.

What remained incomplete was the transformation of the second major form of motion in Aristotelian geocentrism – rectilinear motion – typical of the terrestrial sphere. Perhaps, we could say, in a broader sense, that a rectilinearity existed throughout the entire Aristotelian geocentric universe. This explained the position of the heavens. They were above, and descended progressively towards, the earth. But they did not fall, because in the Aristotelian model, they were part of a weightless ether. Rectilinearity proper, however, as the form of normal motion, began in the sublunar, terrestrial sphere with

that it is a frank discussion of the merits of the Copernican and Ptolemaic systems; the subject must be treated from a purely hypothetical standpoint, and thus must be set forth in the Preface” – in other words, that the Copernican model was unproven. *Galileo: and his Condemnation*, pp. 44-45.

its material of four elements – fire, air, water and earth. These too are ranked in successive layers, according to their weight, and the direction, up or down, in which they are led by their weight.

Aspects of the Aristotelian theory of rectilinear motion, such as the belief that the downward speed of falling objects was proportional to their mass, had already been empirically disproved in the legendary Galilean experiment in which objects with different weights were dropped from the tower of Pisa and hit the ground at (almost) the same time. Galileo also showed that a thrown object does not fall vertically to the ground, as Aristotle thought, once the force of its projection is spent, but that its movement is parabolic. Galileo, however, had not arrived at the theory of universal gravitation. Posterity's negative judgment of his explanation of the tides found what it regarded as the correct explanation in the theory of gravitation, relating the tides to the earth and the moon, as we have noted.

More systematically, without gravity, Copernicus the mathematician and Galileo the experimental scientist, had no conclusive explanation of the heliocentric system. For Copernicus, the heliocentric system recommended itself as a matter of mathematical harmonies and simplicity; for Galileo, it was a host of observations (such as a spinning sun indicated by moving sun spots) that lent plausibility to the new host of orbits and spinning motions (including those ascribed to the earth) of the heliocentric system. But there was no conclusive *physical* explanation or proof (other than Galileo's failed tides theory) that the earth spun on its axis and orbited the sun, rather than the sun turning around the earth – until Newton's theory of universal gravitation came along. Newton's theory of universal gravitation supplied a vital element for the explanation of any orbital motion and why the sun, and not the earth, should be the centre of the orbits of the planets.

The structure of planetary motion – and specifically of the orbit of the earth around the sun – was explained by Newton through a melding of the distinct concepts of inertial motion and gravity. Elsewhere, I have put it this way. The “mathematical model of the orbits of the planets around the sun is interpreted in terms of two physical laws. One is the uninterrupted, constant and lateral *inertial* motion of the planets, all other things being equal. The second is the deflection of the lateral inertial motion of the planets into a curved orbit by a force of *gravity* operating between the central body, the sun, and the planets.”⁴⁸

Now, of course, a vital point of Newton’s theory of *universal* theory of gravitation is that it is a force which draws any two bodies towards each other, and that the power of the gravitational “pull” of one body is proportionate to its massivity. For this reason, in Newton’s theory of orbital motion, it is the sun, much greater in size, that draws the earth around it, and not the earth which draws the sun around it, in orbit.

The dimension of rectilinear motion in the geocentric universe had to do with the weight of different material elements. But it had to do also with their relation *to the earth*, specifically – with their ranking and ordering which proceeds towards the physical earth. In Torah terms, the spiritual sources, to which the four elements – fire, air, water and earth – tend are serially layered upon and in the earth. The four elements, which are different from materiality of the heavens, are all “from” and directed to the earth. This applies even to fire which tends to rise, for its presence is possible because it takes hold of a physical, earthly object, such as a wick⁴⁹. The

⁴⁸ S. D. Cowen, “Torah Metaphysics and Newtonian Empiricism”, *B’Or HaTorah*, Number 11, 1999, p. 110.

⁴⁹ Rabbi M.M. Schneerson, *Sefer HaSichos* 5749, NY: Kehos, p. 284, fn 34 (discussed at length by R. Aharon Menachem Mendel Kastell in an essay

entire “vertical” dimension of universe as a whole is explained by Torah as a chain of transmission of Divine influence *to the earth*. The materials and levels of creation serve and progress towards the earth, which is their goal (*telos*).

Newtonian universal gravitation leveled the universe (and the different kinds of materiality present in the geocentric model) into a uniform, infinite “world machine”, to use Kuhn’s term. The geocentric universe was a “ladder”, so to speak, between the human being and “G-d”, that is between the earth and the border, beyond which lay the realm of the spiritual and Divine transcendence. Its serial ordering down towards a centre, the earth, was replaced in the Newtonian universe by a single “playing field” in which operated the logic of the inertial motion and the gravitational pull of “masses”—the more massive, the more central. This eliminated the earth’s uniqueness and cast it from the centre to periphery.

Notwithstanding his seemingly G-dless, mechanistic universe, Newton was a profoundly religious man. He quipped that the universe’s Architect was “very well skilled in Mechanics & Geometry”⁵⁰, but, it seems, he experienced a profound personal spiritual tension with his own system. He had produced a system which “worked” powerfully. But he was racked by the meaning of its mechanics and its concealment of what he understood to be its living personal, interventionist Creator. The millions of words of his writing in his theological writings, collected as the “Newton Project” – which only relatively recently came to light – attest to his yearning for a recognition in the structure of the cosmos of the Divine attributes of a living G-d. In these writings, he was interested in the revelation of G-d in creation – not as

on “Gravity and Chassidus” published in Melbourne in *He’oros HaT’mimim v’Anash*).

⁵⁰ Quoted in A Kushelevsky, “Why Wasn’t Newton born in China?”, *B’Or HaTorah*, Number 11, 1999, p. 118, 120.

reflected in mechanism – but as set out in prophetic writings of a living G-d. These arcane writings of Newton include work on alchemy – a subject based significantly in the doctrine of the four elements of the terrestrial sphere, which figure dominantly in the geocentric model.

The structure of the geocentric universe, in the Torah model, evidences the Divine attributes at every level: in the nine principal heavenly spheres driven at a tenth level by an encompassing transcendent level⁵¹– and in the four elements of the terrestrial sphere⁵². Each of these levels of the universe in the Torah’s geocentric model – as well as in the spiritual levels of creation which precede them, express, as explained in mystical writings, the Divine attributes for the manifestation of which in nature Newton yearned.

Rabbi Schneur Zalman of Liadi

Newton’s theory of “universal gravitation” served, in the modern history of science, to lay to supplant finally the Aristotelian theory of rectilinear motion towards the earth. But let us consider the significance of the rectilinear dimension – though not in terms of the specific axioms and laws of *Aristotelian* physics, with which Torah did not have to agree. Rather, let us consider the significance of the “circular” and the “rectilinear” (the vertical line, up and down) in the metaphysics of Torah geocentrism, as these appear in the Chassidic philosophy taught by Rabbi Schneur Zalman. Here, it must again be stressed, we are not talking in terms of detailed practical, empirical *physical* science, but of the metaphysical frameworks, which form the ultimate criteria of, not simply effective, but also wholly true, science from the standpoint of Torah.

⁵¹ *Moreh Nevuchim*, Part 2, Chapter 4.

⁵² See *Likkutei Sichos*, Vol. 16, p. 87 ff.

Rabbi Schneur Zalman of Liadi discusses these, not only in relation to the mystical teachings of the Torah in relation to the structure of creation, but also in relation to a topic relevant to gravitation itself, as we shall see below. The concept of the hierarchical (rectilinear) line and circle are metaphors in Torah thought for two Divine creative powers. The circle is a metaphor for an encompassing transcendent G-dly power, which enlivens all existence out of nothingness, and does so constantly: it effects constant creation *ex nihilo*. In the language of Torah mysticism, it is called *sovev kol almin*, the G-dliness which encompasses (“encircles”) all worlds. The meaning of “encompassing” or “encircling” signifies that it transcends nature. It is superior to nature, both in that it creates nature and maintains its existence; and can also, as an expression of the will of G-d, alter nature. It is beyond the structures and orders of nature, which are typically of a hierarchical, differentiated, organismic character. Transcending G-dliness has no beginning and no end as suggested by the metaphor of the circle, implicit in its name (*sovev* – “surrounding”). A circle encompasses everything which is within it, here all the structures of nature and creation. It is at one and the same time “outside nature”, as the transcendent condition of nature’s existence and maintenance, but it is also present equally in all specific things: it is “equal” in them as the foundation of their existence.

As taught in the writings of Rabbi Schneur Zalman, the Creator employs a second G-dly power, to “contract” and contain the transcendent G-dly force into the differentiated entities and structuring orders of creation. This structuring, delimiting power, called *memaleh kol almin*, the G-dliness which “fills all worlds” and is symbolized by a line (*kav*), representing “descent” This structuring, ordering and differentiating G-dly power manifests itself throughout creation – the universe – as an “order of descent” (*sefer his’talsbalus*). This starts with the

emanation by the Creator of a number of Divine attributes, which then are manifested in a progression of “worlds” which are initially purely spiritual and then are materialized in further descent serially through the physical spheres of the Heavens and finally in the Earth and its elements. It is all one process of hierarchical, differentiating descent.

The metaphorical figures of circle (will) and line (inner development) feature throughout the entire “order of descent” of creation. Nevertheless, there is a general division in creation, between a more pristine level, where circles prevail and a subsequent level, where ordered, differentiated descent (the line) prevails. The first is a general realm in which Divine attributes appear as powerful wills. This is called the realm of *Iggulim* (circles). The subsequent general realm is one in which the Divine attributes are harmonized in hierarchical, ordered and balanced structure. This is called the realm of *Yosbar* (“upright” or “straight”). Rabbi Schneur Zalman makes reference to these in his discussion of the physical universe, as we shall see.

The structure of the universe is thus a material analogue of the final segment of the “order of descent” of worlds, where this architecture expresses itself physically. Whilst the *Rishonim*⁵³ spoke of the “worlds” of the “angels”, the “heavenly spheres” and the “earth”, Chassidic and Kabbalistic thought call these with the worlds of *b’riah*, *yetzirah* and *assiyah*⁵⁴. The Torah geocentric model of the universe relates to the final, physical stages of the “order of descent” of the chain of Divine transmission downwards towards the earth. The circular spheres of the Heavens themselves are in descent; and,

⁵³ And above all, it would appear, Maimonides, whose first four chapters in the Laws of the Foundations of the Torah, relate to *seder his’talshalus*.

⁵⁴ Rabbi M. M. Schneerson, *Reshimos* (NY: Kehos), Vol. 5, *Reshima* #82, p. 116. This division is found both on a “general” (*k’laliyim*) and “specific” (*p’rotiyim*) level (*ibid.*).

as mentioned above, the “layered” sources of the four elements constituting the terrestrial sphere, are also in descent or progression downwards towards the centre of the earth.

With this we can understand the response of Rabbi Schneur Zalman of Liadi, when asked why people standing at the “bottom” of the earth, viz America, do not fall off it:

...the answer lies in explanation of the *Eitz Chaim* that the Nine Spheres are nurtured by that state termed *iggulim*, ‘Circles,’ and in a circle there is no above or below. For this reason, those who live opposite us, ‘down below’, have their heavens high above them arching in one continuity with the heaven above us, and the earth there is *below*, relative to the heavens over it⁵⁵.

In other words, the centre (the earth) is “downwards” *vis-à-vis* the encircling heavens on any point of the earth’s surface. The heavy elements, amongst those four elements constitutive (in combination) of terrestrial entities, seek and are drawn to their sources in the earth. Their tendency “downwards” means down towards the earth and its centre. This is not the same as Newtonian “universal gravitation” because “universal gravitation” is (1) a mutual attraction of bodies and (2) the individual gravitational “pull” of an object is proportional to the “massivity” of its mass. By contrast to the first feature of “universal gravitation”, the physical terrestrial object is drawn towards the “centre” of the earth; we do not find in Torah sources, that it should in even the slightest degree draw the earth towards it. It is drawn towards *its* source, its spiritually designated place and station, in the centre of the earth. The source is not drawn towards it. Moreover, this is a relationship between the four foundations of terrestrial matter and the

⁵⁵ Related by the grandson of the Rabbi Schneur Zalman of Liadi, Rabbi Menachem Mendel (the *Tzemach Tzedek*) in Rabbi M. M. Schneerson, *HaYom Yom* (transl. Y.M Kagan), NY: Kehos, for the 14th day of Tammuz.

earth. The material of the heavenly spheres and bodies, writes Maimonides, is of a different order⁵⁶.

With regard to the second feature of “universal gravitation”, that the “degree” of gravitational pull is proportionate to the mass of the object: were this in fact true (and the material properties of the earth and the sun similar), the earth would be swept up into the orbit of the sun. As noted, a number of times above, from the standpoint of the relativity of the two bodies – the sun and the earth – we cannot say which moves around which, *without* the assumption of universal gravitation. Since Torah, the arbitrator of metaphysical truth, tells us that the earth is stationary and the sun moves, the assumption of “universal gravitation” is unacceptable. It is an assumption that is functional to the heliocentric perspective. The sun, according to the geocentric model has its place, in its sphere, which circles the earth. Each object in the descent of levels of physical creation towards the earth does not “gravitate” towards an object bigger than it, but occupies the place, designated for it by the Creator in the structured order of the universe. Universal gravitation is a functional component of a rival – and, for Torah, not wholly true – metaphysic, however practically useful the science built on it may be.

The mystical literature of Torah states, and its great exponent, Rabbi Schneur Zalman of Liadi, explains, the statement of the Sages that “G-d desired for Himself in the lowest realms”⁵⁷, that is, at the lowest “down below”, the earth. In the spiritual rungs of the creation, G-dliness is *already* manifest. Even in the physical Heavens, a spiritual harmony is manifest that is greater than in the terrestrial sphere⁵⁸. It is specifically on the earth, where the coarsest materiality is found – and then also in a flux of decomposition and

⁵⁶ *Laws of the Foundations of the Torah* 3:3, 8-9.

⁵⁷ *Midrash Tanchuma*, Noso 15.

⁵⁸ Maharal of Prague, *Derech Chayim* on *Ethics of the Fathers*, 1:18.

recomposition – that G-dliness is most “concealed”. It is this from the elements of this material world that the human being’s body and environment are made. A soul made in the image of G-d, however, inhabits that body and this world, and is able to refine both through fulfilment of G-d’s commandments. With the completion of the refinement of the lowest world, through which it – the earth – will become a fit vessel for revealed G-dliness, there will be seen truly that “there is no other than He”⁵⁹. That is why the earth is both the “lowest” stage *and* the goal, the centre, of the cosmos. There the Torah was given to souls in bodies, who through the service of G-d in fulfilment of Divine ethical commandments, could redeem and bring the entire universe to fulfilment of its redemptive purpose. And there, in the lowest and coarsest of all levels of creation occurs the greatest demonstration of the unity of G-dliness: that G-d is one “below” as He is “above”.

In the meantime, we use a science, which, while not metaphysically wholly true, is yet powerful. G-d permits and mandates us to apply this science, as discussed above, as an instrument in the ethical refinement of creation. One of the transformations which science – not simply through its application, but in the growth of scientific research – is to accomplish is the transformation of science itself: in its own concepts, science will disclose G-dliness as the foundation of physical reality⁶⁰.

⁵⁹ Deuteronomy 4:35. See *Likkutei Sichos*, Vol. 7, 134-138.

⁶⁰ *Likkutei Sichos*, Vol. 15, pp. 47-48.