Kepler's 'Optics': Passion For Scientific Discovery

by Susan Welsh

Optics: Paralipomena to Witelo & Optical Part of Astronomy
by Johannes Kepler
Translated by William H. Donahue
Santa Fe, New Mexico: Green Lion Press, 2000
459 pages, hardbound, $55

Reading this book is like looking at one of those beautiful Hubble Telescope photos of a star being born, in a far-distant nebula, a couple of million light-years ago. This long-awaited first English translation of Kepler's *Optics* allows the English-speaking reader to peer four centuries into the past, at the very birth of modern science.

The *Optics* was published in 1604, while Kepler was still in the throes of what he called his "war on Mars," which would result in the publication of his revolutionary *New Astronomy* five years later, and eventually lead to the crowning work of his life, *The Harmony of the World,* in 1619. The *Optics* appeared in the same year as Shakespeare's *Othello,* and three years before the founding of the Jamestown colony in America.

Before Kepler, European science was, for the most part, still sunk in medieval scholasticism and Aristotelianism. The breakthroughs of Cardinal Nicolaus of Cusa (1401-64), whom Kepler (a Protestant) described as "the divine Cusa," had opened the door for a scientific revolution. But with Venice's defeat of the League of Cambrai in 1511, Venice and the Aristotelians had come to dominate the political-strategic and scientific landscape. The stunning scientific achievements of Leonardo da Vinci (1452-1519), recorded in his notebooks, remained unpublished. His enormous legacy—including extensive work in optics and astronomy—was scattered to the four winds after his death, and as much as three-quarters of it was destroyed. While Leonardo's scientific work was not unknown in the Europe of the 16th Century, the extent of its influence is still a matter of heated debate. Kepler's *Optics* is thoroughly "Leonardian" in method, and sometimes even in the detail of the discoveries reported (see box), yet Kepler never mentions his great forerunner. In view of Kepler's scrupulous intellectual honesty,[1] we can only conclude from this that he did not know Leonardo's work—at least not directly. As for Copernicus (1473-1543), his argument for a heliocentric system set the stage for Kepler, but did not, itself, escape the straitjacket of Aristotelianism. It did not explore—did not even consider—the question of the *physical causality* by which his system might actually function. That was the revolution in science that required a universal genius: Johannes Kepler.

With William Donahue's translation of the *Optics,* nearly all of Kepler's most important works are now available in English (though most are now out of print!). I only hope that Donahue, who also translated the *New Astronomy,* will move on to translate Kepler's second important treatise on optics, the *Dioptrice* (1611). Without this, it is impossible to get a full conception of Kepler's matured work in this domain, so vital for physics and astronomy. The second priority translation project on my list would be his 1615 *Nova Stereometria*

1. By contrast with Kepler's contemporary Galileo, and with Isaac Newton a century later, both of whom were promiscuous plagiarizers. For a discussion of Galileo, the tool of Venetian intelligence operative Paolo Sarpi, see Susan Welsh, "Leonardo's 'Leaps': Metaphor And The Process Of Creative Discovery," *EIR,* Nov. 29, 1996. Newton's plagiarism was so thorough, that he apparently convinced even himself, that he was the author of Kepler's so-called Three Laws—not to mention Leibniz's calculus.

Doliorum Vinaiorum (*New Solid Geometry of Wine Barrels*), an important work with respect to the development of the calculus a century later.

In the *Optics,* discoveries fairly leap from nearly every page:

- Kepler's work on optical theory—his investigation of reflection and refraction—created the foundation for what we know today as the science of optics. This includes his first explanation of how the eye perceives images in a mirror (the object is in front of the mirror, yet the observer perceives it as behind); his distinction between optical "images" and "pictures"—what we would call today "virtual" and "real" images; his conception of the "distance-measuring triangle," by means of which the eye and brain gauge the location of objects in space; and his work on the structure of the eye, with the discovery that the visual picture appears, inverted, on the retina (rather than right-side-up on the cornea, as had hitherto been believed). Kepler made this last discovery based on mainly geometrical calculations; it was later validated by his collaborator Christoph Scheiner, who devised a means of viewing the actual image on the retina of a cadaver. (Scheiner also built the telescope that Kepler designed, which we call today the "Keplerian.")


AD VITELLIONEM
PARALIPOMENA,
Quibus
ASTRONOMIÆ
PARS OPTICA
TRADITVR;
Potißimùm
DE ARTIFICIOSA OBSERVATIONE ET ÆSTIMATIONE DIAMETRORVM deliquiorumq; Solis & Lunæ.
CVM EXEMPLIS INSIGNIVM ECLIPSIVM.
Habes hoc libro, Lector, inter alia multa noua,
Tractatum luculentum de modo viſionis, & humorum oculi vſu, contra Opticos & Anatomicos,
AVTHORE
IOANNE KEPLERO, S. C. M^tis Mathematico.
FRANCOFVRTI,
Apud Claudium Marnium & Hæredes Ioannis Aubrii
Anno M. DCIV.
Cum Priuilegio S. C. Maieſtatis.

The title page of Kepler's Optics. *"Today," he writes, "there is more danger from the abundance of bad books than there was once from the scarcity of good ones."*

- Kepler makes several original contributions to the geometrical theory of conic sections, including the first use of the term "focus"; the conclusion that the parabola has one focus at infinity; and the idea that the conic sections form a continuum generated by a moving focus (**Figure 1**). These discoveries were not only important for Kepler's ongoing astronomical researches (including the discovery of the planets' elliptical orbits), but also for the development of the calculus.
- But these are all preliminaries. The core of the book is what Kepler calls "the optical part of astronomy." The *Optics* is the cornerstone upon which Kepler erected the entire edifice of his astronomical work. He describes it this way, in his preface to the *Dioptrice:* "I . . . was able to attack some optical theorems, which in themselves may appear rather insignificant, but which nevertheless contain in themselves the germ of the highest things and whose taking care of and more refined analysis thus appeared to me necessary. It is unjust, I believe, to judge the optical science as inferior in comparison with astronomy; it is the latter which depends on the senses and instruments, while optics as such does not lack any geometrical certitude."[2]

In the *Optics,* he examines the optical characteristics of eclipses; the refraction of the Sun's rays before they reach the eye of the astronomer, and how this distorts the observation; the phenomenon of parallax, as the key to unlocking the mystery of the distances of the celestial bodies from one another; and the physical characteristics of the Sun, Moon, and comets. He even puts forward a startling proof that Euclid was a "Copernican"—i.e., that he believed in a heliocentric system, in opposition to the later hoaxster Ptolemy (see box).

All of this is presented so as to be accessible, at least to a certain extent, to the layman willing to apply himself diligently to the task of understanding it.[3] For example, Kepler presents the clearest

2. Quoted in Paul Görlich, "Kepler's Optical Achievements," *Kepler: Four Hundred Years, Vistas in Astronomy,* Vol. 18 (Oxford, U.K.: Pergamon Press, 1975).

3. This is not meant to imply that what Kepler writes is simple. In his *New Astronomy,* he addresses the difficulty faced by the creative genius who is writing for an audience ill-equipped intellectually to understand him; a genius who, by the very nature of his work, is overturning the closely held axiomatic beliefs of that audience: "If anyone thinks that the obscurity of this presenta-

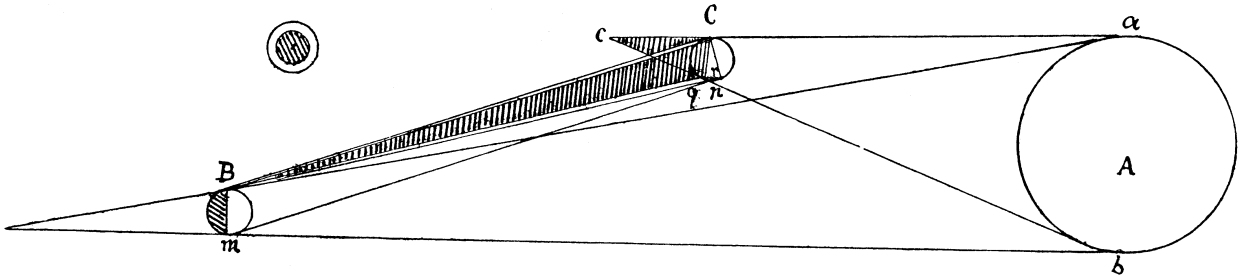
Kepler And Leonardo

Did Leonardo da Vinci's extensive unpublished research on optics and astronomy influence Kepler's *Optics,* directly or indirectly? There are many areas in which Leonardo's work certainly presaged that of Kepler.

Kepler's book, for example, contains extensive discussion of the *camera obscura,* as a model for considering what occurs in the eye. He writes that "this art was, as far as I know, first presented by J. Baptista Porta" (1589). Yet, Leonardo nearly a century earlier devoted over 230 drawings to the problem of the *camera obscura!*[1]

Then there is the matter of "Earthshine." Why is it, that when only a crescent of the Moon is brightly lit, you can still detect the rest of the Moon, dimly lit? Leonardo was the first to come up with the correct explanation: The light is provided by the reflection of the Sun's rays off the Earth's surface (see drawing). But Kepler's *Optics* is the first *published* location of the correct explanation. He attributes the discovery ("to my knowledge") to his teacher, Michael Mästlin, of the University of Tübingen, 12 years before. Did Mästlin discover it anew, or was there some yet-unknown means whereby Leonardo's influence made its way to Germany?

1. Kim H. Veltman, *Studies on Leonardo da Vinci II: Continuity and Discovery in Optics and Astronomy,* in consultation with Kenneth D. Keele. This is apparently an unfinished manuscript (www.mmi.unimaas.nl/people/Veltman/books/contin/title.html).



Leonardo da Vinci's discovery of "Earthshine" predated Kepler's published account: The Earth, Leonardo wrote in his notebook, "receives the solar rays and reflects them on the lower waters of the Moon, and indeed affords the part of the Moon that is in shadow as much radiance as the Moon gives the Earth at midnight. Therefore it is not totally dark, and hence some have believed that the Moon must in parts have a light of its own besides that which is given it by the Sun. . . ." In Leonardo's drawing, A is the Sun, B the Earth, and C the Moon. Source: Codex Leicester.

explanation of "parallax" that I have ever found. (This is the paradox, famous in the history of astronomy, about which James Joyce wrote in his novel *Ulysses* the epigram: "Parallax. I never exactly understood.") In Chapter 9, "On Parallaxes," Kepler notes several times that he is spelling out certain things "for the sake of the more inexperienced."

So, while this book may not become a best-seller, I do expect that everybody who loves Kepler and who treasures scientific truthfulness, will rush right out and get a copy.

'Sweating And Panting'

Kepler's optical discoveries provide a rich field for analysis by researchers better qualified than myself. In this review, I shall stick to drawing out some crucial methodological points which resonate most closely with recent writings of *EIR* Founding Editor Lyndon H. LaRouche, Jr., using mostly Kepler's own words to do so.

Regular readers of *EIR* will have noticed that LaRouche mentions Kepler in practically everything he writes. The reason is that Kepler is, for LaRouche, the "textbook case" of the true creative thinker. The reader of the *Optics*—as of any of Kepler's writings—will immediately get an inkling of why this is so.

Take the following quotation from LaRouche's recent "A

tion arises from the perplexity of my mind, I shall myself only thus far acknowledge to him my guilt, that I was unwilling to leave anything untested, no matter how utterly obscure, and no matter how irrelevant to the practice of astrology, which many deem the sole end of this celestial philosophy. But as for the subject matter, I urge any such person to read the *Conics* of Apollonius. He will see that there are some matters which no mind, however gifted, can present in such a way as to be understood in a cursory reading. There is need of meditation, and a close thinking through of what is said."

And elsewhere in the same work, discussing his laborious calculations to determine the true orbit of Mars, he asks for the reader's patience and perseverance: "If this wearisome method has filled you with loathing, it should more properly fill you with compassion for me, as I have gone through it at least seventy times at the expense of a great deal of time, and you will cease to wonder that the fifth year has now gone by since I took up Mars, although the year 1603 was nearly all taken up by optical investigations."

Those readers of *EIR* who complain that LaRouche's writings are "too difficult," should bear in mind Kepler's admonition.

New Guide For The Perplexed: How The Clone Prince Went Mad!" (*EIR*, Oct. 12, 2001):

> [C]ontrary to the famous argument of the morally deranged Immanuel Kant, there is a specific quality of human passion, without which the work of discovering and transmitting knowledge of universal physical principles could not occur. This specific quality of passion is not only essential for scientific discovery. As Kepler introduced the notion of the *intentions* of the Solar System, for defining the principle of universal gravitation, passion, in the sense of *intention,* must be included by the mind as an integral part of the image of the physical universe outside our sense-perceptions as such. *This passion is not only characteristic of the act of discovery; it is also the essential internal quality, of intention, of that which is discovered*. The same quality of passion is intrinsic to Classical well-tempered counterpoint.

What an idea! For Kepler, as for LaRouche, it signifies the coherence of the *cognitive, biotic, and abiotic* domains. It means that God created the universe in such a way that man, made in His image, would be able to make truthful discoveries of universal principle about it; and further, that to do this, requires a certain quality of (non-Romantic) *passion* which absolutely distinguishes man from the beasts.

In the *Optics,* we see this quality of passion right from the beginning, with the author's dedication of the work to his patron, Emperor Rudolf II: "I have tracked geometry through the cosmic bodies portrayed through her, following the Creator's imprints with sweat and panting." (Can you imagine Kant or Newton writing about "sweat and panting"?)

It is with such characteristic passion that Kepler sets about fearlessly to assail the seemingly impregnable fortress of Aristotelianism—a mortally dangerous enterprise in his day and age. In his Appendix to Chapter 1, he boldly writes:

> The foolish studies of humans have come to such a pitch of vanity that no one's work becomes famous unless he either builds up or burns down the temple of Diana—unless, I say, he either fortifies himself with the authority of Aristotle, or takes a stand in battle against him, seeking to show off. This is indeed why the most true axioms of the optical theorists (amplified upon in this chapter) have hitherto been held in neglect, and, through this paucity of opticians, have undeservedly been regarded as inferior to the Aristotelian darkness, since Aristotle reigns everywhere, while the optical writers turn a blind eye and privately remain content with their liberty.

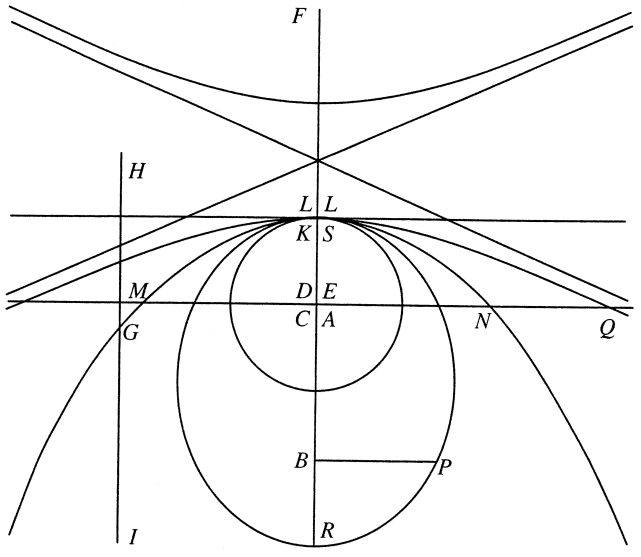
After dissecting Aristotle's opinions on optics, point by point, Kepler concludes:

> I expect that the Academics are going to bring up something against this, and are going to focus on how to place the honor of their master (who himself never sought it) before the truth. For the rest, whoever you are, whom it pleases to contend with me, let it be known that you are going to be held unworthy in this ring unless you enter into my chamber [*camera*—a pun referring to Kepler's theory of the *camera obscura,* or pinhole camera] described in Chapter 2 following, which was the only thing Aristotle lacked. If you ignore this after being warned, the same excuse that saved Aristotle [i.e., ignorance] will not save you.

LaRouche frequently stresses the importance of a *playful* state of mind, as a prerequisite to creative discovery—in Friedrich Schiller's sense of the *Spieltrieb,* or "play drive." In Kepler, this is delightfully apparent. A translator's note quotes him from a 1610 work in the German language: "Now, as God the Creator has played [*gespielt*], He has also taught nature, His image, to play; and the game is just the same as the one He had played [*vorgespielt*] for her."

And in Kepler's concluding chapter, a densely argued

FIGURE 1
The Conic Sections



In Kepler's illustration (redrawn for this modern edition), the circle has only one focus at A, at the center. The ellipse has two foci, at B and C. In the parabola, one focus is at D, and the other on the axis, at infinity. The hyperbola has its foci at F and E. In this book, Kepler uses for the first time the term "focus" in this way. He was also the first to realize that the parabola has a focus at infinity.

Was Euclid A Euclidean?

Historians of science generally maintain that an Earth-centered cosmology dominated scientific thought before Copernicus—although Aristarchus of Samos, a Greek astronomer of the Third Century B.C., is recognized to have had a heliocentric conception. Aristarchus' work is lost, and only a scant reference to it by Archimedes has survived. Academic historians basically assign it the status of "an opinion," and leave it at that. Lyndon LaRouche, however, has long maintained that the heliocentric cosmology was in fact more widely accepted among Greek scientists, until Ptolemy subverted it, in the Second Century A.D.

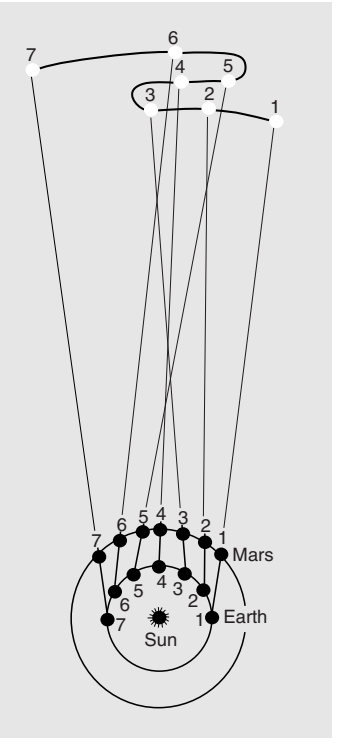
Kepler provides stunning confirmation of this, in his proof that Euclid (ca. 300 B.C.) was "a Copernican"!

Kepler makes the argument, not directly, but by showing *how Euclid's mind worked*.

The issue is the so-called retrograde motion of the planets (see illustration): From our vantage-point here on Earth, the planets appear to move along steadily in an easterly direction, from one night to the next, as compared to the constellations behind them. But every so often, a planet appears to stand still, then reverse its steps for a time, and then resume its easterly journey, making a "loop." This phenomenon has amazed star-gazers for as long as human beings have turned their eyes to the heavens. Ptolemy attempted to account for it by a bizarre interlocking of "epicycles." Only when the Sun is placed at the center of the system, can the imaginary epicycles be eliminated.

With this in mind, Kepler cites Euclid's *Optics,* to show that "Euclid propounded pure, unadulterated Copernican astronomy." Here is Kepler:

> "If," [Euclid] says, "some things be carried with unequal speed, and the eye also be among them, those which are carried with the same speed as the eye will be thought to stand still; those which are carried more slowly than the eye, to be carried in the opposite direction; those which are carried more swiftly, to go ahead." I shall change nothing but the words. If the planets and the earth, the lookout post of our vision, . . . are carried forward, and it should happen that the earth and a planet are moved forward equally (with respect to some identical straight line), the planet will seem to stand still; but if the planet be slower, it will seem to be carried backwards; and if it be faster, it will seem to be carried forwards. If there be anyone so nitpicking, so particular, as not to be able to hear this, let him substitute the moon in place of the earth, and locate upon it some viewer of celestial objects, then the same things would follow in the moon: this earth of ours, even if it really be at rest, will appear to move, but the moon will appear to be at rest, although it moves, and those things will not be able to be overturned by any solution.



The apparent path of Mars (retrograde motion), as seen from the Earth, against the background of what the ancients called the "fixed stars."

Kepler further emphasizes that Euclid uses an *astronomical* term to describe the perceived motion, making it obvious that he had astronomical matters in mind (as opposed to more mundane observations on how a fence looks when you ride past it in a cart, for example).

Euclid has gotten a "bad press" in *EIR* lately, as LaRouche emphasizes the importance of experimentally verifiable *anti-Euclidean* geometries, citing the breakthrough of Bernhard Riemann, who "expelled from science all unproven kinds of so-called 'self-evident' definitions, axioms, and postulates, including those of the Euclidean and non-Euclidean geometries" (LaRouche, "A New Guide For The Perplexed: How The Clone Prince Went Mad!" *EIR,* Oct. 12, 2001).

In view of Kepler's discovery, I leave it to the reader to ponder whether Euclid, the man, was actually a "Euclidean," in the sense of being a doctrinaire adherent to the 2,300-year-old system that bears his name.

series of mathematical/astronomical problems regarding eclipses, we finally arrive at Problem 27, defined as follows:

> *At a given elevation of the pole, the beginning and end, or moments, being visible, and the sun's place known, with hourly motion and diameters of the luminaries also chosen, and the qualitative motion of latitude (taken roughly), and finally the distances of the luminaries from the center of the earth, to investigate the instant of true conjunction and the true latitude; and from it the difference of meridians as well* [Kepler's emphasis].

Got that? The author continues:

> Let's play. For there is no reward for this work more certain than this pleasure. And if it is allowed, we make it our practice even to work with song. I want to know the instant at which the true conjunction [of Sun and Moon] occurred in Denmark, so that a more reliable difference of meridians may be had. At the same time, I also desire to know whether an observer hindered by deceptions of vision will note the beginning earlier, the end later. . . .

The Coherence Of God's Created Universe

As previously noted, Kepler emphasizes that God created a universe coherent with the mind of the man observing it. How wonderful that is! Otherwise, the lonely man, set adrift on a planet spinning through space, would have no means of understanding the universe in which he lives. The modern existentialist!

Thus, Kepler emphasizes the usefulness to astronomy, of the very fact that eclipses of the Sun and Moon occur:

> For the most noble and ancient part of astronomy is the eclipse of the sun and the moon, a subject that, as Pliny says, is in the entire study of nature the most wondrous, and most like a portent. Anyone who ponders this carefully will find (if he will refuse to have recourse to faith in holy scripture) both that there is a God, founder of all nature, and that in the very mechanics of it He had care for the humans that were to come. For this theater of the world is so ordered that there exist in it suitable signs by which human minds, likenesses of God, are not only invited to study the divine works, from which they may evaluate the Founder's goodness, but also are assisted in inquiring more deeply. . . .
>
> Furthermore, the extent to which humans are assisted by eclipses of the luminaries in all of astronomy, all the books of the astronomers teach. For, as regards the motions of the sun and moon, and the lengths of years and months, this entire theory first arose solely from the observation of eclipses, nor could it be constructed otherwise. Moreover, it cannot be smoothed and polished further except by considering eclipses of the luminaries more accurately and finely, which is the aim of this book.

Kepler also points to the usefulness of the fact that in human beings, the eyes are placed "more to the sides and downwards, following the nose," by comparison with animals. This, because the human bodies "themselves invite them to association"—i.e., social intercourse; this "you may take to apply beautifully to one person opposite another." Another cause of the placement of the eyes, he continues, "is derived from human dignity." Unlike grazing animals, whose eyes are directed downward to root around in the earth, "the human being, master of creatures, has his face so directed that he should be invited continually to contemplate how far flung are the limits of his possession: they are the heaven itself, contiguous to the mountains, as it appears."

In the *Optics,* as in other locations, Kepler makes an argument for the heliocentric system, as being uniquely suitable for God's purpose, uniquely coherent with the existence of man—unlike the Ptolemaic, Earth-centered cosmology:

> And so it was evidently not fitting that the human being, destined to be the inhabitant and watchman of this world, should reside in its middle, as if in a closed cubicle, under which circumstance he would never have made his way through to the contemplation of heavenly bodies that are so remote, but rather, by the annual translatory motion of the earth, his domicile, *he circumambulates and strolls around in this most ample building, so as to be able more rightly to perceive and measure the individual members of the house. The geometrical art imitates something similar in measuring inaccessible spaces. For unless the measurer passes from one station to another, and turns his eyes sideways at each, he is unable to arrive at the measure sought* [emphasis added].

Parallax: 'Of Godlike Use'

A final example of Kepler's "God-centered" methodological approach, is in his discussion of parallax, which Kepler says is "of godlike use in astronomy."

Close one eye, and raise your arm so as to look across your thumb to an object across the room; then, leaving your thumb where it is, open the closed eye, and close the other one. You will see that what appears to lie behind your thumb appears to shift. This leap is called "parallax," and it enables us to calculate the distances of objects from the eye—using the distance between the two eyes as the base of an isoceles triangle, and measuring the angles at that base. But, Kepler explains, for calculation of the distance of the celestial bodies, the distance of the eyes from each other is too small to be of help. Indeed, our vision may be completely in error in judging the positions of the planets.

But, he goes on:

> This defect in the sense of vision Nature removes through a wonderful device. For it was by all means the will of God the Creator that the human being, His image, should lift up his eye from these earthly things to those heavenly ones, and should contemplate such great monuments of His wisdom. Hence, the entire arrangement of the fabric of the world tends to bear witness to us of this will of the Creator, as if by a voice sent forth. For that reason, the ratio of the earth's globe to the orb of the moon has been made perceptible, so that what has deserted the eyes of individual humans, the attentiveness of all of them living on the whole surface of the earth, assisted by its magnitude, might supplement, and might in this way teach the position of the planets

Kepler In English

The following works by Kepler are available in English translation (in chronological order).

**Mysterium Cosmographicum. The Secret of the Universe* (1596, 1621), trans. by A.M. Duncan (New York: Abaris Books, Inc., 1981).

**Concerning the More Certain Fundamentals of Astrology* (1602) (Edmonds, Wash.: Sure Fire Press, 1988).

Optics: Paralipomena to Witelo & Optical Part of Astronomy (1604), trans. by W.H. Donahue (Santa Fe, N.M.: Green Lion Press, 2000).

**Johannes Kepler. New Astronomy* (1609), trans. by W.H. Donahue (Cambridge, U.K.: Cambridge University Press, 1992).

*Edward Rosen, *Kepler's Conversation with Galileo's Sidereal Messenger* (1610) (New York and London: Johnson Reprint Corporation, The Sources of Science, No. 5, 1965).

**The Six-Cornered Snowflake* (1611), trans. by Colin Hardie (Oxford, U.K.: Oxford University Press, 1966).

Epitome of Copernican Astronomy and Harmonies of the World (1618-21), excerpts, trans. by Charles Glenn Wallis (New York: Prometheus Books, 1995).

**The Harmony of the World* (1619), trans. by E.J. Aiton, A.M. Duncan, J.V. Field (Philadelphia: American Philosophical Society, 1997).

*John Lear, *Kepler's Dream* (1634—posthumous), trans. by Patricia Frueh Kirkwood (Berkeley and Los Angeles: University of California Press, 1965). Another translation of the same work: *Somnium,* trans. by Edward Rosen (Madison, Wisc. and London: University of Wisconsin Press, 1967).

*Carola Baumgardt, *Johannes Kepler: Life and Letters* (New York: Philosophical Library, 1951). With an introduction by Albert Einstein.

*N. Jardine, *The Birth of History and Philosophy of Science. Kepler's "A Defence of Tycho against Ursus" with Essays on Its Provenance and Significance* (Cambridge, U.K.: Cambridge University Press, 1984). An unpublished manuscript by Kepler.

*Out of print.

Some of these works are available from Ben Franklin Booksellers. Call, toll-free, 1-800-453-4108.

on the diameter of the world by those prior positions with respect to the surface: i.e., the distances of the angles.

In other words, by observing a celestial body from two distant places on the Earth's surface, or from two different points in the Earth's annual orbit around the Sun, we can increase the baseline of our measuring triangle, to the point that astronomical calculations can be made.[4]

The astronomical sections of the *Optics* are mainly devoted to working through calculations of parallax, using data from solar or lunar eclipses. This work, in turn, would feed into Kepler's still-ongoing effort to calculate the orbit of Mars. He intended to write another work, his *Hipparchus,* which would work out the distances of various celestial bodies; while this plan was never carried out, some of the information he intended for it appeared in other locations.

If all this discussion of God's intention in creating the universe in such a way that man might explore it, strikes you as somehow "quaint" or "old-fashioned," perhaps "mystical," maybe there is a reason why Kepler was a creative genius, and you are not. You have been brainwashed by four centuries of anti-Keplerian propaganda (Galilean, Newtonian), whose primary purpose was to *remove* the cognitive being, the scientist, from the world which he is observing. (That's being "objective," we are taught in school.) It is no accident that it has taken four centuries for a few of Kepler's major works to become available in English translation (he wrote 80 books, and many shorter works). In a Newtonian world, Kepler is routinely denounced as a mystic, and his actual work suppressed.[5]

Think it through again. As LaRouche teaches, Kepler's extraordinary intellectual potency can reawaken the mind of the reader, bringing to life what occurred in the mind of that great discoverer, long ago.

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4. This method is not new to Kepler, but dates to antiquity. It allowed quite accurate calculations of the distance between the Moon and the Earth to be made by Hipparchus, for example, in the Second Century B.C. Calculation of the much greater distance of the Sun or the stars from the Earth proved far more difficult, since the parallax is harder to detect, and Kepler's own calculations of the Sun's distance were too small by nearly an order of magnitude. It was only with the development of high-powered telescopes, that a more accurate measurement could be made. See Albert van Helden, *Measuring the Universe: Cosmic Dimensions From Aristarchus To Halley* (Chicago: University of Chicago Press, 1985). My point in quoting Kepler here, is to emphasize his methodology: the coherence among the cognitive, biotic, and abiotic domains.

5. A typical example is from Anton Pannekoek's *A History of Astronomy* (New York: Dover Publications, Inc., reprint of 1961 edition), concerning Kepler's *The Harmony of the World:* "But among all these fantastic relations [the harmonies] we find one precious discovery, afterwards always cited as *Kepler's third law*. . . . Later science has accepted from the entire work on 'The Harmony' only that one page containing the third law."

'Nathan The Wise': Timely Attack On The 'Clash Of Civilizations'

by Anita Gallagher

Gotthold Emphraim Lessing's 1779 play, *Nathan the Wise,* is, if anything, a more powerful attack today on the "clash of civilizations" pathway into which the different religions could be manipulated, than at the time it was written. Likewise, the alternative it clearly poses—that Christian, Jew, and Muslim should deal with each other by *competing to do good* and to improve the world—emerges even more starkly against the war which now threatens the world should it fail.

In a stroke of good fortune, the play was recently staged outside Washington, D.C., at George Mason University in Virginia. University playwright and professor Paul D'Andrea presented a two-hour play, adapted from Lessing's five-act drama, under the same title. *Nathan the Wise* is the centerpiece of The Jerusalem Project, an effort to promote understanding among diverse groups at GMU, its theater, the Jewish Community Center of Northern Virginia, various high school classes studying the play, and others. With the near-collapse of Mideast peace efforts, and the attempts to trap the United States into a war against Muslim nations, the performance could not be more timely, or more vital for allowing the audience the opportunity to re-create the solution today, by observing the characters on the stage.

The History Behind The Play

Lessing set the play in 1192, in the Third Crusade, after the Muslim warrior Prince Saladin retook Jerusalem from the Christians. Saladin then established the Peace of Ramla, which lasted until his death in 1195. During those three years, Jews, Christians, and Muslims lived in peace in Jerusalem, which Saladin believed possible because all three religions believed in the same God and reverenced the Hebrew Old Testament.

Lessing, the son of a minister, wrote the play as an intervention into his own times. It was a continuation by another means—irony—of his philosophical war against the theologians who believed in salvation through revealed religion alone. Lessing based his Jewish character "Nathan" on Moses Mendelssohn, Lessing's close personal friend and collaborator in uplifting the culture of the German nation. Mendelssohn, in turn, had studied the works of the great Jewish-Arabic writer and philosopher Moses Maimonides, who was the his-