

Genevieve Gebhart, "Convinced by Comparison: Lutheran Doctrine and Neoplatonic Conviction in Kepler's Theory of Light," *intersections* 11, no. 1 (2010): 44-52.

## ABSTRACT

Johannes Kepler's investigation of the epistemology and ontology surrounding the nature of light bridged the gap between his Lutheran and Neoplatonic foundations and his revolutionary idea of a physical, causal astronomy. Kepler sought to find logically the "true cause" behind the *virtus motrix* (motive power) that moved the planets and determined their organization. He employed Lutheran *regressus* reasoning and merged Plotinian- Neoplatonic emanationism with his own empirical observations to form a theory of light, which he legitimized with analogy and *exemplum* reasoning. Though his observations forced him to reject the Neoplatonic idea of light as a *virtus motrix*, he demonstrated that light and the *virtus motrix* were two species of the genus of forces that attenuate with distance. These conclusions allowed Kepler to theologically, mystically, and empirically confirm the motion of the planets as the effects of a universal, physical law.

[http://depts.washington.edu/chid/intersections\\_Summer\\_2010/Genevieve\\_Gebhart\\_Lutheranism\\_and\\_Neplatonism\\_in\\_Kepler's\\_Theory\\_of\\_Light.pdf](http://depts.washington.edu/chid/intersections_Summer_2010/Genevieve_Gebhart_Lutheranism_and_Neplatonism_in_Kepler's_Theory_of_Light.pdf)

# Convinced by Comparison

## Lutheran Doctrine and Neoplatonic Conviction in Kepler's Theory of Light

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Over the course of his numerous publications, Johannes Kepler's theory of light bridged the gap between his theological and Neoplatonic foundations and his revolutionary idea of a physical, causal astronomy. During his early education at Tübingen, Kepler encountered Michael Maestlin, the professor of astronomy with whom he first studied Copernicanism. This introduction to the possibility of a heliocentric astronomy complemented Kepler's belief that the sun was the only possible source of the planets' driving power and therefore had to be at the center of the planetary system.<sup>1</sup> In addition to endorsing Copernicanism, Maestlin also promoted the fundamentally Lutheran belief that the study of the natural world yields knowledge of God's plan for mankind, a race uniquely equipped to discover the universe's secrets through an innate knowledge of geometry that had been "inscribed on the human soul when it was created."<sup>2</sup> To this fundamental Lutheran doctrine, Maestlin added an important caveat: he insisted that scientific accuracy, in astronomy especially, augmented one's knowledge of God and providence.<sup>3</sup> This theological foundation was not mystical as much as it was a common property of Lutheran belief and that of many other contemporary Christians at the time. This "common sense" Lutheran theology provided an academically legitimate basis upon which to connect the mathematical arguments of the divine with the physical arguments of natural philosophy.<sup>4</sup> In Kepler, this Lutheran worldview manifested itself in his relentless study of the physical world as the visible image of God.

Before examining the theological goals and arguments that define Kepler's first major work, *Mysterium cosmographicum*, one must first understand the *regressus* reasoning that dominates its structure. Foremost theologian of the Protestant

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<sup>1</sup> Johannes Kepler and William H. Donahue, *New astronomy* [*Astronomia nova*, ed.] (Cambridge: Cambridge University Press, 1992), xiii.

<sup>2</sup> Peter Barker and Bernard R. Goldstein, "Theological Foundations of Kepler's Astronomy," *Osiris* 16 (2001): 105.

<sup>3</sup> *Ibid.*, 98.

<sup>4</sup> *Ibid.*, 111.



Johannes Kepler, 1610.

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Reformation Philip Melanchthon profoundly influenced Kepler's arguments in *Mysterium* by establishing regressus argument as the most rigorous form of logical proof. A regressus consists of three sets of arguments. The first, argument *a posteriori*, derives description of an effect from description of its possible causes. The second, the *negatiatio* or the *consideratio*, eliminates available alternatives, leaving one as the "true" cause. The final stage, argument *a priori* assumes the new "true" cause and from it deduces the original effect.<sup>5</sup> The Lutheran intellectual community accepted the regressus method, and further accepted *a priori* demonstration as ideal in determining unique, true cause.<sup>6</sup>

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<sup>5</sup> Ibid., 91.

<sup>6</sup> Ibid., 98.

Kepler regarded Copernicus's *De revolutionibus* as offering no more than a posteriori demonstration to "save the appearances." In *Mysterium* he states that, "I had then reached the point of ascribing to this same Earth the motion of the Sun, but where Copernicus did so through mathematical arguments, mine were physical, or rather, metaphysical."<sup>7</sup> Kepler claimed that the arrangement of the cosmos could have been proven logically using the idea of creation and appealing to the "divine blueprint" of a priori reasoning.<sup>8</sup> He goes on to state his rational goals and their very mystical motivation:

There were three things in particular about which I persistently sought the reasons why they were such and not otherwise: the number, the size, and the motion of the circles. That I dared so much was due to the splendid harmony of those things which are at rest, the Sun, the fixed stars, and the intermediate space, with God the Father, and the Son, and the Holy Spirit.<sup>9</sup>

Kepler placed his triune God within the celestial sphere: the center as God, the sphere as Christ the Son, and the space between as the Holy Spirit.<sup>10</sup> Throughout his attempts to deduce the distances of the planets a priori with Pythagorean principles and symmetry, Kepler maintained faith in his ability to uncover the *virtus motrix* (motive power) behind planetary motion and organization. In *Mysterium* he offers his first appeals to analogy between light and this *virtus motrix*, though they emerge only as weak "existence proofs" that allow Kepler to assume that the Sun's influence weakens as a function of distance.<sup>11</sup> At this point Kepler's knowledge of the *virtus motrix* was of course considerably less comprehensive than that of light, a gap he would close as his knowledge of each expanded.

Kepler grounded his metaphysics of light in Plotinian-Neoplatonic emanationism, the ideology developed by Plotinus in which the source of all being is the cascading overflow or emanation of the divine One's essence. This applies to all physical things, including lesser forms of being, which, like the divine, project a likeness or image onto their surroundings. The cascading effect extends

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<sup>7</sup> Johannes Kepler and E. J. Aiton. 1981. *The secret of the universe = Mysterium cosmographicum*, Janus series, number 9 (New York: Abaris Books, 1981), 63.

<sup>8</sup> Johannes Kepler, E. J. Aiton, A. M. Duncan, and Judith Veronika Field, *The harmony of the world*, Memoirs of the American Philosophical Society, vol. 209. (Philadelphia: American Philosophical Society, 1997), xv.

<sup>9</sup> Kepler and Aiton, 63.

<sup>10</sup> David C. Lindberg, "The Genesis of Kepler's Theory of Light: Light Metaphysics from Plotinus to Kepler," *Osiris* 2 (1986): 30.

<sup>11</sup> Dedre Gentner, Sarah Brem, Ronald W. Ferguson, Arthur B. Markman, Bjorn B. Levidow, Phillip Wolff, and Kenneth D. Forbus, "Analogical Reasoning and Conceptual Change: A Case Study of Johannes Kepler," *The Journal of the Learning Sciences* 6, no. 1 (2001):16.

infinitely, so that all physical things affect all other physical things at all times.<sup>12</sup> Plotinus linked light to his doctrine of emanation by comparing the rays of light of the Sun to the essence emanating from the One, calling each the *species immateriata* of its source. When Ficino adopted Plotinus's emanationism in the 15<sup>th</sup> century, he further likened light to the soul, arguing that visible light unites the celestial and terrestrial realms in the same way the soul unites superior and inferior being.<sup>13</sup> In the animistic universe of Ficino's Renaissance, light was equally an animistic entity.<sup>14</sup> Kepler adopted Plotinus's emanationism and Ficino's animism, and agreed with both that light, as a case of emanation readily accessible to human senses, was the doorway to understanding the universal principle of emanation.<sup>15</sup> However, Ficino, and Plotinus before him, struggled with Neoplatonism's historical dilemma between unity and diversity, continuity and polarity; at some point classifications about light had to be made, but Neoplatonic ideology yielded no places on the continuum where clear lines could be drawn.<sup>16</sup> Plotinus and Ficino both found themselves caught between these opposite truths of the Neoplatonic tradition, and among the confusion failed to commit to definite answers to the crucial ontological questions regarding light's corporeality, spirituality, and effect on its medium.

Kepler harmonized Neoplatonism's various contradictions and discontinuities concerning the qualities of light with his own empirical observations to formulate his theory of the nature of light. He presents its basic axioms in the first propositions of his optical treatise, *Ad Vitellionem paralipomena quibus astronomiae pars optica traditur*. Kepler starts by stating that the property of emanation is inherent to light, and clarifying that every point on a luminous body is a source of spherical emanation for an infinite number of lines, or geometric rays. His mystical foundations remain apparent: Kepler claims that this uniformly rectilinear propagation of light from all points on its source is due the teleological tendency of all things to imitate their Creator, and therefore strive for perfect, divine centricity. He also argues that light travels instantaneously to infinity as a two-dimensional geometrical surface that has "no matter, weight, or resistance."<sup>17</sup> Where Plotinus ambiguously rejected light's corporeality, Kepler

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<sup>12</sup> Lindberg, 12.

<sup>13</sup> Ibid., 26.

<sup>14</sup> Richard Westfall, "HA&S 220/CHID270 Autumn '09; Comments on Readings #5," <http://faculty.washington.edu/boynton/H220-CHID270/Readings/R5.pdf> (accessed June 10, 2010).

<sup>15</sup> Lindberg, 10.

<sup>16</sup> Ibid., 26.

<sup>17</sup> Johannes Kepler, *Ad Vitellionem paralipomena, quibus astronomiae pars optica traditur. Potissimum de artificiosa observatione et aestimatione diametrorum deliquiorumque solis & lunae. Cum exemplis insignium eclipsium. Habes hoc libro, lector, inter alia multa nova, tractatum luculentum de modo visionis, et humorum oculi usu, contra opticos et anatomicos.* (Bruxelles: Culture et Civilisation, 1968), 8.

went further and defined the nature of light as mathematical, and light itself as mathematical substance.<sup>18</sup> Kepler also observed that light's concentration decreased as a function of the distance from its source, from which he derived the inverse-square law that he first states in *Ad Vitellionem paralipomena*. It is important to note that at this point Kepler states the effects of the inverse-square law in terms of the force's density or concentration – the power is simply spread out, not lost, across a given distance.<sup>19</sup> With these propositions Kepler succeeded in providing a stable empirical foundation from which to launch his study of light and consequently of the *virtus motrix*. Ultimately, however, his theory of the nature of light operated under the notion that one cannot define light, or God, for that matter; one can only declare what it is *not* and use comparison to support the negation.

Kepler's comparison of choice was analogy. He returned to the analogy between light and the *virtus motrix* almost obsessively across his body of work, introducing it in *Mysterium* and refining it throughout *Astronomia nova* and *Epitome astronomia Copernicanae*. In *Ad Vitellionem paralipomena* Kepler praises analogies as his "most faithful masters, acquainted with all the secrets of nature...they bring the solution of an infinity of cases lying between the extreme and the mean, and where they clearly present to our eyes the whole essence of the question."<sup>20</sup> Kepler extended his analogy to the point that light and the *virtus motrix* nearly became one and the same. In Chapter thirty-four of *Astronomia* he describes light as "an immaterial species of that fire which is in the body of the sun, so this power which enfolds and bears the bodies of the planets, is an immaterial species residing in the sun itself...the primary agent of every motion in the universe."<sup>21</sup> The apparent similarities between both the quality and behavior of light and the *virtus motrix* were convincing, especially against the backdrop of Kepler's Copernican, mystical, and theological convictions.

In *Mysterium* he points out a few key early observations concerning light and the *virtus motrix*: both emanate instantaneously from their source (essentially, in Kepler's mind, the Sun for both), both are geometrical surfaces that do not exist in the intervening medium, and neither loses any power in travelling from its source to its illuminable or movable object.<sup>22</sup> Kepler did not limit himself to the similarities between light and the *virtus motrix*, however; he further analogized

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<sup>18</sup> Lindberg, 42.

<sup>19</sup> Genter *et al*, 18.

<sup>20</sup> *Ibid.*, 29.

<sup>21</sup> Kepler and Donahue, 381.

<sup>22</sup> "Johannes Kepler – and his early astronomy and physics," <http://www.new-science-theory.com/johannes-kepler.html> (accessed June 10, 2010)

the Sun and the planets to sailors in a river, magnets, orators gazing at a crowd, and balanced scales to answer questions that analogy to light could not address.<sup>23</sup> By allowing more familiar domains to inform his understanding of the *virtus motrix*, Kepler was able to pursue alignments and systems that would otherwise have been unapparent.

Despite the persuasive capacity of the analogies, Kepler's own observations forced him to reject the temptation to equate the *virtus motrix* with light and the Neoplatonic species *immateriata* it represented. Kepler's first and most basic observation was to note that light interacts with only the surfaces of the bodies it illuminates, while his *virtus motrix* interacts with the "whole corporeality" of the planets it moves.<sup>24</sup> Kepler's observation that light emanates spherically and the *virtus motrix* circularly from the Sun led to his analysis of light and the *virtus motrix* during a planetary eclipse: one planet may be eclipsed by another and therefore receive no visible light, yet the eclipsed planet does not stop moving and thus must still receive *virtus motrix*.<sup>25</sup> Here Kepler's theory of the *virtus motrix* appears primarily empirically justified and independent from his theory of light, but this independence is less a rejection and more a development of the theological and mystical motivations at the basis of Kepler's theory.<sup>26</sup> Kepler did justice to his Lutheran and Neoplatonic beliefs by establishing the empirical truths behind the phenomena they glorified. His deeply held belief in the Sun's dominance was at stake, and over time he had to revise some of his less critical, more abstract beliefs in favor of the evidence that validated his greater worldview of a heliocentric system.

Clearly, highlighting similarities could get Kepler only so far in his efforts to find the "number, size, and motion of the circles," so he attacked the inconsistencies between light and the *virtus motrix* with *exemplum* reasoning.<sup>27</sup> The *exemplum* is a more specific brand of analogy, geared toward illuminating universal laws and patterns of argument. Traditionally, *exemplum* "appeals to a similar or illustrative incident which is not intrinsically connected with the matter under discussion."<sup>28</sup> In the context of a *regressus*, *exemplum* may replace the *negatiatio* step in order to establish a *genus* to which all instances in question, or

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<sup>23</sup> Genter et al, 31.

<sup>24</sup> Lindberg, 39.

<sup>25</sup> Genter et al, 23.

<sup>26</sup> Lindberg, 41.

<sup>27</sup> Genter et al, 63.

<sup>28</sup> Kristoffel Demoen, "A Paradigm for the Analysis of Paradigms: The Rhetorical *Exemplum* in Ancient and Imperial Greek Theory," *Rhetorica*. 15, no. 2 (1997): 126.

exempla, belong as species.<sup>29</sup> Following the tradition of Lutheran natural philosophy, Kepler used logic and rhetoric to link physical and mathematical reasoning.<sup>30</sup> His light analogies from Chapter thirty-four of *Astronomia* establish the physical basis for the mathematical exemplum-based inferences that validate the distance-velocity law – Kepler’s second law of planetary motion – in Chapter forty. This same rhetorical pattern of specific physical analogy to broad mathematical exemplum appears again in Chapter fifty-seven, which argues that reciprocation – Kepler’s first law – represents a natural law and is therefore part of *the* plan, God’s plan, for the world. For Kepler, successfully matching calculation to observation was not enough; the pattern inherent in the observations had to lend itself to physical explanation and therefore to classification as a universal law.<sup>31</sup>

Kepler’s demonstration of light and the *virtus motrix* as two species of the same genus indicates the culmination of great epistemological and ontological modifications to the universe he first presented in *Mysterium*. In *Mysterium*, Kepler proposed an *anima motrix* (motive spirit) as the mover of the planets, a “single moving soul in the center of all the spheres, that is, in the sun.”<sup>32</sup> He later called his motive force the *vis motrix* (motive force) or, most consistently, the *virtus motrix*, referring to a more physical and tangible phenomenon. As his terminology became less animistic and more mechanical, so did his ontology. His initial motive spirit, derived directly from the theological and mystical nature of light, evolved with observation into a mechanical concept of the Sun’s influence.<sup>33</sup> Kepler’s epistemology had to encompass the contradictory traditions that influenced his adoption of a physical universe, particularly Neoplatonism, Lutheranism, and the emerging mechanical philosophy of the 17th century. Embracing this intellectual ‘schizophrenia’ was the only way he could guarantee conclusions and demonstrate results to his audience’s – and his own – high standards of validity.

Although he could not claim to define all the physical details of his *virtus motrix*, he could claim its existence, and at least some of its characteristics, by relating it to light and magnetism as a species of the genus of forces that attenuate with

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<sup>29</sup> Barker and Goldstein, 106.

<sup>30</sup> *Ibid.*, 107.

<sup>31</sup> G. Hon and Y. Zik, “Kepler’s Optical Part of Astronomy (1604): Introducing the Ecliptic Instrument,” *Perspectives on Science* 17, no. 3 (2009): 308.

<sup>32</sup> Timothy D. Lyons, “Scientific Realism and the Stratagema de Divide et Impera,” *British Journal for the Philosophy of Science* 57, no. 3 (2006): 545.

<sup>33</sup> Genter et al, 31.



distance.<sup>34</sup> Kepler imposed fundamentally Lutheran principles onto the Neoplatonic concept of emanation, which he used as a guide in his physical investigation of the mechanical motive force of the solar system. By recognizing the physical force responsible for the motions of the planets as a species of an established genus, Kepler could on theological grounds confirm its effects as laws of nature inherent in God's plan for Creation. Throughout this investigation, Kepler's theory of light developed alongside his changing concept of *virtus motrix*, each granting him the vital understanding he could not gain from the other.

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<sup>34</sup> Barker and Goldstein, 107.