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The scriptures are filled with images of light, the most memorable being Christ's simple declaration, "I am the light of the world." Ivan Aivazovsky, *Jesus Walks on Water*, 1888 (public domain).

Physical Light and the Light of Christ

David A. Grandy

A religiously minded science teacher once told me that the special theory of relativity could not be correct because, if true, it would keep God from moving or communicating at superluminal speeds. Even though I knew little about special relativity at the time, I sensed that the theory was less limiting than my teacher believed. After all, for photons moving at light speed, “there is no passage of time,” as Hermann Bondi has put it, owing to complete time dilation.¹ Wouldn’t the disappearance of time open up alternative travel and communication possibilities for God?

This question becomes particularly compelling when we consider scriptures that suggest God’s capacity to transcend time and his deep association with light.² Passages from all four standard works portray light as a principle of truth, intelligence, creation, and divinity. And while science, with its predilection for naturalistic explanations, would seem to have little to say about matters of religious import, it has in the last century chastened us with a fresh awareness of light. I say “chastened” because before 1900, physicists assumed that light could be understood according to Isaac Newton’s laws of mechanics. Newton did not accord

1. Hermann Bondi, *Relativity and Common Sense: A New Approach to Einstein* (Garden City, N.Y.: Anchor Books, 1964), 108. Note that when Bondi talks about light, he is referring to the entire electromagnetic spectrum (all the way from radio waves to gamma waves), not just the small portion of the spectrum to which the human eye is sensitive. This also is my definition of light.

2. See, for example, Doctrine and Covenants 38:1–2 and 130:7 for passages connoting God’s transtemporal existence.

David A. Grandy

I first took an interest in physical light as a young missionary. Passages from all four standard works, but particularly the Doctrine and Covenants, led me to wonder whether the light of everyday experience might be understood as an expression of God's love. Later, while serving in the military, I became interested in modern physics, and this interest impelled me to take night-school classes at Harvard University and then to pursue a PhD in history and philosophy of science at Indiana University. After landing a job at BYU–Hawaii and teaching for several years, I decided to study light more rigorously, an endeavor that bridged into my work at BYU–Provo and that resulted in the publication of several articles and one book (*The Speed of Light: Constancy and Cosmos*). My sense is that, like all things sacred, light is inexhaustibly deep.



special status to light, believing it to consist of particles whose behavior mimicked the action of particles composing material bodies. Celebrating Newton's prism experiments not long after his death, James Thomson wrote:

E'en Light itself, which every thing displays,
Shone undiscover'd, till his brighter mind
Untwisted all the shining robe of day;
And, from the whitening undistinguish'd blaze,
Collecting every ray into his kind,
To the charm'd eye educed the gorgeous train
Of parent colours.³

3. James Thomson, "To the Memory of Sir Isaac Newton," in *The Poetical Works of James Thomson* (Boston: Houghton, Mifflin, 1863), 48–49.

In this poem, Thomson finds Newton's mind brighter than light itself. But no scientifically minded poet would offer this kind of tribute today. Light has proved too puzzling. As Ralph Baierlein puts it, "Light, it seems, is always ready with another surprise,"⁴ and for the last century the surprises have repeatedly upended older understandings of light. What is more, these surprises have, among scientists and nonscientists alike, triggered a great deal of philosophical and theological commentary. In this article, I argue that physical light—the light that science investigates and the agency by which we see the world—resonates metaphysical overtones, some of which may be considered theological or spiritual. To be specific, I propose that special relativity's portrayal of light breaks the frame of mechanistic thought and thereby allows for a reconsideration of the reverential view of light that prevailed in the West prior to the early modern era. Implicit in this older view is the thought that physical light is in some ways indistinguishable from spiritual light, or the light of Christ.

This is not to suggest that Albert Einstein, the architect of special relativity, would agree with what follows or even take an interest in my argument. His god, he stated, was Baruch Spinoza's, a god intimately allied with nature but oblivious to human affairs.⁵ All the same, no scientific theory pronounces for or against God; nor can a theory be said to categorically sanction a particular definition of God. All theories, however, may be mined for spiritual insight, just as literature, art, and music may be so mined. Here I offer an analogy for bridging from one domain to the other—from religion to science—to prompt further discussion, without insisting that my ideas are conclusive. If light teaches us anything, it is that there is always another surprise around the corner.

Additionally, science enjoins intellectual modesty, both as a guiding principle and as historical fact. What compels scientific assent in one era may strike the next generation of researchers as misguided and unrealistic. But this is to put the matter too pessimistically, for scientists do not simply cycle through hypotheses ever hoping to find the right one. They learn from their errors, revising hypotheses as they grow to see nature in new ways. Special relativity is one such new way, and my submission is that it offers a fresh perspective on how God interacts with his creation.

4. Ralph Baierlein, *Newton to Einstein: The Trail of Light* (Cambridge, UK: Cambridge University Press, 2001), 95.

5. Banesh Hoffmann, *Albert Einstein: Creator and Rebel* (New York: Viking, 1972), 94–95, 195.

First, however, let me make a general statement about methodology and motivation—what assumptions inform my attempt to interrelate scientific and religious understandings of light and why I feel the question of light is religiously important.

Guiding Assumptions and Significance

One reviewer of an early draft of this article rightly stated that “the word ‘light’ is often used in a symbolic fashion in the scriptures.” I certainly agree, but it strikes me that behind its symbolic meanings, light is something in and of itself. At least that is the intuition that motivates this article, and if this intuition is correct, it would seem that the study of light should be spiritually rewarding, particularly in view of the profound significance that scripture ascribes to light. For example: “The glory of God is intelligence, or, in other words, light and truth” (D&C 93:36).

Now, should we just let the word “light” here function as a symbol for glory, intelligence, and truth, or may we also wonder about light itself as we know it, or fail to know it, in familiar, everyday settings? My inclination is to wonder, and to do that, I turn to science, which is the only endeavor I know of that rigorously studies physical light. I do not believe that science knows everything there is to know about light, but if one is prompted by the scriptures to study light, there is no other place to start.

The danger here, according to many observers, is that those who aim for this kind of interdisciplinary understanding of light will take religious or poetic liberties with science while working up outlooks that most scientists then regard as idiosyncratic at best and simply false at worst. To be sure, such an approach is always a concern, but to the degree that it lives from the premise that science is a world apart from other human endeavors, it is, in my view, overstated and misleading. Drawing inspiration from science (an incorrect understanding of science, as it turned out), the logical positivists attempted to ground all human knowledge to absolutely secure foundations—that is, to propositions that no sane person could contest—but this attempt, by their own admission, failed. What they came to realize is that “there is no escape from metaphysics,”⁶ no escape from philosophical, religious, and poetic predispositions, even as we engage in the careful analytical work of science.

6. E. A. Burtt, *The Metaphysical Foundations of Modern Physical Science* (Amherst, N.Y.: Humanity Books, 1999), 227.

Not only that, but pure science attracts thinkers by reason of its grand speculations, which is not a knock against it but merely an acknowledgement of its vast explanatory reach. As Levi R. Bryant, echoing Bruno Latour and Adam Miller, explains:

Science is properly understood as an exploration of the transcendent. . . . Science guides our prodigious voyage through the realm of what is remote. Science introduces us to black holes at the center of each galaxy, subatomic particles beneath our threshold of perception, the appearance of things within the wavelengths of infrared and ultraviolet light, and the perceptual universe of the great white shark where the world is sensed in terms of electro-magnetic signatures. Science brings us before the genuinely foreign.⁷

Although theology and the philosophy of religion are also remote and speculative, pure religion ultimately directs or redirects our gaze back home—back to family, neighbors, coworkers, widows and orphans, and those who suffer. So I think the old characterization of science as a non-speculative, facts-only, ground-level endeavor leaves a lot unsaid, as does the criticism that religion is otherworldly and overly concerned with unseen and possibly nonexistent agencies. The two domains of thought interpenetrate more freely than we generally recognize, I believe. This article is an attempt to step beyond the merely symbolic understanding of light to see if “the glory of God” might be found in a familiar setting, at least provisionally.

“Easter in ordinary,” as one scholar has put it, suggesting that the sacred may be inscribed in the commonplace.⁸ This, of course, is not just a religious sensibility but a poetic one as well. Where others see discontinuity between poetry, religion, and science, I tend to see continuity, which tendency makes me partial to Ralph Waldo Emerson’s assertion that “never did any science originate, but by poetic perception.”⁹ Toward the end of this article I introduce some poetic images, both to advance the argument and to mark the truth of Einstein’s claim that “physical [scientific] concepts are free creations of the human mind, and are not, however

7. Levi R. Bryant, foreword to Adam S. Miller, *Speculative Grace: Bruno Latour and Object-Oriented Theology* (New York: Fordham University Press, 2013), xvii–xviii.

8. Nicholas Lash, *Easter in Ordinary: Reflections on Human Experience and the Knowledge of God* (Charlottesville: University of Virginia Press, 1988).

9. Ralph Waldo Emerson, *The Complete Works of Ralph Waldo Emerson*, 12 vols. (Cambridge, Mass.: Riverside Press, 1903–4), 8:365.

it may seem, uniquely determined by the external world.”¹⁰ To be sure, the events of nature spark our wonder, but we are the ones who creatively connect the dots, and there is no uniquely right way to do so, just as there is no uniquely right way to constellate the stars.

With that as prolegomena, we now consider some historical background.

The Lull before the Storm

In 1900, Lord Kelvin, a prominent British physicist, stated that just two problems marred the “beauty and clearness of the dynamical theory [of heat and light].”¹¹ Both problems reached back to Thomas Young’s 1801 observation of wave interference fringes on a backdrop after he let light pass through a two-slitted barrier. The alternating dark and bright fringes (see fig. 1) indicated that, contra Newton, light consists of waves, not particles. Letting the behavior of sound and water waves guide his thinking, Young insisted that when light waves meet in phase (crest meeting crest), bright fringes or bands appear, signifying constructive interference; when they meet out of phase (crest meeting trough), dark fringes appear, signifying destructive interference. The resulting pattern, the array of alternating bands, seriously challenged Newton’s model of light, for it would seem that if light consisted of particles, we would see on the backdrop something very different—just two longish regions of light opposite the slits.

By 1830, the entire physics community had migrated over to the wave theory of light. But when physicists thought of light waves, they were obliged to think of something else as well—a material medium through which those waves propagated. Unlike particles, which were imagined to be self-existing entities, waves could not be imagined to be anything

10. Albert Einstein and Leopold Infeld, *The Evolution of Physics: The Growth of Ideas from Early Concepts to Relativity and Quanta* (New York: Simon and Schuster, 1961), 31. Elsewhere Einstein alluded to the creative aspect of science by stating that while scientific theories may end up looking as if they were powered into existence by nothing more than logical deliberation, they in fact reach back to “child-like thought”—at least his special theory of relativity originated from such. He then concluded, “Discovery is not a work of logical thought, even if the final product is bound in logical form.” Cited in John D. Norton, “Chasing the Light: Einstein’s Most Famous Thought Experiment,” in *Thought Experiments in Philosophy, Science, and the Arts*, ed. Mélanie Frappier, Letitia Meynell, and James Robert Brown (New York: Routledge, 2013), 130.

11. Lord Kelvin, *Baltimore Lectures on Molecular Dynamics and the Wave Theory of Light* (London: Cambridge University Press Warehouse, 1904), 486.

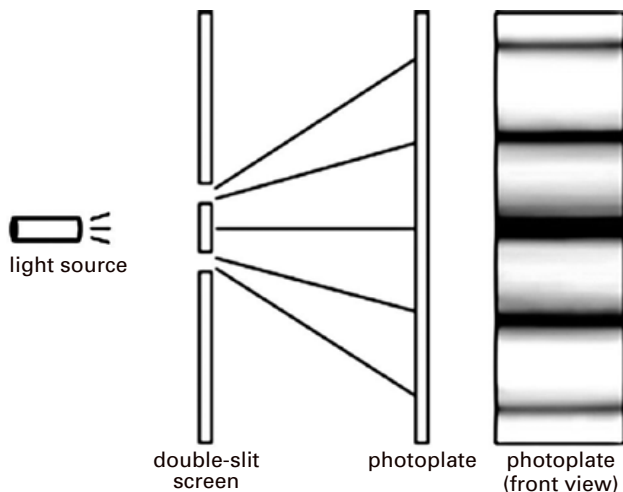


FIGURE 1. Light is directed toward a two-slitted barrier and then blocked by a backdrop, in this case a photoplate or light-sensitive film. If light consists of particles, two particle clusters should show up opposite the slits. Instead an interference pattern registers, signifying light's wave nature.

more than the wave action of some physical substance. How, after all, could water waves exist without water or sound waves without air? Or light waves without a comparable supporting medium? The trouble was—and this was the first problem Lord Kelvin had in mind—that no such medium had been found, despite much hard theoretical work and careful experimentation.¹² The situation was a bit absurd, or at least difficult to explain. Some have compared it to the incident described in Lewis Carroll's *Alice in Wonderland*, where the grin of the Cheshire cat hangs in the air without the cat.¹³

12. The hard theoretical work consisted of determining the properties of this presumed medium, the ether. For ether to function as assumed, it had to be (among other things) subtle or ethereal and rigid: subtle so that material bodies could pass through it without being affected by its presence; rigid because only an incredibly rigid substance (calculated to be at least a million times more rigid than steel) could support waves moving at light speed. Merging these and other properties into a single hypothetical substance taxed the ingenuity of many first-rate thinkers. The careful experimentation involved researchers' attempts to physically detect the ether, an endeavor elaborated later in the body of this article.

13. Daniel Kleppner and Robert J. Kolenkow, *An Introduction to Mechanics* (Cambridge, UK: Cambridge University Press, 2010), 450.

Lord Kelvin's second problem concerned the failure of the wave theory of light to correctly predict the emission of blackbody radiation at high frequencies. Max Planck solved this problem in 1900 but only by reintroducing a particle or quantum model of light. This solution, which it seems Planck viewed as merely a stopgap measure,¹⁴ was a harbinger of the even bigger surprise of wave-particle duality.

As for the first problem—that of the missing material medium—this was solved by Einstein in 1905 when he published papers that introduced his special theory of relativity. But to say Einstein “solved” the problem is not to say that he cleared up all the conceptual difficulties relating to light's motion. Along with others, I argue that Einstein's solution—particularly his postulate of light-speed constancy—opens new horizons of thought by challenging the mechanistic metaphysics that characterized science after Galileo, Descartes, and Newton. Of course, special relativity does not address the question of God's existence, and so it cannot be said to decide anything of theological import. Nevertheless, for those inclined to think along a scriptural wavelength while tracking the trajectory of scientific thought, it offers fresh perspectives on the question of how God as a being of light might interact with his creation. At the very least, it helps us realize that Newton's laws of mechanics do not tell the whole story of physical reality. Other factors figure into that story, so that in the coarsely mechanistic fabric of things there is always surprise, the expression of which is often bound up in light.

For Christians, God's command “Let there be light” opened the Creation with its vast expanse of possibility. Whether viewed from a religious or scientific perspective, light still awakes us to new possibility. It is not just the agency that illuminates the present world but also a principle that may be said to intimate realms of being beyond our normal ken. One such realm is implicit in the view of light found in Christian scripture.

A Christian View of Light

In the Gospel of John, Jesus Christ is introduced as the *Logos*; that is, the Word of God by which the cosmos was created and rendered intelligible. It appears that John is responding here, at least in part, to the Greek belief that the universe is a place of reason, beauty, and harmony,

14. Thomas S. Kuhn, *Black-Body Theory and the Quantum Discontinuity, 1894–1912* (Oxford, U.K.: Oxford University Press, 1978).

and he is tracing those qualities instead back to Christ. Striking a note that would appeal to both Jew and Gentile, he states that in Christ the *Logos* “was life; and the life was the light of men” (John 1:4). Christ was “the true Light, which lighteth every man that cometh into the world” (John 1:9). Here light could almost trade places with life, for light is not simply a pleasant addition to reality, a nice extra. Rather, it shines or burns with life-combusting radiance.

The Gospel of John is filled with other images of light, the most memorable being Christ’s simple declaration, “I am the light of the world” (John 8:12). For those attuned to biblical echoes, this affirmation reverberates with “Let there be light,” the first great creation formula of the book of Genesis. Although God will later create the lights of the heavens (the sun, moon, and stars), he does not, according to Michael Welker, work in darkness and so first calls into existence an ambience of brightness. Welker insists that an understanding of Genesis begins with the realization that “Creation connects diverse processes and domains of life and orders them in such a way that they can be known by human beings and that human beings can enter into communication with God.”¹⁵ The circumambient light-realm enables this ordering, integrating activity; it is a matrix that engenders life, understanding, and communion with God.

Not only that, but light as a principle of creation seems to remain eternally operative in the cosmos. The circumambient light-realm timelessly informs what comes thereafter, so that now physical light may be said to participate in the moment of creation. In section 88 of the Doctrine and Covenants, we read:

This is the light of Christ. As also he is in the sun, and the light of the sun, and the power thereof by which it was made. As also he is in the moon, and . . . the light of the stars, and the power thereof by which they were made. . . . Which light proceedeth forth from the presence of God to fill the immensity of space—The light which is in all things, which giveth life to all things, which is the law by which all things are governed, even the power of God who sitteth upon his throne, who is in the bosom of eternity, who is in the midst of all things. (7–13)

Consistent with other LDS scripture, this passage challenges the spirit-matter dichotomy that informs mainstream modern thought.¹⁶ Most

15. Michael Welker, “Creation: Big Bang or the World of Seven Days?” *Theology Today* 52, no. 2 (1995): 186.

16. See Doctrine and Covenants 29:34–35; 131:7–8.

contemporary Christians and even many LDS believers, I suspect, do not regard the light of the sun, moon, and stars as the light of Christ and the power by which they were made or created. But long before modern physicists began to probe the mysteries of physical light, Christians found in physical light intimations of God's presence in the world. Augustine of Hippo wrote that the Father had sent forth the Son not as the earth sends forth water but as light sends forth light: "For what is the brightness of light if not light itself? And consequently, it is co-eternal with the light of which it is the light."¹⁷ This brief declaration reflects Augustine's conviction that the Son is coeternal with the Father, and just as light is able to grace the finite world while retaining its aboriginal purity, so the Son descended into a cramped, finite sphere without compromising his Father's unbounded benevolence. Of all the elements of the world, Augustine insisted, light alone never suffers corruption.¹⁸

The inclination to appreciate light for its propensity to be at once a part of the world and yet apart from it lived on for centuries. Otto von Simson states that throughout the Middle Ages light was regarded as "the most noble of natural phenomena, the least material, the closest approximation to pure form."¹⁹ This belief figured into the development of the Gothic cathedral, which has been described as embodying "an architecture of light."²⁰ Pointed arches and flying buttresses allowed builders to construct a material edifice that seemed almost to dissolve into ambient light and space. This tendency toward etherealization mirrored a universal property of matter. Sand and ashes, Bonaventure noted, become glass when handled properly, coal gives way to fire, and dull stones become bright when rubbed. In each case, light shines through the dark veil of matter, refining and clarifying it in the process.²¹

Living in the thirteenth century, Robert Grosseteste viewed light as the seed crystal of creation. The universe, he insisted, began when God created a dimensionless point of light containing both form and matter. As the single point expanded, differentiation ensued to produce the

17. Saint Augustine, *The Trinity*, 4:20, trans. Stephen McKenna (Washington, D.C.: Catholic University of America Press, 1963), 165.

18. Augustine, *Letters*, ed. Wilfrid Parsons, vol. 3 (Washington, D.C.: Catholic University of America Press, 1953), 26.

19. Otto von Simson, *The Gothic Cathedral: Origins of Gothic Architecture and the Medieval Concept of Order* (New York: Pantheon Books, 1962), 51.

20. Daniel J. Boorstin, *The Creators: A History of Heroes of the Imagination* (New York: Vintage, 1992), 246.

21. Simson, *Gothic Cathedral*, 51–52.

material multiplicity of the cosmos.²² The first moment of creation, the moment of first light, hence lives on in all later moments, and this fact expresses itself in the splendor of the physical universe. Given this, light for Grosseteste was “the natural essence outside the soul which most completely imitates the divine nature and links the soul with God.”²³

Dante Alighieri, another late medieval student of light, ends his *Divine Comedy* by paying homage to eternal light. “In its profundity,” he writes, “I saw—ingathered and bound by love into one single volume—what, in the universe, seems separate, scattered.”²⁴ So densely packed with reality was this light that a moment’s contemplation thereof weighed more heavily on him, and slipped more easily from his memory and understanding, than twenty-five centuries of recorded history. But despite his inability to hold on to the vision, Dante came away knowing that eternal light embraces the miracle of harmonizing the upper and lower worlds. Therein two seemingly incommensurable magnitudes—divine perfection and human imperfection—are brought into relation.

This reverential attitude toward light died out in the early modern period, particularly after Newton seemed to reduce the action of light to mechanistic principles. It revived in the early twentieth century with the development of relativity theory and quantum mechanics, though by then the intellectual landscape had changed so radically that light-related puzzles were more likely to inspire flights of philosophical fancy than acclamations of God’s love. Still, at least two Christian theologians have drawn religious inspiration from the new physics and its revelations about light. Thomas Torrance and Iain MacKenzie both argue that Einstein’s universe—a universe built around the unfailing constancy of the speed of light—restates the unfailing constancy of the love of God toward his creation.²⁵ Further, light speed constancy preempts any

22. Robert Grosseteste, *On the Six Days of Creation*, trans. C. F. J. Martin (Oxford, UK: Oxford University Press, 1996), 97–101.

23. R. W. Southern, *Robert Grosseteste: The Growth of an English Mind in Medieval Europe*, 2d ed. (Oxford, UK: Clarendon Press, 1992), 218.

24. Dante Alighieri, *Paradiso*, canto 33, lines 85–87, in *The Divine Comedy of Dante Alighieri, A Verse Translation: Paradiso*, trans. Allen Mandelbaum (Berkeley and Los Angeles: University of California Press, 1982), 294.

25. Thomas F. Torrance, “The Theology of Light,” *Christian Theology and Scientific Culture, comprising the Theological Lectures at The Queen’s University, Belfast, for 1980* (Eugene, Ore.: Wipf and Stock Publishers, 1998), 78–87. Torrance proposes that the “reliability and trustworthiness of the universe” may be grasped “through reference to the constancy of light, for it does help us,

suggestion of cosmic favoritism or privilege, a fact which echoes the biblical declaration that “God is no respecter of persons” (Acts 10:34).

In Einstein’s universe, no reference frame is privileged, and while this fact implies the relativity of all reference frames, it also points back to a universal constant—the speed of light—that regulates the interaction of those frames. Thus there is a deep coherency to the world that, once understood, gives the lie to the shallow secular view that truth is situational and subjective. “The vision,” writes Stanley Jaki in rehearsing Einstein’s aspiration, “was that of a cosmic reality, fully coherent, unified, and simple, existing independently of the observer; that is, not relative to him, and yielding its secrets in the measure in which the mathematical formulas, through which it was investigated, embodied unifying power and simplicity.”²⁶

For Torrance and MacKenzie, the miracle of this deep coherency is that no single part of the vast unity is eclipsed by any other part, or even by the cosmic whole, which they understand to be light integrated. Owing to God’s capacity to bestow his elemental love “in the same free, invariant and equable way”²⁷ on all creation, to let the sun “rise on the evil and on the good” (Matt. 5:45), he remains mindful of the smallest and seemingly most insignificant details (the fall of a sparrow, say), even while attending to the entire universe.

One is reminded here of Galileo’s comment that “God and Nature are so employed in the governing of human affairs that they could not apply themselves more thereto if they truly had no other care than only that of mankind.” To secure this thought, Galileo notes the action of light: “And this, I think, I am able to make out by a most pertinent and

I believe, to appreciate in a new way the constancy or faithfulness of God” (81). Iain MacKenzie, *The “Obscurism” of Light: A Theological Study into the Nature of Light* (Norwich, UK: Canterbury Press, 1996), 49–61. MacKenzie states: “The constancy of the speed of light irrespective of whether its source is moving or static and without regard to the physical disposition of its observer, whether moving in any direction or static, points to the unqualified constancy of the God who has created all things by that Word made flesh” (60).

26. Stanley Jaki, “The Absolute beneath the Relative: Reflections on Einstein’s Theories,” in *Einstein and the Humanities*, ed. Dennis P. Ryan (New York: Greenwood Press, 1987), 10. Torrance puts it this way: “The universe is profoundly intricate and mysterious and full of surprises, but far from being arbitrary it manifests everywhere throughout all change and fluctuation an integrity and trustworthiness which are to be associated with the invariant properties of light.” Torrance, “Theology of Light,” 80.

27. Torrance, “Theology of Light,” 85.

most noble example, taken from the operation of the Sun's light, which, . . . in ripening that bunch of grapes, nay, that one single grape, . . . does apply itself so that it could not be more intense, if the sum of all its business had been the maturation of that one grape."²⁸ God focuses his entire attention on each detail of the world *as if it were the whole world*: this is both the everyday lesson of light, according to Galileo, and an idea growing out of the foundations of modern physics, according to Torrance and MacKenzie.

It is also Dante's idea, at least insofar as it suggests a light-integrated universe whose primordial intrigue is love: "what, in the universe, seems separate, scattered," is in fact "ingathered and bound by love" through the agency of light. The unitary, indivisible action of light brings the seemingly separate and scattered parts of the world into a coherent whole. This is an idea with many variations in modern physics, one of which I now address. Again, my aim is to offer suggestive rather than definitive understandings of light.

Einstein's Light

Now recall that the story of special relativity begins with the discovery that light has a wave nature. The classical and still commonsensical understanding of waves requires a material medium through which waves pass, for it is the medium itself that vibrates and thereby gives birth to light waves. But in the late nineteenth century, physicists sought without success to experimentally detect the medium—the universal ether—which they felt must support the propagation of light waves.

For most researchers the idea of self-existing light waves—light undulating with nothing to support the undulation—was well-nigh unthinkable. But for the young Albert Einstein, the universal ether was an even more problematic notion, and his inclination was to give it up altogether—never mind that its dismissal left physicists floundering for something to grab onto.²⁹ The problem reached back to Newton's

28. Galileo Galilei, *Dialogue on the Great World Systems*, in the Salusbury translation, revised, annotated, and with an introduction by Giorgio de Santillana (Chicago: University of Chicago Press, 1953), 378–79.

29. Martin J. Klein, "Thermodynamics in Einstein's Thought," *Science* 157 (August 4, 1967): 509–16. Also see Albert Einstein, *Relativity: The Special and the General Theory*, trans. Robert W. Lawson (New York: Crown Publishers, 1961). The presentation above is historical and therefore differs from what one generally encounters in physics texts whose expositions routinely begin with a

assertion that inertial (nonaccelerated) motion is indistinguishable from rest. Imagine someone—let’s call her Alice—in a railway car moving at a constant speed in a constant direction; that is, moving inertially. As she watches the surrounding countryside glide by, she is absolutely certain that she is moving and the scenery outside her window is stationary. But this she cannot prove, for, according to Newton, no experiment performed in one inertial setting will yield a different result when performed in another. It is possible, therefore, to imagine another person—we’ll call him Bob—standing on the ground, looking at the train, and insisting that he is moving while Alice is stationary. We now have two opposing narratives of the same event, and no scientific experiment can break the deadlock. If, for instance, Alice and Bob each toss a ball straight up and then watch to see whether it falls straight down, each will observe the same result. So neither person can win the argument as to who is moving and who is stationary.

Einstein unreservedly embraced this no-win principle because it dissolved the apparent distinction between rest and inertial motion. In the spirit of science, it streamlined our understanding of nature by describing rest as just another instance of inertial motion. And upon thinking through the implications of the proposed ether, Einstein realized that the experimental detection of the ether would undo the no-win principle by turning rest into a distinctive state of motion. As it was imagined, the ether pervaded every nook and cranny of the cosmos. Moreover, it did not move, though, owing to its ethereality, things like rocks and planets moved through it with the greatest of ease. It was, therefore, a universal rest frame, a vast, motionless expanse of extremely subtle matter that, if detected, could serve as a backdrop for determining whether a body was at rest or in inertial motion.

statement of the two postulates upon which the special theory of relativity is based: (1) the laws of physics are the same (yield the same experimental results) for all inertial observers, a proposition that is sometimes called the “principle of relativity”; and (2) the speed of light in an inertial reference frame is independent of the motion of the light source—is, in effect, the same for all inertial observers. The difficulty with starting out this way in my mind is that it offers no insight into why Einstein developed the highly counterintuitive second postulate. But Einstein explains his arrival at this idea as a matter of getting the speed of light to agree with the first postulate, as evidenced by the title of chapter 7 of the aforementioned book (*Relativity: The Special and General Theory*): “The Apparent Incompatibility of the Law of the Propagation of Light with the Principle of Relativity” (17).

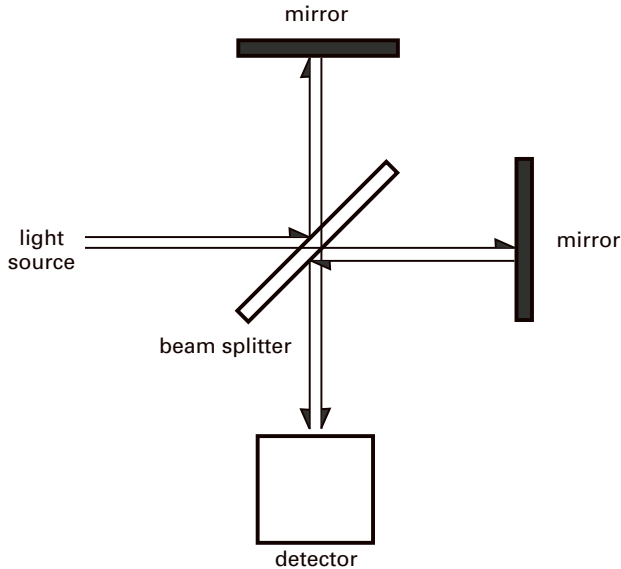


FIGURE 2. With the earth thought to be moving through the universal ether, a light beam is split in half and the two halves travel the same distance along perpendicular paths. After bouncing off the mirrors, the beams reunite at the beam-splitter and travel together to the detector. Theory indicated that one beam would be slowed relative to the other (because of ether wind) and therefore destructive interference would occur as the beams reunite out of phase. The detector, however, revealed no such interference and, by implication, no slowing.

Simply put, if a body were stationary with respect to the motionless ether, it would be at rest in the universal rest frame. That is, it would be at rest relative to the ultimate touchstone of motion, the reference frame coincidental with the universe itself. If, however, a body were moving inertially relative to the ether, it clearly would not be at rest from the vantage point of someone cosituated with the ether. So, in principle, it would seem to be easy to distinguish between rest and inertial motion—once, of course, physicists detected the ether.

To detect the ether, researchers sent two light beams moving along perpendicular paths and compared their speeds (see fig. 2). They surmised that the earth moved through the stationary ether to create an ether wind, just as one can create a wind on a windless day by moving through the air. Physical objects would be unaffected by the wind, owing to the ether's subtlety, but light waves would necessarily be affected by

virtue of their dependence on the ether for their existence. Consequently, if they had to travel into the ether wind, their speed would be retarded, just as a headwind retards the speed of an airplane. If, however, they traveled perpendicular to the wind (crosswind), they would suffer less retardation. One beam, therefore, should move slower than the other, given the ninety-degree difference in orientation. Even if one beam did not move directly into the wind, it would move more directly than the other and therefore undergo a greater slowing effect.

As noted, researchers could find no evidence of ether wind because neither beam was slowed relative to the other. This result challenged the ingenuity of physicists, but only Einstein stepped forward with a startling new idea. In his first paper on special relativity, he wrote, “We shall . . . find in what follows that the velocity of light in our theory plays the role, physically, of an infinitely great velocity.”³⁰ The elaboration of this role is one of modern physics’ first intimations that light is not just another phenomenon in the mix of material reality. To be sure, it is in the mix of material reality (as is evident from its everyday ubiquity), but its ontological significance is elemental. It is associated with the world’s structure and may be said to express the world’s space-time unity. A striking consequence of this unity is light speed constancy.

Imagine driving on a freeway with your cruise control set at 60 miles per hour. This is a constant speed relative to the earth’s surface, but it is a variable speed from all other vantage points. Relative to a jackrabbit running alongside the road at 20 miles per hour, you are moving at 40 miles an hour—if the rabbit is running in the same direction. If it is running in the opposite direction, you are moving at a relative speed of 80 miles per hour.

This is the stuff of everyday experience. We all know instinctively that speed is a matter of arithmetic. The effective impact speed of two soccer players, for example, is greater if they are running toward each other than if one overtakes the other from behind. In the first instance, we add the two values; in the second, we subtract one from the other. If the two players are running at the same speed in the same direction, their relative velocity is zero and no impact occurs.

As a young man, Einstein puzzled over light’s motion. The wave theory of light indicated that light would move at a constant velocity

30. Albert Einstein, “On the Electrodynamics of Moving Bodies,” in Arthur Miller, *Albert Einstein’s Special Theory of Relativity* (Reading, Mass.: Addison-Wesley Publishing, 1981), 401.

relative to the universal ether. This theory, however, would make the speed of light variable from all other vantage points or reference frames, just as a vehicle's constant speed relative to the earth is a variable speed from other vantage points. But if this were true, Einstein reasoned, Isaac Newton's postulate regarding the equivalence of rest and inertial motion would be violated. Newton insisted that the laws of physics are the same for all inertial situations (rest included), and so no experiment can distinguish between a situation where inertial motion is said to be occurring and one that is said to be at rest.

Einstein said he found the prospect of violating Newton's postulate "unbearable."³¹ In his mind, the wave motion of light through the ether, which was considered inertial motion, had to be a constant or invariant speed from every vantage point. Any observer would, in other words, always measure the speed of light at a given value, irrespective of the speed of the light source and irrespective of one's own speed relative to the light beam. No adding or subtracting of speeds.

This move validated Newton's postulate for all phenomena, optical as well as mechanical, but it led to the cognitive dissonance one experiences when trying to imagine a light beam moving at the same speed for every differently moving observer. To follow N. David Mermin: "How can this be? How can there be a speed c with the property that if something moves with speed c then it must have the speed c in any inertial frame of reference? This fact—known as the *constancy of the speed of light*—is highly counterintuitive. Indeed, 'counterintuitive' is too weak a word. It seems downright impossible."³²

Mermin goes on to explain that light-speed constancy implies the plasticity of space and time: the space-time values of material bodies are keyed to the finite speed of light so as to ensure that no material body ever reaches that speed. Whereas before (in Newtonian physics) speed was the variable quantity and space and time were unchanging, now with respect to light the roles have been reversed. Light, or the speed of light,

31. Albert Einstein, "Fundamental Ideas and Methods of the Theory of Relativity, Presented in Their Development," in *The Berlin Years, Writings, 1918–1921*, trans. Alfred Engel, Collected Papers of Albert Einstein, Writings series, 7 vols. (Princeton, N.J.: Princeton University Press, 1987), vol. 7, doc. 31, p. 135.

32. N. David Mermin, *It's About Time: Understanding Einstein's Relativity* (Princeton, N.J.: Princeton University Press, 2005), 25, emphasis in original. Although I indicate this later in the body of the article, it is important to note that the speed of light as a universal constant is realized only in a vacuum. When light encounters material media, it slows down.

is determinative of the speed of other phenomena. This is because light expresses or manifests the metric within which all bodies move. Hans Reichenbach put it this way: “Clocks and yardsticks, the material instruments for measuring space and time, have only a subordinate function. They adjust themselves to the geometry of light and obey all the laws which light furnishes for the comparison of magnitudes. One is reminded of a magnetic needle adjusting itself to the field of magnetic forces, but not choosing its direction independently. Clocks and yardsticks, too, have no independent magnitude; rather, they adjust themselves to the metric field of space, the structure of which manifests itself most clearly in the rays of light.”³³

Material bodies stand under the kinematic sovereignty of light. We live in a “universe of light,” says Torrance, because light is a universal ordering principle.³⁴ Nothing can exceed its immense velocity,³⁵ and,

33. Hans Reichenbach, *From Copernicus to Einstein*, trans. Ralph B. Winn (New York: Philosophical Library, 1942), 67–68. Strictly speaking, this statement refers to Einstein’s general theory of relativity, which posits that all motion (noninertial as well as inertial) is relative. “Relative” here implies that motion is always a two-body affair (at least) and that it is always possible to insist without fear of experimental contradiction that the other body is moving (or stationary), as in the case of Alice and Bob above. General relativity embraces special relativity as a special case—limited to inertial motion and so-called flat space-time—and bridges into considerations of space-time curvature. Reichenbach, who took classes from Einstein shortly after the latter had published his general theory, explains how light assumed a greater ontological role in Einstein’s thinking as he generalized special relativity: “Whereas in Einstein’s original theory [special relativity] light served merely to determine simultaneity, it became clear in the later revision of theory [general relativity] that light may be used for all measurements of time, and even for the measurement of space. One may construct a geometry of light in which light determines the comparison of spatial distances. Thus light comes to serve as the ordering net of physics, which gathers within the meshes of its rays all the events of the world and puts them in a numerical order” (67). I would like to add that to my way of thinking this statement (and others within the body of the article) portrays light as something much more than a nice extra or pleasant addition to reality. The light we witness on an everyday basis specifies a principle of cosmic unity, a primal integrity that permits the emergence of plurality and difference within a single context that never shatters under the weight of multiplicity.

34. Torrance, “Theology of Light,” 76.

35. Earlier I observed that science enjoins intellectual modesty: no theory is so secure as to be beyond the reach of disconfirmation. Accordingly, I note that some scientists believe that particles other than photons (gravitons, for example) move at light speed. Also, the speed of light may have changed since

more cogently, the speed of light regulates the behavior of all material bodies in an absolutely impartial way. Scientifically, this impartiality gives us a world, a cosmos, by bringing all within the embrace of a single law or principle that never suffers contravention. Theologically, it may be regarded as an earnest or witness of God's unfailing love and faithfulness toward his creation.

"The speed of light is really not like other speeds," writes Harald Fritzsich; "it is the quantity that has the most fundamental implications for the structure of space and time, or, better yet, of space-time."³⁶ These implications track back to Einstein's decision to subordinate the space and time values of material objects to the speed of light. As Alan Lightman puts it, "Einstein calculated quantitatively how the ticking rates of clocks and the lengths of measuring sticks in motion with respect to each other must differ so that both sets of instruments measure the same speed for a passing ray of light."³⁷ As they move at differing rates through space, clocks, yardsticks, telescopes, and all other scientific devices undergo varying degrees of change, all of which ensure they never reach the speed of light. These changes, known as the relativistic effects of time dilation, length contraction, and mass increase, mark an abrupt departure from Newtonian physics. For one thing, they compromise the classical ideal of perfect metrical rigidity. This is not a decisive blow to science, since we can calculate the degree of compromise and work that into our descriptions. It is, however, a reminder that as our instruments measure the material world, they dance—that is, adjust themselves—to the tempo of light. The speed of light is quietly resident in their physicality.

the big bang. While these hypotheses lack the kind of confirmation that compels widespread assent, they serve to remind us that the arguments developed here with respect to the speed of light are provisional.

36. Harald Fritzsich, *An Equation That Changed the World: Newton, Einstein, and the Theory of Relativity* (Chicago: University of Chicago Press, 1994), 118. A. S. Eddington writes: "The speed of 299,796 kilometres a second which occupies a unique position in every measure-system is commonly referred to as the speed of light. But it is much more than that; it is the speed at which the mass of matter becomes infinite; lengths contract to zero, [and] clocks stand still. Therefore it crops up in all kinds of problems whether light is concerned or not." *The Nature of the Physical World* (London: J. M. Dent and Sons, 1964), 64.

37. Alan Lightman, "The Contradictory Genius," *The New York Review of Books* 44 (April 10, 1997): 18.

What is more, our everyday assumptions about reality are staggered upon contemplating the world from the vantage point of the only thing we know that does achieve light speed, which is light itself. From our perspective, light requires about eight minutes to travel from the sun to the earth. But from the perspective of a photon undergoing complete time dilation and therefore forever on the brink of the next instant, no time elapses at all. This is why John Wheeler writes, “Light and influences propagated by light make zero-interval linkages between events near and far.”³⁸ Or, to follow Sidney Perkowitz: “To the best understanding we can muster, . . . the universe is made so that light always travels its own distance of zero, while to us its clock is stopped and its speed is absolutely fixed. These sober conclusions read as if they come out of some fevered fantasy. Light, indeed, is different from anything else we know.”³⁹

To the same effect, Bernard Haisch asks “how the universe of space and time would appear from the perspective of a beam of light.” His response:

The laws of relativity are clear on this point. If you could ride a beam of light as an observer, all of space [in the direction of the beam’s motion] would shrink to a point, and all of time would collapse to an instant. In the reference frame of light, there is no space and time. If we look up at the Andromeda galaxy in the night sky, we see light that from our point of view took 2 million years to traverse that vast distance of space. But to a beam of light radiating from some star in the Andromeda galaxy, the transmission from its point of origin to our eye was instantaneous.⁴⁰

38. John Archibald Wheeler, *A Journey into Gravity and Spacetime* (New York: Scientific American Library, 1990), 43. Elsewhere, Wheeler and Edwin Taylor explain that in space-time geometry the space-time interval is calculated by subtracting the time factor from the space factors. They then emphatically remark with regard to two events A and B, which are separate from the point of view of everyday experience but which lie along the path traveled by light through space-time, “*The interval vanishes when the time part of the separation between A and B is identical in magnitude to the space part of the separation.*” Further, “*The interval between two events is zero when they can be connected by one light ray.*” *Spacetime Physics* (New York: W. H. Freeman, 1966), 38, emphasis in original.

39. Sidney Perkowitz, *Empire of Light: A History of Discovery in Science and Art* (New York: Henry Holt, 1996), 76.

40. Bernard Haisch, “Brilliant Disguise: Light, Matter, and the Zero-Point Field,” *Science and Spirit* 10, no. 3 (1991): 30–31. I have added the bracketed qualifier to guard against the inference that all of space is collapsed to a dimensionless

For light, one moment is indistinguishable from another; or as J. T. Fraser puts it, “All instants in the life of the photon are simultaneous.”⁴¹ And, perhaps in some sense, evocative of the moment of creation. Consider that both modern cosmology and Christianity regard light as a first principle or primal reality. In the Judeo-Christian tradition, God calls forth light before initiating any further physical creation. Similarly, the big bang—modern science’s creation narrative—is a flash of light within whose expansion physical bodies eventually coalesce.⁴² This comparison, however, embodies only a broad similarity. Of greater import is the idea that whatever happens first, in an origivative sense, defines what is possible thereafter. Thinking in this vein, Fraser traces the constancy of the speed of light back to the big bang, insisting that this first velocity “has retained a unique and invariant relation to all

point within light’s reference frame. Length (spatial) contraction, according to Einstein, occurs only in one’s direction of motion. Even with this caveat in place, however, the idea of spaceless (and timeless) travel in a given direction remains startling. J. Ward Moody, relying on Einstein’s notion of relativity of simultaneity (a principle derived from special relativity and one which subverts the Newtonian assumption that events in the universe have the same temporal sequence for all observers, no matter how different their states of motion may be), explains the experience of a hypothetical light-speed traveler vis-à-vis that of an earth-bound observer: “Suppose someone on Earth experiences two events at the exact same time. Call the moment these events occur ‘now.’ Someone moving rapidly past Earth would not see these events taking place at a single specific time. For this traveler, the events, will separate more and more with increasing speed until at the speed of light one event happens instantaneously and the other event is infinitely distant in the future. If this person were traveling at the speed of light when time began, then we can say their existence between those events—which now stretches from the beginning of time to the infinite future—will be played out in what is perceived to be a single instant on Earth.” Moody notes that this scenario obtains only as the traveler moves “toward the location of one event and away from the other”—that is, along a given direction of motion. He adds, however, that this qualifier does not “weaken the principle.” J. Ward Moody, “Time in Scripture and Science: A Conciliatory Key?” in *Converging Paths to Truth: The Summerhays Lectures on Science and Religion*, ed. Michael D. Rhodes and J. Ward Moody (Salt Lake City: Deseret Book, 2011), 104–5, 120.

41. J. T. Fraser, *The Genesis and Evolution of Time: A Critique of Interpretation in Physics* (Amherst: University of Massachusetts Press, 1982), 39. See also J. T. Fraser, *Time: The Familiar Stranger* (Amherst: University of Massachusetts Press, 1987), 222–42.

42. For more on how light might instantiate or symbolize the interrelationship of God and humanity, see David Grandy and Marc-Charles Ingerson, “The Perichoresis of Light,” *Theology and Science* 10 (August 2012): 259–80.

other states of motion that have subsequently become possible.”⁴³ Nothing can exceed the speed of light because that primitive flash of light set bounds on all future states of motion, and it did this by being the defining moment of creation. By reason of its ontological primacy, it frames future possibilities.

Viewed this way, the ontological primacy of that first moment lives on light, which may help explain light’s unaging nature. After all, as Bondi insists, light “cannot change once it has been produced, owing to the fact that it does not age, and therefore it must remain the same.”⁴⁴ Brian Greene similarly explains that “light does not get old; a photon that emerged from the big bang is the same age today as it was then. There is no passage of time at light speed.”⁴⁵

I hasten to add that this outlook needs to be rounded out by other considerations. Science, in fact, does not permit the claim that we see any of the photons associated with the big bang. Even so, the photons which we do see now (I am using the verb “see” rather loosely here, for reasons to be explained shortly) are not unlike the big bang singularity itself, which is routinely (though not unanimously) described as the event marking the origin—the zero point, as it were—of space and time. If, as Fraser contends, light speed constancy is a throwback to the big bang, it might be that light itself conserves in some tracelike way that moment when, as Stephen Hawking puts it, “all the laws of science” were as yet unrealized owing to the infinitesimal smallness and infinite density of a universe on the brink of inflationary space-time expansion.⁴⁶

Photons, traveling “their own distance of zero” both spatially and temporally, may be said to mark that instant, or the brink of that instant as a zero-dimensional embryonic cosmos exploded into space-time being. This is as much a poetic as a scientific image—tiny photons mirroring the moment of creation—but for some, it inspires religious belief. J. N. Findlay, for instance, writes that “we may see . . . a remarkable naturalization of Eternity in the physical phenomenon of Light. For the photons which bind the universe together, everything, without loss

43. Fraser, *Genesis and Evolution of Time*, 39.

44. Bondi, *Relativity and Common Sense*, 108.

45. Brian Greene, *The Elegant Universe: Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory* (New York: Vintage Books, 2000), 51.

46. Stephen W. Hawking, *A Brief History of Time: From the Big Bang to Black Holes* (New York: Bantam Books, 1988), 8.

of order, will collapse into something like instantaneousness.”⁴⁷ John Wheeler pays similar tribute to photons, though in the register of quantum theory. After describing how photons circumvent space and time in scientific experiments, he proposes that each photon constitutes an “elementary act of creation” when it finally strikes the human eye or some other instrument of detection. He then asks, “For a process of creation that can and does operate anywhere, that reveals itself and yet hides itself, what could one have dreamed up out of pure imagination more magic—and fitting—than this?”⁴⁸

There is, in brief, more than meets the eye in our everyday interaction with light.

Light in the World

Implicit in the foregoing is the notion that light travels at its characteristic speed only while moving through a vacuum. When moving through a material substance—glass, water, or air, say—its speed is reduced. Thus light is very much in the mix of material reality, even though material bodies “adjust themselves to the geometry of light and obey all the laws which light furnishes for the comparison of magnitudes.”⁴⁹ On the one hand, those bodies stand under the kinematic sovereignty of light, taking their cues from light as they move through space and time; on the other, they slow, block, and even extinguish light.

The first part of the foregoing statement describes light as portrayed by Einstein’s special theory of relativity: pure and untouched by material bodies. The second describes light as we find it in everyday experience: dimmed and slowed by the materials through which it moves, bouncing off of surfaces, and generally at the mercy of a solid, material world whose reality is thought to subsist primarily in its hardness and opacity. One would scarcely guess from light’s acquiescent action in this world that it is a principle that structures and integrates the cosmos.

I propose that despite light’s seemingly subordinate role in our material world, the light of Christ is fully operational as a foundational reality in this world, just as described in section 88 of the Doctrine and

47. J. N. Findlay, “Time and Eternity,” *Review of Metaphysics* 32 (September 1978): 11.

48. John A. Wheeler, “Law without Law,” in *Quantum Theory and Measurement*, ed. John A. Wheeler and Wojciech Hubert Zurek (Princeton: Princeton University Press, 1983), 189.

49. Reichenbach, *From Copernicus to Einstein*, 67–68.

Covenants. Consider light's elemental graciousness whereby vision is accomplished: light drops out of sight to give us sight. This is a point that reaches back to Plato, who portrayed light not as something seen but as the agency of seeing and therefore not fully commensurate with visible reality.⁵⁰ Augustine understood light similarly, and modern thinkers, less inclined to think about light's religious or mystical possibilities, have straightforwardly asserted that light is not an object of vision but the invisible means by which vision occurs.⁵¹ To take a simple example, light

50. Plato, *The Republic* 507–10, trans. G. M. A. Grube, rev. C. D. C. Reeve, in *Plato: The Complete Works*, ed. John M. Cooper (Indianapolis: Hackett Publishing, 1997), 1127–30. Someone might object that my argument here is mere wordplay because light holds no more privileged place in our perceptual experience than sound: we don't see light (photons or light waves) and we don't hear sound waves because that's not the way we generally talk: we talk about seeing objects (which reflect light) and hearing things (which produce sound waves). But there are problems with this objection. For one, sound waves and light waves are not completely analogous because, as explained above, light waves require no medium of propagation while sound waves do. This fact alone, of course, does not imply that one kind of wave would occupy a different kind of place in our perceptual experience than the other, but it does alert us to the possibility. Relying on special relativity to make his point, John Schumacher argues that light's "order of movement" is utterly different from that of sound. Acoustical events may be plotted against a backdrop of visual experience and thereby anticipated before they arrive. Upon seeing a flash of lightning, we know thunder is on its way. But, says Schumacher, there is no comparable backdrop for visual events. We cannot see them or anticipate their coming; we just see them upon their arrival. In Schumacher's words, "Any truly limit movement must occupy a unique place in our experience: we can have no news of its upcoming arrival until it arrives itself, but then it has already arrived." This fact offers insight into the puzzling postulate that the speed of light is constant for all inertial observers. "With no warning of the light that arrives at our place, we cannot resolve its movement in experience," says Schumacher. Unable to see light from afar or to step back from it to view it objectively, we are locked into its unfailing presentness, and there is no backdrop against which its speed, always a matter of arrival for any observer, can be differently parameterized for differently moving observers. John A. Schumacher, *Human Posture: The Nature of Inquiry* (Albany, N.Y.: SUNY Press, 1989), 113–14. See also David Grandy, "Gibson's Ambient Light and Light Speed Constancy," *Philosophical Psychology* 25 (August 2012): 539–54.

51. Jonathan Powers writes, "When we see an object we see patches of colour, of light and shade. We do not see a luminescent stream flooding into our eyes. The 'light' we postulate to account for the way we see 'external objects' is not given in experience; it is inferred from it." Jonathan Powers, *Philosophy and the New Physics* (London: Methuen, 1982), 4. P. W. Bridgman's comment is also

shone into the night sky does not visually announce itself, just as a movie projector beam is not seen above one's head in a theater. Illuminated raindrops or dust particles may be seen, but that is light in conjunction with something material, not light *per se*. Another example is the sun as seen from the moon. It is a material ball of light against the blackness of outer space; it does not visibly radiate light because the moon has no atmosphere to scatter light. As MacKenzie concludes, "Light has a quality of excluding us from beholding it in its most brilliant expression."⁵²

If indeed we could see light, what else would we see? We would be wrapped in a cocoon of light—light would be our blindfold. Instead we are visually situated in the unbounded expanse of light's unseen presence and can therefore see things millions of miles distant. By not seeing light *per se*, we see to the farthest reaches of the universe.

With this thought in mind, Hans Blumenberg describes light as "the 'letting appear' that does not itself appear . . . , the gift that makes no demands, the illumination capable of conquering without force."⁵³ Given its immense cosmological significance, one might expect to see it on bright display, monopolizing the stage, as it were, and commanding our visual interest. Surprisingly, however, it shows up only as it

apropos: "The most elementary examination of what light means in terms of direct experience shows that we never experience light itself, but our experience deals only with things lighted. This fundamental fact is never modified by the most complicated or refined physical experiments that have ever been devised." P. W. Bridgman, *The Logic of Modern Physics* (New York: Macmillan, 1927), 151. Finally, James J. Gibson writes, "A single point of light in an otherwise dark field is not 'light'; it specifies either a very distant source of light or a very small source, a luminous object. A single instant or 'flash' of such a point specifies a brief event at the source, that is, the *on* and the *off*. A fire with coals or flames, a lamp with a wick or filament, a sun or a moon—all these are quite specific objects and are so specified; no one sees mere light. What about a luminous *field*, such as the sky? To me it seems that I see the sky, not the luminosity as such. What about a *beam* of light in the air? But this is not seeing light, because the beam is only visible if there are illuminated particles in the medium. The same is true of the shafts of sunlight seen in clouds under certain conditions." James J. Gibson, *The Ecological Approach to Visual Perception* (Hillsdale, N.J.: Lawrence Erlbaum, 1986), 54; emphasis in original. Other statements to the same effect from a broad range of thinkers could be offered, but I hope these suffice to make the general point.

52. MacKenzie, "Obscurism" of Light, 110.

53. Hans Blumenberg, "Light as a Metaphor for Truth," in *Modernity and the Hegemony of Vision*, ed. David Michael Levin (Berkeley: University of California Press, 1993), 31.

announces *other things*. That is, it shows up only in conjunction with bodies responsible for its fall from light speed to lower speeds.

Let me venture a theological parallel here. Light “comes down” from its characteristic speed as it is slowed and blocked by material bodies, just as, in Christian thought, God the Son came down from heaven while being hedged about by earthly limitations and to be seen of mortals. This divine descent or condescension, moreover, involved a voluntary dimming of God’s glory. In his epistle to the Philippians, Paul wrote that Jesus Christ, though in “the form of God,” “made himself of no reputation, and took upon him the form of a servant, and was made in the likeness of men: And being found in fashion as a man, he humbled himself, and became obedient unto death, even the death of the cross” (Philip. 2:5–8). As we find it in this world, light seems to similarly retreat into nameless obscurity, notwithstanding its cosmic significance. To the extent that it announces itself, it also announces other things, thereby allowing them to become the cynosure of all eyes, the spectacle that commands our interest. Put differently, a principle of cosmic unity subserves local, mundane events, letting them appear more sovereign than they really are. That which is great—of great ontological import—becomes least as it is eclipsed by events of lesser significance. Events, one might add, that draw their intelligibility from the world-structuring principle they eclipse.

Rarely do we notice the giftlike aspect of the seeing experience. Of course we see by the agency of light, but, more fundamentally, we see because light graciously cedes its place in the visual experience to other things. It is a vanishing act of divine munificence, and one that gives us the visible world. As noted, Plato surmised this truth nearly 2,500 years ago, and he consequently called light the “offspring of the good, which the good begot as its analogue”: just as the ungraspable idea of the good imparts intelligibility to all other (lesser) ideas, so unseen light imparts visibility to all physical bodies.⁵⁴ One is like the other in that neither can be reduced to the revelation it effectuates.

54. Plato, *The Republic* 508b–509c. Later in the book (616b–d) Plato assigns to light a world-structuring function. Reporting the near-death, or after-death, experience of Er, Socrates (Plato’s principal interlocutor) states that Er and other deceased souls journeyed “to a place where they could look down from above on a straight column of light that stretched over the whole of heaven and earth, more like a rainbow than anything else, but brighter and more pure. After another day, they came to the light itself, and there, in the middle of the light, they saw the extremities of its bonds stretching from the heavens, for the light binds the heavens like the cables girding a trireme and hold its entire revolution together.”

Long after Plato portrayed light as having cosmological import, Einstein, working from different premises, took a comparable step. He insisted that the speed of light is not merely the rate at which light moves through space and time; instead, it is a principle that structures the space-time universe. Thus light may be said to be much more than the agency that enables vision. It is, as scripture portrays it, a font of cosmic intelligibility, or “the true light that lighteth every man that cometh into the world” (D&C 93:2; see also John 1:9). By reason of its universal relevance, it gives us a cosmic expanse in which we “live, and move, and have our being” (Acts 17:28), and, more than that, it graciously slips from view so that we can act without being overpowered by its sublime presence.

Redemptive Light at the Interface of Two Worlds

Quantum mechanics offers two views of light, each of which would appear to exclude the other: wave and particle. A similar light-related tension informs special relativity. On the one hand, light moves finitely fast, even when moving in a vacuum. On the other, according to Einstein, it “plays the role, physically, of an infinitely great velocity.”⁵⁵ This role emerges from Einstein’s decision to make the finite velocity of light an invariant velocity from all perspectives. Nothing we do consequently—no motion or maneuver on our part—will ever allow us to close the interval on a light beam moving *in vacuo*: it will always stay ahead of us by a speed of 186,000 miles per second. In brief, light is perfectly indifferent to the motion of material objects. As Arthur Zajonc expresses it, “The nature of light cannot be reduced to matter or its motions; it is its own thing.”⁵⁶ And yet, as just noted, light is very much in the mix of material reality.

I have suggested what this might mean for those interested in religion and philosophy. I might also remark that some have found it useful to think of light as a horizon—something at the interface of two worlds.⁵⁷ Like light, horizons suggest the infinite while demarcating the finite, and they do this by being indifferent to the speed at which we attempt to overtake them. Not fully coincidental with the physical features of the world that set them off, horizons recede with our advance, thereby neutralizing

55. Einstein, “On the Electrodynamics of Moving Bodies,” 401.

56. Arthur Zajonc, *Catching the Light: The Entwined History of Light and Mind* (New York: Oxford University Press, 1993), 260.

57. David Bohm, *Wholeness and the Implicate Order* (London: Ark Paperbacks, 1983), 123.

attempts to overtake them. Absolute invariance in the face of local change, the experience of stepping off toward something without closing the interval, may prepare the mind for larger possibilities. Hugh Nibley observed that desert Bedouin reflexively assumed that life went on forever because, travel as they may, they never reached the horizon.⁵⁸

At issue here is what L. H. Myers calls “the near and the far.” In his novel of the same name, Myers describes desert travelers whose daily toil is redeemed by the sight of the setting sun. As the twelve-year-old Prince Jali watches the sun sink in the west every evening, the travail of the day is suffused with an unsuspected vastness of meaning. Hence for Jali there are “two deserts”: one that is “weariness to trudge” and that makes him feel like “an insect” crawling across “a little patch of brown sand,” and another, brought on by “the red glitter of sunset” whose “glory for the eye” turns “his whole body into a living arrow” ready to “flash into” the faraway vista.⁵⁹

The near, of course, is the finite sense of being tightly circumscribed and thus cut off from other things in the space-time regime, which seems to stretch on forever in an absolutely impersonal way; the far is the sense of expansive unity, of being gathered into some widely meaningful pattern of things. The far breaks the frame of the near; that is, the frame of ordinary or myopic reality. Later in the book, Hari, contemplating the landscape at sunset, yearns for the moment when “the knot of selfhood [would] loosen” so as to dissolve him into some larger pattern of possibility.⁶⁰ Whether all people would agree with the precise description, most have at one time or another been rescued from the daily grind by sunset or some other light-related event that unexpectedly redeems their struggle.

It might be that at the end of the day light is a redemptive principle, one that brings us back home, albeit at a higher turn of the spiral. In his book *How Experiments End*, Peter Galison tells us why sunset is not quite the mirror image of sunrise: “The sunset, refracted through the dust and droplets kicked up by all that has happened, recounts in compressed form the whole story of the day.”⁶¹ If sunrise holds forth

58. Hugh Nibley, *The Message of the Joseph Smith Papyri: An Egyptian Endowment* (Salt Lake City: Deseret Book, 1975), 80.

59. L. H. Myers, “The Near and the Far,” book 1 of *The Root and the Flower* (London: Jonathan Cape, 1935), 15–16.

60. Myers, “Near and the Far,” 180–81.

61. Peter Galison, *How Experiments End* (Chicago: University of Chicago Press, 1987), 278.

multiple yet-to-be realized possibilities, sunset captures all realized possibilities—all events—in a single moment. Or, to follow Sappho, sunset (announced by Hesper, the evening star) gathers together all that sunrise scatters abroad:

Thou, Hesper, bringest homeward all
That radiant dawn sped far and wide,
The sheep to fold, the goat to stall,
The children to their mother's side.⁶²

First, light scatters abroad, then it gathers back home. The scattering action of light is easy to see; visually speaking, light opens up and bids us entry into a world of different, apparently scattered objects. The gathering action of light is much harder to descry. Dante's epiphany led him to understand that in light's economy all which "in the universe, seems separate, scattered" is really "ingathered and bound by love into one single volume."⁶³ Einstein's special relativity prompts a pared-down, naturalized realization of the same thought: light makes "zero-interval linkages between events near and far."⁶⁴

Dante, of course, had no inkling of Einsteinian space-time, and we can be certain that Einstein was not thinking of Dante when he theorized that events lying along the path which light travels through space-time are without interval from the point of view of a photon. The two men thought along very different wavelengths. It is, nevertheless, an interesting parallelism that they came to similar conclusions about light's capacity to connect "events near and far" from our perspective in a "zero-interval" or spaceless, timeless fashion.

Keying off both Dante and Einstein, let me suggest that the two-way action of light expresses the atoning sacrifice of Jesus Christ—his exile or descent from heaven, his travail, and his ascendant return. In section 88, just before the light of Christ is identified with the light of the sun, moon, and stars, we read, "He [Christ] that ascended up on high, as also he descended below all things, in that he comprehended all things, that he might be in all and through all things, the light of truth; which truth shineth. This is the light of Christ" (D&C 88:6–7).

62. Sappho, *The Songs of Sappho*, trans. Rennell Rodd (Mount Vernon, N.Y.: Peter Pauper Press, 1966), 57.

63. Dante Alighieri, *Paradiso*, canto 33, lines 85–87.

64. Wheeler, *Journey into Gravity and Spacetime*, 43.

The themes of descent, ascent, and comprehension are here woven together. Comprehension is integral in that it connotes understanding, which implies the gathering together or encompassing of things that once were separate, scattered, chaotic, and therefore lost, in the sense that they could not be brought into a comprehensive whole. To say that Christ “comprehended all things” is to suggest that he renders all things knowable and reachable by having brought them within the comprehensive embrace of his sacrificial love. His descent below all things and his subsequent ascent back into heaven trace an upward all-inclusionary spiral that is the physical cosmos. This originative act of truth and love is not tucked away in the past, not lost from view. It is, after all, the very act that rescues and gathers in all that is lost. It therefore registers as ever-present truth: it shines. It manifests itself in the light of the sun, moon, and stars, which is the light of Christ. Like photons moving at light speed, and like the Atonement itself, that light is undying.

David A. Grandy is Professor of Philosophy at Brigham Young University. He earned his PhD from Indiana University in history and philosophy of science. His most recent books are *Everyday Quantum Reality*, *The Speed of Light: Constancy and Cosmos*, and, with Dan Burton, *Magic, Mystery, and Science: The Occult in Western Civilization*, all with Indiana University Press. His most recent articles have appeared in *Philosophical Psychology*, *Theology and Science*, and *KronoScope*. He has long been interested in space, time, light, and vision. He thanks the readers who refereed this article for their insightful comments.