Physics and Christian Theology: Beauty, a Common Dialect?

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by Tracee Hackel

As the literature for this Oxbridge 2005 conference notes, "C.S. Lewis once said, 'the sweetest thing in all my life has been the longing . . . to find the place where all the beauty came from.' " Lewis is not alone in his quest. While one might expect such company as writers, artists, musicians, and philosophers, it might be surprising to discover a stellar contingent of Nobel Prize winners and other significant physicists along for the journey. It appears, as we will see in the following accounts, that beauty has long been the unsung companion of great discoveries in the physical sciences. Taking a look at the role beauty plays in the realms of both physics and theology could point the way to a place where Christian theology and the modern science of physics might have a conversation profitable to both disciplines.

Beauty and Physics

It is difficult to say exactly what role beauty plays in the realm of physical science. Does it function as a motivator, spurring the scientist on to true discoveries? This is what Nobel Laureate physicist Subrahmanyan Chandrasekhar suggests in his book of essays entitled *Truth and Beauty: Aesthetics and Motivations in Science*. Mathematician Henri Poincaré puts it this way in his book *Science and Method*, "The scientist does not study nature because it is useful: He studies it because he takes pleasure in it, and he takes pleasure in it because it is beautiful. If nature were not beautiful, it would not be worth knowing."[1] If Poincaré is right then if there were no beauty, there would be no science.

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One striking example of beauty's motivating power comes from Hermann Weyl, one of the most influential mathematicians of the twentieth century. Weyl worked with Albert Einstein at the Institute for Advanced Study in Princeton, New Jersey, after they both fled Nazi Germany. He characterized his work in this way: "My work always tried to unite the true with the beautiful; but when I had to choose one or the other, I usually chose the beautiful."[2]

There are two other examples elicited from Freeman Dyson by Chandrasekhar: Weyl's gauge theory of gravitation and his two-component relativistic wave equation of the neutrino. In both cases, he chose the "beautiful" over the "true," and his formulations contradicted the accepted wisdom of the time but were later proven to be true. As Chandrasekhar puts it, "We have evidence, then, that a theory developed by a scientist, with an exceptionally well-developed aesthetic sensibility, can turn out to be true even if, at the time of its formulation, it appeared not to be so."[3] The beauty of Weyl's work led him into new territory and revealed a truer understanding of the world. In this view it is the beauty of nature or the intuition's perception of beauty that entices the scientist into the realm of true explanations for the phenomena of the universe.

Or does beauty function as that which confirms the truth of theories for which there may be no current means of experimentation? Ernst Peter Fischer, a German science historian, describes such an approach in his book, *Beauty*

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and the Beast: The Aesthetic Moment in Science. Fischer shows this use of beauty in his account concerning the acceptance of the Copernican model of the rotation of the earth around the sun. He observes that in the mid-nineteenth century when technology had finally developed to the point of being able to test Copernicus's hypothesis and proved him right: ". . . the event generated very little interest . . . no one needed measurements to be convinced of a heliocentric world . . . The Copernican model had already permeated their thinking . . . people accepted the new world-view because it was beautiful to them."[4]

The beauty of Copernicus's theory had confirmed to people its truth long before anyone had the technology to verify it.

Buckminster Fuller, visionary, inventor, and architect, is reported on more than one occasion to have described the function of beauty in his work this way, "When I am working on a problem I never think about beauty. I only think about how to solve the problem. But when I have finished, if the solution is not beautiful, I know it is wrong." For Fuller the beauty of a solution confirmed its truth.

Paul Dirac, a founder of quantum mechanics in the twentieth century, whose namesake equation predicted the existence of anti-matter, summed up his approach to physics and mathematics in this way, " . . . if one is working from the point of view of getting beauty into one's equation, and if one has really sound insights, one is sure of a line of progress."[5] Sir John Polkinghorne, a doctor of both physics and theology, who studied under Dirac at Cambridge, said about him at a conference held in his honor, "Dirac had a great singleness of purpose, a lifelong search for beautiful equations."[6] This led him to make many significant advances in unifying the theories of relativity and electromagnetism. Without his discoveries we would have no cell phones or any other wireless communication today.

Werner Heisenberg, a 1932 Nobel Laureate, famous for his formulation of the uncertainty principle, provides us with one more interesting example of how beauty has accompanied great scientific discovery. He describes his experience of the moment when the key to quantum theory was revealed to him, in this way: "The energy principle had held for all the terms, and I could no longer doubt the mathematical consistency and coherence of the kind of quantum mechanics to which my calculations pointed. At first, I was deeply alarmed. I had the feeling that, through the surface of atomic phenomena, I was looking at a strangely beautiful interior, and felt almost giddy at the thought that I now had to probe this wealth of mathematical structure nature had so generously spread out before me."[7]

Heisenberg knew that he had run into the truth, because his sense of the beauty of what he had seen was overpowering. The beauty confirmed the truth of his equations. In this case, Heisenberg's experience of beauty also motivated him to more discovery as he "probed the wealth of the mathematical structure" displayed before him.

Chiara Nappi of the Institute for Advanced Study, in a book review of a Dirac biography for the *American Scientist*, states, "It is this same quest for beauty, unity, and consistency that fuels theoretical physics today."[8] Regardless of the place beauty occupies in the practice of physics, whether as a motivating or confirming characteristic, it is clear from the writings of many scientists that the observation and perception of beauty plays a key role in the discovery of true explanations of the natural world. It would appear that beauty functions as a sort of handmaiden to the truth in the process of discovery. She either ushers one into the presence of her master, or testifies to our place in the presence of greatness. If that be the case, then it might also be the case, as Chandrasekhar suggests in his work, that a mind trained or gifted with a strong aesthetic sense, one that can recognize beauty when she is revealed, is one that is particularly equipped to make the sorts of discoveries that form the foundations of our most profound and productive understandings of the universe. In other words, those who know beauty when they see it will be the best physicists. It might even be that those committed to seeking out the beautiful in their work will be those who come closest to, and may actually attain, the holy grail of all physics, the great Unified Theory of Everything.

Beauty and Trinitarian Theology

The Scriptures[9] tell us that it is the Lord God who is the source of all

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beauty and who is beauty Himself. Passages found in places such as Psalms 48 and 50, Lamentations 2, and Ezekiel 16 describe Jerusalem or Zion, the place where God chose to dwell among His people, as "perfect in beauty." Other passages found in I Chronicles 16, II Chronicles 20, and Psalms 29 and 96 exhort God's people to worship Him in "the beauty of holiness."[10] Still other portions of Scripture prophesy the coming of God's salvation in Jesus Christ and describe this coming savior as beautiful, for example: Isaiah 4:2 and 33:17, Psalm 110, and Hosea 14:6. Some passages speak of God's beauty directly, like Job 40:10 and Psalm 96:6; perhaps none more directly than Psalm 27:4 which declares, "One thing I ask of the Lord, this is what I seek; that I may dwell in the house of the Lord all the days of my life, to gaze upon the beauty of the Lord and to seek him in his temple." According to biblical wisdom there is nothing better, nothing more worthy, nothing more beautiful in existence than God Himself.

Even from this limited look at the biblical witness, it would appear that C.S. Lewis does not make an unwarranted claim regarding the source of beauty in his book *The Four Loves*. When he writes of Friendship as the "instrument by which God reveals to each the beauties of all the others," Lewis goes on to say, "They are, like all beauties, derived from Him . . . "[11] If all beauty derives from God, then God, as He has revealed Himself to us as one God who exists in the three persons of the Father, Son, and Holy Spirit, is Himself the highest form of beauty there is. If that is the case, then it might follow that a Christian, someone whose life is "now hidden with Christ in God,"[12] who participates in the life of the Trinity, would be most likely to recognize beauty wherever it might be found.

In Romans 12:2, the Apostle Paul exhorts us with these words, "Do not conform any longer to the pattern of this world, but be transformed by the renewing of your mind." Paul does the same in Ephesians 4:23 where he writes to the church that we are "to be made new in the attitude of (our) minds." In the second letter to the Corinthians, Paul again describes the impact of Christian faith upon one's mind, " . . . we take every thought captive to Christ" (10:5). Paul's letter to the Philippians contains one of his most powerful expositions of the nature and work of God in Jesus Christ when he tells the people, "I consider everything a loss compared to the surpassing greatness of knowing Christ Jesus my Lord" (3:8).

It is fairly evident that the Apostle Paul, who was an exceptional student of the Old Testament and wrote a majority of the New, understands and expects people's faith in Jesus Christ to alter their perception of the world. Paul ends his instruction to the Philippian church saying, "Finally, brothers, whatever is true, whatever is noble, whatever is right, whatever is pure, whatever is lovely, whatever is admirable—if anything is excellent or praiseworthy—think about such things" (4:8). Not only will Christians be people whose patterns of thinking are transformed

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by their relationship with Jesus Christ, but they will be people who cultivate this new life of the mind by thinking about what is "true, noble, right, pure, lovely, admirable, excellent, or praiseworthy." In other words, a mind renewed and transformed by the Spirit of God, given to us through Jesus Christ at the pleasure of our Heavenly Father, is a mind that is at home in the realm of the true and the beautiful.

Would it not be reasonable to expect that this transformation of one's mind might have implications when we consider an area of human endeavor, like physics, which appears to depend so much on beauty as a motivating force or confirming feature in discovering truth? Could it be that physicists whose thoughts are captive to Christ, or at the very least influenced in some way by a Trinitarian concept of God, would be among those physicists most likely to make significant discoveries, especially where unified theories are concerned?

Beauty a Common Dialect?

Thomas F. Torrance in his book, *Theological and Natural Science*, leads his readers back to antiquity to find a groundbreaking physicist whose discoveries were explicitly related to his Christian mindset. He writes, "Never in all the history of science has Christian theology had such a transforming impact on science as through John Philoponos of Alexandria in the sixth century."[13] According to Torrance, the work of Philoponos hinged upon his distinction between created and uncreated light, specifically in relation to the "incarnation of the Creator Word of God in Jesus Christ."[14] This line of thought led Philoponos to " . . . put forward a theory of light and theory of impetus, which . . . produced a dynamic understanding not only of sciences such as optics, physics, and meteorology, but of the unitary universe of heaven and earth. In the course of this transformation of classical science he advanced relational conceptions of time and space…"[15]

Though rejected by his Aristotelian contemporaries, Torrance labels Philoponos's work as "an astonishing anticipation" of the work of James Clerk Maxwell and Albert Einstein over one thousand years later.[16] The insights Philoponos gained into the workings of the physical universe were directly related to his Christian beliefs, especially those concerning the relationship between at least two persons of the Trinity, the Creator and the Word: the Father and the Son.

Along the same lines of thought, Fischer writes of Johannes Kepler, one of the founding fathers of astronomy in the seventeenth century: "He believed that no other vision of the world gave witness more clearly to the Christian trinity than the Copernican proposal that the sun was in the center . . . In the heliocentric system, Kepler saw the incredible 'image of the triune God,' and as someone who viewed all scientific study as a service to God—as worship—this was what he had been seeking all along."[17]

Fischer states later in his book that: "Traditional physics

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is Trinitarian with its three basic dimensions: the space-time continuum so clearly indicated by Einstein, indestructible energy expressed in the nineteenth century, and causality that determines all activity in space—time and energetic environment."[18]

Although he advocates for a new approach to physics today, it is clear that Fischer acknowledges the influence of Christian Trinitarian theology on not only those who have made significant discoveries in the realm of the physical sciences, but also upon the foundations of the discipline itself.

Colin E. Gunton, professor of Christian doctrine at King's College, London, contributed to a book of collected conference papers, *Trinitarian Theology Today*, a piece entitled "Relation and Relativity: The Trinity and the Created World." In this piece he says, "The claim to be argued is that some Trinitarian concepts appear to bear a certain likeness to some of the concepts that have been either appropriated or developed by modern scientists."[19] As one example, Gunton cites Michael Faraday. Faraday was a British scientist and inventor in the nineteenth century who is best known for his work with electricity—electromagnetism and electrochemistry in particular.

Gunton says that he begins his examples with Faraday because: "He speaks of the solar system rather as the classical Trinitarian theologians did of the Trinity. What we have in Faraday is a kind of doctrine of the *perichoresis*, the interpenetration, of matter. As the three persons of the Trinity interpenetrate the being of the others, so it is with the matter of which the world is made."[20]

Gunton claims that he is " . . . not suggesting that the doctrine of the Trinity is in any way necessarily responsible for the way that Faraday came to think—at least not directly . . . "[21] Yet he does remark in a footnote on the same page that his further reading, namely a book on Faraday by Geoffrey Cantor, "suggests that Faraday's conception of the notion of unity in diversity reveals 'a clear echo of the Christian tri-unity.' "[22] There may be no direct influence of his Trinitarian theology on his science, but some kind of influence is evident.

It is this same quest for beauty, unity, and consistency that fuels theoretical physics today.

Fischer comments on Faraday's painstaking years of work, "The length and intensity of Faraday's search can best be understood as an expression of his longing for beauty . . . "[23] Faraday was, in fact, a devout Christian. He belonged to a congregation of the Sandemanian sect, a group that had broken away from the Scottish Presbyterian church over some finer points in the Westminster Confession. He attended services regularly and served two terms as an elder in his church. One obvious explanation for the correspondence of Faraday's work with a Christian doctrine of the Trinity and for his keen pursuit of beauty is that the formation of his mind in the Trinitarian faith had some impact on his ability to discern so much that is true about the physical world.

The dynamic and relational theories of light put forward by John Philoponos in the sixth century and the work on electricity done by Michael Faraday in the nineteenth both paved the way for the work of James Clerk Maxwell in the late nineteenth century. In fact, Faraday's findings became one of the four Maxwell equations depicting the laws of the continuous dynamic field of particles of light.

Maxwell was raised in Scotland in an evangelical Christian home. His father was Presbyterian and his mother was Episcopal. As an adult he became an elder in the Corsock Parish Church his father had built.[24] Torrance writes: "It is ultimately to him that we owe the radical change in our understanding of physical reality and of the rational structure of physics. . . In bringing his distinctive form of light theory and impetus theory together, to which he gave expression in his epoch-making

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work *A Dynamical Theory of the Electromagnetic Field*, he formulated his famous differential equations, and in his great work *A Treatise on Electricity and Magnetism*, he laid the foundations upon which our empirico-theoretical science rests, and supplied the platform for their further advance. That work must be reckoned with Newton's *Principia Mathematica* as one of the two great works on which all modern science rests."[25]

Maxwell's insight, which led him to unify the theories of electricity and magnetism, launched human understanding beyond the mechanistic world of Newtonian physics into the new universe of relativity and quantum mechanics. What is interesting is that Torrance attributes this insight directly to Maxwell's understanding of Trinitarian theology: "Of special interest for him was, I believe, the teaching by Robert Boyd of Trochrig on the Holy Trinity, in his great work *Praelectiones in Ephesios* . . . he showed that on a human level the relations between persons belong substantially not accidentally to what they really are. Relation there is the most important thing to know. That is the kind of ontological and dynamical relation which Clerk Maxwell was to call to his aid when again and again he failed to offer a satisfactory explanation of the behavior of the moving lines of force in the electromagnetic field in terms of Newtonian physics and mechanics . . . . Thus when Clerk Maxwell put forward an explanation of the behavior of electromagnetic particles which are what they are in onto-dynamical relation to one another, in particular of the way in which the particles of light moving at the speed of light relate ontologically to one another, he came up with the concept of the continuous dynamic field, and developed equations which are laws representing the structure of the field. The formulation of those equations Einstein held to be the most important event in physics since Newton's time . . . . It was not that Clerk Maxwell imported theological conceptions as such into his science, but that it was the slant of his deeply Christian mind informed by faith that exercised a guiding role in the choice and formation of his leading scientific concepts."[26]

Being steeped in Trinitarian Christian theology appears to have made Maxwell particularly adept at the kind of thinking required to discover the necessary components of quantum mechanics. It is probably not surprising to see Maxwell's equations cited as a prime example of the beautiful either; Fischer prints them out in their entirety in his chapter entitled, "Aesthetic Science: Beautiful Ideas and Elegant Experiments."[27]

It was the Maxwell equations and his work on solving them that led German physicist Albert Einstein to the theory of general relativity, about which Paul Dirac claimed, "What makes the theory so acceptable to physicists, in spite of its going against the principle of simplicity, is its great *mathematical* beauty."[28] Torrance devotes a whole chapter of his book, *Theological and Natural Science*, to "Einstein and God."[29] Although Einstein was Jewish, Torrance claims the influence of Christian Trinitarian thought upon him. This influence came through three primary sources: his first wife who was a Serbian Orthodox believer, his regular reading of the Old and New Testaments, and his time living on the campus of Princeton Seminary, interacting often with the Christian theology professors there, while at the Institute for Advanced Study. If Torrance is right, then we have another example of a mind formed by at least some understanding of Trinitarian theology that has made a profound discovery in the realm of physics.

Each scientist mentioned above has either sought out beauty in his work, such as Kepler and Faraday, or has produced work known as particularly beautiful, such as Maxwell and Einstein. In each case beauty plays a part in the scientist's major discoveries. In addition, with the possible exception of Kepler, each of these physicists was one who made milestone contributions to the discipline of physics by uniting two or more concepts that had been previously perceived to be irreconcilable or unrelated. There is also some evidence that each of them were in some way influenced by a Christian doctrine of the Trinity, which led them to perceive the beauty of the creation they were studying in a way that others before them had not. This mindset led them to concepts of the way the world works that were relational, unifying, and which later exploration has shown to be true.

All of this fits together with the

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understanding that the Trinity is the highest form of beauty from which all other beauty derives. The Trinity, one God in three persons, is both distinct and unified, and is in essence relational. It is probably no accident that the concepts of the world considered most beautiful, and which bear out to be true, are those which in some way reflect this unifying, relational beauty of the One from whom they are derived.

If this is so, then it might also be true that those whose minds are formed by, or at least have within their thought life some concept of, the highest beauty would be those minds most adept at perceiving the derived beauty that serves as a handmaiden to the truth. It might just be the case that those whose minds are renewed by the transforming work of the Father, Son, and Holy Spirit would be those who are most likely to make the most profound and beautiful discoveries in the physical sciences, especially where it concerns the ultimate theory of how the universe is related and what unifies it. The "holy grail" of modern physics might actually be "Holy" after all. Physics and theology may not be as far apart as they seem at times. At the very least, it would appear that beauty might provide a common dialect for a conversation that would enrich and enlighten both disciplines.

ENDNOTES

[1]Ernst Peter Fischer, *Beauty and the Beast: The Aesthetic Moment in Science,* trans. Elizabeth Oehlkers (New York: Plenum Trade, 1997), 12.

[2]Subrahmanyan Chandrasekhar, *Truth and Beauty: Aesthetics and Motivations in Science* (Chicago: University of Chicago Press, 1987), 65.

[3]Chandrasekhar, 66.

[4]Fischer, 4.

[5]Chiara R. Nappi, "Dirac's Due," a review of *Paul Dirac: The Man and His Work*, Peter Goddard, ed., in American Scientist, 1 September 1998: 482; *American Scientist Online*, (18 April 2005), http://www.americanscientist.org/bookshelf/pub/diracs-due.

[6]Judy Long, "Beauty, Mystery And Physics Discussed At Dirac Centenary Conference," *Baylor University News*, 3 October 2002, http://wwwbaylor.edu/r/news.php?action=story&story=4230

[7]Chandrasekhar, 54.

[8] Nappi, 482.

[9]All Scripture quoted, unless otherwise noted, is from the *New International Version*, trans. copyright International Bible Society (Grand Rapids, Michigan: Zondervan, 1973).

[10]*The Holy Bible: Authorised King James Version* (London: Eyre & Spottiswoode, 1611).

[11]C.S. Lewis, *The Four Loves* (London: Collins, 1960), 83.

[12]Colossians 3:3

[13]Thomas F. Torrance, *Theological and Natural Science* (Eugene, OR: Wipf and Stock, 2002), 123.

[14]Torrance, 123.

[15]Torrance, 123.

[16]Torrance, 123.

[17]Fischer, 4.

[18]Fischer, 171.

[19]Colin Gunton, "Relation and Relativity: The Trinity and the Created World," *Trinitarian Theology Today*, ed. Christoph Schwöbel (Edinburgh: T & T Clark, 1995), 96.

[20]Gunton, 95.

[21]Gunton, 95.

[22]Gunton, 95 (footnote 5).

[23]Fischer, 8.

[24]Torrance, 12.

[25]Torrance, 12.

[26]Torrance, 14-15.

[27]Fischer, 9.

[28]As quoted in Chandrasekhar, 148.

[29]Torrance, 17-34.