

Chartres Cathedral

Light and Glass

ARTHUR G. ZAJONC

At the close of the twelfth century a miracle recurred in a town sixty miles southwest of Paris. Similar occurrences had been going on for hundreds, indeed, thousands of years there and elsewhere, but just then what had been prepared for centuries in Egypt, Greece, Mesopotamia and Europe flowered in a way that has not been equalled since. It was a miracle of light and earth.

Had you been there you would have seen artisans in preparation, gathering and drying beechwood logs from the forests, placing them together and setting them ablaze. The pure ashes so produced, free of stones and soil, were carefully collected. Nearby a furnace of stone and clay was being erected, fifteen feet long, ten feet wide and four feet high. Others were at the river gathering the fine sand, prepared and cleansed by the flowing river's waters. Two parts of the beechwood ash were mixed with one part of the sand and heated atop the upper hearth of the furnace for a day and a night. Then, at eveningtide, the fritted mixture of ash and sand was ladled into clay pots, and dry wood was added to the fire throughout the night. With the first light of day the metamorphosis was complete: sand and ash, transmuted by fire, had become glass. A substance of the earth had been transformed at the hearth of Hephaestus to become gemstones for a stained glass window in the cathedral at Chartres. Regardless of the color, the process was the same. Working with blowpipe and knife to shape in glass the mighty Christian-Platonic imaginations of God and universe, the medieval artisan re-enacted a practice that had originated in ancient Egypt—the manufacture of glass and the adornment of God's creation.

The mystery of glass is inseparably linked to the mystery of light. Glass without light is dark, lifeless. Walk into the vast nave of Chartres at night illumined by the flickering light of the votive candles and the great walls of glass stand mute, asleep until the first light of day.

When completely clear, glass is invisible although substantial. Like light it possesses the paradoxical character of being something and yet in another way being nothing. Like the eye, being selfless, it remains unseen so that other things may be seen through it.

Likewise light, eternally unseen, selflessly illumines our world while its own nature seems forever to elude our grasp. In glass, water and air, light creates transparency. For Aristotle light was just this action, the "actualization of the potentially transparent." That is, under the aegis of light certain media—until then dark—could be lifted into transparency. It happens every time you turn on the room lights. Light was not a substance for Aristotle but a potent, actualizing force that, in a sense, completed the alchemical task of the fire. In the glass-maker's furnace earth was freed of its dross, of its opacity in order to become potentially transparent glass; but without light its crystalline qualities remain concealed awaiting, like a sleeping princess, the kiss of light.

What is the character of light? How has our understanding of its nature changed over time, and in what relationship to it do we stand?

In 1901 the physicist Max Planck reluctantly advanced the hypothesis that light was quantized, that is to say, that the structure or organization of light was in certain respects fragmented or atomized. Between the time of his proposal and the appearance of P.A.M. Dirac's famous text *The Principles of Quantum Mechanics* in 1930, the quantum theory of matter and of light underwent enormous development attaining, in all essentials, the form it has today. With it a new scientific imagination of light and substance was injected into the thought-life of the world.

During just these same years Rudolf Steiner was energetically advancing his "spiritual science" through lectures and books. He proposed a re-imagination of the world and man even more far-reaching than that being put forward by physicists at the turn of the century. Part of that re-imagination was an understanding of light as having arisen from the deeds of spiritual beings whose inner life

became over time the outer world we inhabit today. One cannot help but ask, what if any relationship exists between these two very distinct impulses that so powerfully entered the spiritual sphere of mankind at the dawn of the twentieth century?

Perhaps ironically, I feel that to answer that question we must begin with the Greek understanding of light, and particularly of vision. Against that background we can trace the evolution of man's understanding of light as a history of consciousness whose logical endpoint is the quantum theory of light.

Greek Vision

In antiquity the Greek conception of light displays the markings of human and spiritual experience. Consider for example the views of Empedocles and of Plato, who suggest that in order for sight to occur not one but *two* lights must be active, the external light of the sun and the internal light of the eye. Empedocles poetically describes the eye as like a lantern fitted round closely with membranes that protect the subtle luminous fire of the eye from the elements of nature. From the eye ray out beams as if from a lantern on a stormy night. Plato provides greater detail writing of the eye's emanation as mingling with daylight to form thereby a bridge or medium along which the sense of sight may operate. If the exterior light is absent the world is dark; if the interior is lacking then one is blind.

The notion of a radiant fire interior to the eye is alien to modern science, and yet it was so clearly self-evident to the ancient mind that the view persisted in various forms through the Middle Ages. I would suggest that to the ancient Greek the experience of vision was one in which the spiritual activity of seeing was given a standing equal to or greater than physical causation. They sensed a very real spiritual or "ethereal" emanation from the eye as part of the action of seeing. As time passed the vitality of that experience faded and the fossilized vestiges of the Greek view became part of a codified tradition to be found for example in the brilliant books of Euclid on the geometry of sight.

In that process of evolution the eye gradually became a passive *camera obscura*, or "dark chamber," on whose rear wall an image of the world was projected. No longer was seeing a human activity, but rather was understood as the inevitable consequence of the interaction of light and a physical organ.

In our century a new meaning can be given to the inner fire of the eye. The study of perception by psychologists has, in my view, yielded an appreciation for the Greek experience that can be framed in our own language. For over two hundred years physicians have been performing cataract operations on patients who have been blind since birth. Such operations offer us the opportunity to answer the question first put to John Locke by Molyneux: If an adult, blind from birth, were suddenly given perfect eyes what would he see? If sight is simply the natural response of a passive physical organ, then the hitherto unexperienced world of color, form, objects... everything, should flash into one's soul from the first moment the bandages are removed. This was, in fact, what patients and physicians expected. The sad and sometimes even tragic truth is, however, that the patient, now with perfect eyes, has the physical apparatus but still lacks the faculty of sight. Within the new visual organs a fire of intelligence needs to be kindled, and far more must be learned than we can imagine. The congenitally blind once given the physical ability for sight truly begins by seeing nothing and only very gradually, and often very painfully, learns to see extremely poorly. Most give up the project as too exhausting, going back to the less taxing and confusing world of blindness, literally reverting to a sightless world.

When I say that they see nothing I mean, of course, not that they lack raw sensations, but only that they can initially make nothing whatsoever out of them. I think of the sad case of an eight-year-old lad who after his operation was asked what he saw. His physician waved his hand before his unflinching eyes. Nothing. But then when asked to reach out he could, by touch, see the hand, crying out excitedly that yes he saw it now, and so learned to follow its slow movement across his field of view. But such progress was painfully slow and easily forgotten. The evidence of nearly seventy case studies shows that none ended with the subject seeing even as well as a child of three.

These facts should alert us to the wise activity that takes place in every one of our senses when we use them. Without a soul-spiritual activity of impressive scope we would be completely cut off from our surroundings. Seeing does indeed require functioning organs and an external light, but an inner soul-spiritual light is needed as well. I would suggest that when the Greeks, or Rudolf Steiner, speak of an emanation from the eyes, we should understand that the fire of

our will is joined with an extraordinary if inconspicuous intelligence that reaches out to the objects of perception. That intelligence is developed in early childhood when in our first three years we miraculously learn to walk, to speak, and also to organize the basis for our future life of thought.¹ The all-important aspect of thinking that forms raw sensations into meaningful impressions, of joining concept to percept, must not be overlooked or underestimated. Like walking or speaking, if seeing is not learned in childhood then it is essentially impossible to regain. The powerful forces that make this growth possible—forces that Steiner says are connected to the Christ—are no longer available to us in the natural way they were during our first three years.

The light of thinking is a metaphor possessed of real truth. During our early childhood a light is kindled within us, as Empedocles suggested. Without it we remain blind. We must bring our own light into the world to call its dark images to life. The glass images at Chartres remain silent without the light of day. Without the real light of our soul, so too would the infinite potential of nature never rise to expression. The world can only sing through us (as it did through Orpheus) as we play the instruments we have been given. Light is, as Aristotle says, an agency of actualization, of calling forth into being what rests latent around us. The ability for seeing was kindled in us by the first light of the world. St. Bernard was right when he saw in the penetration by light of the stained glass an image of Christ's conception and birth through the Virgin. His light conceives in us during childhood, all unawares, the light of the eye, that will be born as the gift of seeing.

Corporeal and Electrical Light

By the time of the Scientific Revolution of the sixteenth century, views regarding the nature of light had undergone enormous transformation, especially at the hands of brilliant Arab opticians. The views of Plato and Aristotle at which I have hinted, views still sensitive to spiritual and human dimensions of light, were discarded and in their place arose an essentially materialistic understanding of light. Two theories were established in the course of the seventeenth and eighteenth centuries. One proposed light as an effect arising from small physical bodies, while the second supposed light to be a movement or disturbance in a material medium. The former view found

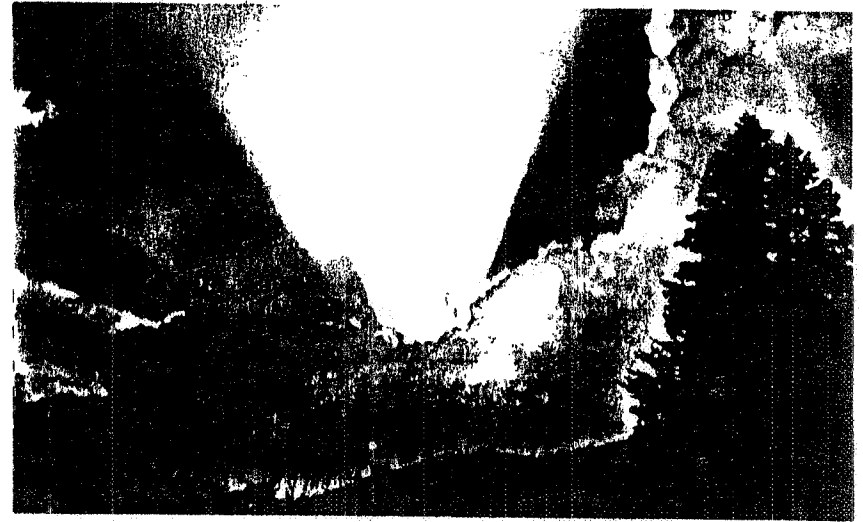
its most complete explication in Isaac Newton. It dominated eighteenth century scientific thought until Fresnel and others successfully resurrected the competing wave theory of light that had been initially advanced by Christian Huygens contemporaneously with Newton's corpuscular view.

The specifics of the theories need not concern us here. What is of significance for us is that both scientists conceived of light in terms of images drawn from the well-known material world around them. In the one case the image, appropriately provided by the Dutchman Huygens, whose life was surrounded by water, is one of wave motion. In the second instance Newton, the architect of gravitational theory and physical dynamics, advanced a theory of light as being variously-sized, immutable corpuscles. Both hypotheses draw their image entirely by analogy with physical sense experience. A trend begun already in the Arabic scientific community reaches here a logical conclusion: Light is a corporeal body alike in all essentials to every other physical body, even if light is enormously smaller.

These two physical hypotheses regarding the nature of light battled one another until the mid-nineteenth century when a startling suggestion was put forward by James Clerk Maxwell. Based on his analysis of the electrical researches of Michael Faraday, he suggested that light should be thought of not as a physical body but as an electrical disturbance. The equations of electromagnetism that now carry his name, the so-called Maxwell equations, can be recast into the form of a "wave equation" that describes, in this instance, the motion not of a water wave but of an electrical wave. This result, taken together with the concept of "field" first suggested by Faraday, ultimately revolutionized the nineteenth century's scientific image of light. Light was now to be understood as fundamentally connected to electricity.

The evolution of light from ethereal emanation to a corporeal body and then on to an electrical phenomenon is tremendously interesting. I see it as evidence for an evolution of consciousness, for a history of mind that reflects Rudolf Steiner's description of the evolution of man. In his "Letters to the Members" he summarizes the thought development of man in the following way:

In the evolution of mankind, Consciousness comes down, step by step, along the ladder of Thought-development. There is a first stage of consciousness: here Man realizes Thoughts in his I, as Beings imbued with Spirit, Soul and Life. Then comes a second



stage, where Man realizes Thoughts in his astral body. Here they appear rather as living and soul-endowed Images of the Spirit-Beings. At a third stage, the Thoughts are realized in Man's ether body; here they are only an inner life-stir, like the after-echo of a life of soul. At the fourth stage, the present one, Thoughts are realized by Man in his physical body, and represent dead Shadows of the Spirit.²

What we witness in the transition from the Greek imagination of light to that of Newton is, I believe, an instance of the development of consciousness from stage three to stage four. In the Greek experience of light something of the *life* of light still stirred; it was still a vital phenomenon to which man's own activity was linked in essential ways. By the seventeenth century such sensibilities had passed away to make room for the shadowy image of light as merely a physical body. Had we gone back earlier before the Greek to the Egyptian and Persian imaginations of light, we would have encountered "pre-scientific" images in which light was unthinkable as separate from a spiritual being of the Sun: Ra for the Egyptian and Ahura Mazda for the Persian. In those civilizations one reaches back to earlier stages in the imaginal history of light. But our concern at present is with more recent developments and their import.

The history of light did not cease with Isaac Newton. Maxwell's electromagnetic theory of light took the development one step further, for no longer could light be understood as something analogous to the physical objects around us, but rather it was to be likened to what is in fact an invisible, or "sub-sensible" reality, namely electricity. To illuminate this further stage of development I would like to point to Rudolf Steiner's discussions of the four elements, ethers and "fallen" ethers.

Ethers, Elements, and Electromagnetism

The ancient Greeks saw the entire "sub-lunar" world as composed of four elements: Earth, Water, Air and Fire. Every object in so far as it was solid was possessed of the quality of Earth; in so far as it was fluid it had the quality of Water; in that it was areoform it was Air; and its warmth was due to the presence of the element of Fire. Within our planetary domain the elements appear to us now in mingled and impure forms, but nonetheless all things were conceived of by the Greek mind as made of only these four elements.

In numerous books and lectures Rudolf Steiner elaborates on the original perception of the Greeks with regard to the four elements by adding to the physical elements other "etheric" elements, termed "ethers," of a purely spiritual character. Already with the element of Fire one encounters a transitional case, for warmth is unlike the other elements in that it can permeate all three others but cannot have a physical existence apart from them. Steiner speaks about it as a bridge to the etheric world.

In the course of world evolution three other ethers arose: the light ether, the tone ether and the life ether.³ Within the compass of this brief article I cannot provide an adequate picture of the ethers, but for our purposes it will be sufficient to connect them with the third developmental stage, the Greek stage, specified in the earlier quotation. In so far as thoughts are realized in man's own ether body they still display a vitality, a mobility in their formation that shows itself to be an "after-echo" of the supersensible origins of thought. The Greek understanding of vision with its vivid account of the interior fire of the eye reveals still a feeling for the supersensible character of light. They yet sensed, I believe, the place of light in the cosmos as an etheric reality whose ultimate origins were to be envisioned in myth. Rudolf Steiner also provides a beautiful account of the genesis

of light, one to which we will refer later.

The transition from the Greek imagination of light to that which arose following the Scientific Revolution represents a movement in consciousness from living to essentially lifeless thinking. The rise of materialism, whether in one's view of light or anything else, is a reflection of just this turning within man. Thoughts no longer light up within the etheric body of man as they once did, but now take hold of our physical nature.⁴ The theories advanced by Newton or Huygens should be understood in this light. They are not advanced today because of new scientific discoveries nor by new data that calls for the overthrow of antiquated ideas. Rather one should understand the evolution and growth of science as an expression of deeper inner transformations in the soul-spiritual nature of man and mankind. The corpuscular and wave theories of light were *physical* theories, and as such accurately reflected the changed soul-spiritual nature of man in the seventeenth and eighteenth centuries.

In view of this, how can one understand the rise of the electromagnetic theory of light in the nineteenth century? Of what is it a reflection? And what about the current state of science with its quantum theory and relativity?

Here one can turn to a further elaboration of the concept of the ethers. Rudolf Steiner describes three "fallen" ethers as counterparts to the three higher ethers (light, tone and life ethers). Each of the ethers has in part fallen prey to the work of adversarial beings whom Steiner calls by their mythic names: Lucifer, Ahriman and the Asuras. Under their influence a new fallen etheric domain is created. The fallen light-ether Steiner identifies with electricity, the fallen tone-ether he connects with magnetism, and the fallen life-ether with a so-called "third force."⁵

Against this background I would suggest that one sees in the electromagnetic theory of light a further evolutionary stage in which man has descended even further from physical-material theories to "sub-physical" theories. Thoughts do not naturally light up within our etheric bodies as they did for the ancient Greek. I would suggest that at least within the scientific community, neither do thoughts grasp the physical body as they did in Newton's time. Now they descend still further to a fallen etheric domain in which we too participate. Nor did the development stop with the electromagnetic theory of Faraday and Maxwell, but continues on to this day showing

itself particularly vividly in the modern quantum theory of light. In this, light takes on an extraordinary non-physical character that seems constantly to defy the concepts of classical physics, that is to say the physics of Newton and the thinking that is imaged in the physical body (stage four).

It is important to remark at this point that the recent developments in the scientific understanding of light from Faraday on, are double-edged in nature. On the one hand as they are traditionally presented these theories continue the descent of thought still further into domains ruled by adversarial beings. Yet they also, even in their fallen guise, reveal their higher origins. Faraday's concept of "field" is rich with implications, and the contemporary dialogue around the "new physics" and the paradoxes of quantum mechanics provide magnificent challenges to the inflexible, lifeless modes of thinking born with the Scientific Revolution. Yet for all that they lack an essential element if one would move from natural science to spiritual science, namely what is sometimes called by Goethe the "moral dimensions" of our natural world.

Light as Deed

Just at the time Max Planck was first advancing his proposal of a quantum theory of light—that is, just as thoughts on light were descending to the level of the third fallen ether—Rudolf Steiner, then forty years of age, began to lecture regarding his spiritual understanding of man and universe. Implicit in that action was an attempt to "redeem thinking," as he would later call it. That is, to so re-enliven thinking that what was once a reality for the Greek mind would become so again for us, but now through a kind of self-conscious, alchemical transformation of the human soul. No longer would such thinking be "natural," a gift from the gods, but would rather be the fruit of human self-development.

Steiner recognized the scientific work of Goethe to be an important step along this path.⁶ In it was initiated a science of natural phenomena that appreciated the full range of human experience in nature. By attending with utmost care to the phenomena themselves, the investigator not only learned to sense, and in fact *see* nature's lawfulness, but following Goethe's scientific method an important added nuance remained that would be expunged through the method of orthodox science. For Goethe urged the investigator to develop a kind of

objective life of feelings, for example in one's relation to color. Through steeping oneself in a particular color experience and listening for the soul-echo it calls forth, an inner or psychological dimension to color can become part of the investigator's realm.⁷ Just such aspects are, of course, excluded from the facts of normal science, and yet they provide the subtle nourishment required for the development of spiritual organs of cognition.

Engagement with the natural world in accordance with Goethe's scientific method, therefore, offers the possibility for a reanimation of thinking. To an enlivened thinking the delicate, soul character of the phenomenal world can gradually become more and more articulate. It is no accident that an artist of the highest order first suggested this mode of scientific inquiry, for in it science and art are bound together. Under the influence of the striving that here occurs, new stirrings arise in man's ether body and, in the world imagination provided by Steiner, our strivings are answered by the harmonious responses of spiritual beings, foremost among them the powerful archangel Michael. Steiner characterizes his response in the following words:

Michael's mission is to convey to men's ether-bodies those forces by which the Thought-Shadows may again acquire *life*. To these new-enlivened Shadows, Souls and Spirits from the supersensible worlds above will incline themselves. And with these, Man, unbound and free, will be able to dwell, even as he dwelt with them of old...⁸

Gradually, as new faculties of cognition unfold and a new, enlivened thinking dawns, ancient imaginations will take on new voices and present themselves in contemporary dress. An example of this is Rudolf Steiner's account of the genesis of light according to his spiritual scientific researches.

In a remote past, prior even to the creation of the Earth as we now know it, angelic beings passed through a stage of their development that can be likened to our own today. They too then possessed an inner life of thought and moral action, for good and for ill. Their inner life was as rich and challenging as ours is now. At the end of that era all that they had thought and inwardly enacted, passed out or died into the embrace of the higher hierarchies. In our present era the thoughts of those angelic beings reappear as the light and darkness of our world. The inner life of the past dies and becomes the future

outer vesture of nature.⁸

The implications of his account for our own inner life are clear and intimidating. The inner world we now cultivate, our thoughts, feelings and actions are not of concern to us alone. In a distant future they too will "die and become," they too will form the light and darkness of a future world. We become thereby a community of creator-beings who slowly rise to self-conscious participation in world formation.

I think back to the miracle of glass-making enacted in the workshops that surrounded the rising walls of the great cathedral at Chartres. The transformation of sand and ash by the action of fire to become the potentially luminous gemstones that would form the walls of the Heavenly City, seems an apt metaphor for the alchemy of soul manifested in our struggles to make of ourselves a pellucid vehicle for the Logos-Light of Christ. If the miracle of the Virgin Birth is recapitulated every dawn through the windows at Chartres, then in us also a birth occurs with every effort we make to take a gemstone from the hearth of our soul, and holding it beside the like work of our neighbor, we together wait for the first light of dawn.

NOTES

1. Rudolf Steiner, *The Spiritual Guidance of Man and Mankind*, (Spring Valley, NY: Anthroposophic Press, 1950), Chapter 1.
2. Rudolf Steiner, *The Michael Mystery*, trans. by E. Bowen-Wedgwood and George Adams (London: Anthroposophical Publishing Co., 1956), p. 23.
3. Rudolf Steiner, *Occult Science*, (London: Rudolf Steiner Press, 1969), pp. 161 ff.
4. Rudolf Steiner, *The Michael Mystery*, pp. 19-20.
5. Rudolf Steiner, *The Etherization of the Blood*, see especially the questions following the lecture.
6. Arthur G. Zajonc, "Facts as Theory: Aspects of Goethe's Philosophy of Science," in *Goethe's Science Reappraised* edited by Frederick Amrine, et al. (Amsterdam: Reidel, 1987) and in *The Journal for Anthroposophy*, Numbers 40/41 and 42. Rudolf Steiner, *Goethe the Scientist and Theory of Knowledge Implicit in Goethe's World Conception* (New York: Anthroposophical Press).
7. Goethe, *Theory of Color*, in his collected *Scientific Writings*, edited and translated by Douglas Miller (Boston: Suhrkamp, 1988). Also see Rudolf Steiner's lecture of April 3, 1912, in *The Spiritual Beings in the Heavenly Bodies and in the Kingdoms of Nature*.
8. Rudolf Steiner, *The Michael Mystery*, p. 20.
9. Rudolf Steiner, "The Connection of the Natural with the Moral-Physical," Dec. 10, 1920.

