

SCIENCE AND ACCESS TO GOD

Epistemological Perspective

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I

Access to God and access to science considered together, access to scientific understanding of the creation and access to theological understanding of God, go back to the great theologians and scientists of Alexandria in the first six centuries of the Christian era. There already shortly before the first century there arose scientists who were dissatisfied with trying to understand the world in *a priori* abstract theoretical forms in Platonic, Aristotelian or Stoic ways, and set about developing a new kind of open inquiry in which they asked positive questions or framed "thought experiments" designed to disclose the nature of the realities into which they inquired. These natural scientists or φυσικοί were sharply criticised by sceptical thinkers of the New Academy like Sextus Empiricus who called them the δογματικοί or "dogmatics", not because they were dogmatic in the later sense of that word, but because they were concerned to ask questions that might yield true answers under the positive or dogmatic constraint of nature.¹ They regarded science as proceeding strictly in accordance with nature, κατὰ φύσιν,

¹ Sextus Empiricus, *Adversus Dogmatikos*, I, viii-xxix.

in order to disclose the actual nature of any reality in question. This was called *δογματική ἐπιστήμη* or "dogmatic science" in which scientific thinking *κατὰ φύσιν* was pursued faithfully under the constraint of what the nature of something really is, *κατ' ἀλήθεια*, and allowed the conceptual assent (*πίστις*) of our minds to that reality, as it becomes progressively disclosed to us, to determine how we are to think truly of it and express our understanding of it. In this context the terms *φύσις* and *ἀλήθεια*, nature and reality, were equivalent. This rigorous scientific mode of inquiry (*ἡ μέθοδος τῆς εὐρέσεως*) was held to apply to every field of scientific knowledge, when an appropriate modality of the reason was developed under the constraint of the specific nature of the object and the information it yielded.

In Alexandria that was how scientific theological inquiry concerned with the nature and activity of God was regarded and developed by the great theologians of the ancient Church.² They too, especially Cyril of Alexandria, spoke of Christian theology as *ἐπιστήμη δογματική*, or "dogmatic science", in which they allowed the nature of God, as he has revealed himself to mankind through the reality of his incarnate Word, to govern how they were to think out and give rigorous expression to its truth in faithful conformity to it, that is strictly *κατὰ φύσιν* and *κατ' ἀληθείαν θεοῦ*. In the course of that development of dogmatic science, it was understandable that theologians and scientists, *θεολογοί* and *φυσικοί*, should influence each other. That is my concern here, with the way in which access to God through his self-revelation affected access to natural science, and thus in which access of theological science to creation affected access of natural science to God. It was such a movement of thought that took place, when the Fathers of the Church hammered out their basic forms of thought and speech, not only in the literary and philosophical culture of the day, but in the midst of the most advanced scientific achievements of the ancient world.

It was in Alexandria particularly that theological and scientific traditions flowed together, and theology and science interacted with each other conceptually, epistemologically and linguistically. Owing to the fact that immense attention was devoted to the doctrines of the incarnation and creation, and of the incarnation within the created order of space and time, a radical transformation in the foundations of

² See my account of this scientific method in "The Hermeneutics of Clement of Alexandria," *Divine Meaning* (Edinburgh: T&T Clark, 1994), 130-78.

knowledge and in cosmological outlook took place: theology and science began to be pursued together within the same unitary world of space and time so that careful attention had to be given to the whole created order as it came from God and as it is sustained by his Word or Λόγος. It is above all, I believe, to John Philoponos of Alexandria in the sixth century,³ theologian and physicist, that we must turn if we are to grasp best something of how knowledge of God and knowledge of the cosmos interacted with each other in a very fruitful and utterly astonishing way, one in which, as we now know, the ultimate foundation upon which all modern empirico-theoretical science was laid. It is on that ground, I believe, that we may understand how access to God and access to science belong together, and how we may with appropriate reserve speak of science in our day as opening and serving access to God.

Already Christian theologians like Athanasius, Basil and Cyril had begun to think out the Christian understanding of God and the world in ways which John Philoponos realised had revolutionary implications for classical philosophy and science. Three basic points may be noted. (a) The biblical doctrine of the one God, the Creator of all things visible and invisible, called in question Greek polytheism and pluralism, polymorphism, hylomorphism and dualism, and demanded a unitary view of the created universe which required a scientific way of knowing that answered to its rational order. (b) The biblical view of the goodness of the creation, reinforced by the doctrine of the incarnation of the eternal Logos or Son of God within the creation, destroyed the idea that sensible and empirical events are not accessible to rational thought, and established instead the reality of the empirical world in the recognition that temporal and sensible realities have a common rationality of a contingent (ἐνδεχόμενος) kind, open to scientific investigation and understanding. (c) The fact that God himself, in creating the universe out of nothing, has conferred upon it one comprehensive rational order, dependent on his own, had the effect of destroying the Aristotelian and Ptolemaic separation between the sensible and the intelligible worlds, and so between terrestrial and celestial mechanics, and at the same time gave rise to dynamic and relational concepts of space and time as

³ See Samuel Sambursky, *The Physical World of Late Antiquity* (Princeton: Princeton University Press, 1962), and *Philoponos and the Rejection of Aristotelian Science*, ed. Richard Sorabji (London: Duckworth, 1987), and John McKenna, *The Life-Setting of The Arbitrator of John Philoponos* (Eugene: Wipf & Stock, 1997).

bearers of rational order in the created universe. That was the Christian view of God and the created universe which John Philoponos inherited and set out to develop and defend against Neoplatonic and Aristotelian attacks, and on that basis to deepen and develop scientific and theological understanding of the created order.

Reflection on two major ingredients in this theological inheritance opened up for Philoponos a revolutionary conception of natural science, which then fed back into his incarnational theology giving it a more realist and dynamic emphasis not least in respect of the understanding of space and time. These were: (1) the demand of the Judaeo-Christian doctrine of *creatio ex nihilo* for a radical rethinking of the classical Greek conceptions of the universe; and (2) the bearing of the distinction between *uncreated* and *created light* upon the classical sciences of optics, physics and dynamics. Both of these had the effect of generating a scientific outlook upon the created order that was congenial and conducive to doctrinal formulation of Christian Faith.

(1) The Christian doctrine of creation understood from the perspective of the incarnation of God the Word in space and time.

It was in Alexandria the great centre where classical science and cosmology had reached its height, but where a stultifying amalgam of Aristotelian and Neoplatonic ideas had come to prevail under the teaching of Proclus, that John Philoponos opened his attack upon the pagan ideas of the eternity of the world in his work *De aeternitate mundi contra Proclum*, and followed it up by *De aeternitate mundi contra Aristotelem* developed in a series of critical commentaries on the works of Aristotle.⁴ In them he set out a philosophico-scientific account of the Christian doctrine of creation out of nothing, and of the unitary universe with a rejection of epistemological and cosmological dualism which he claimed obstructed scientific investigation of empirical and cosmological realities. He demolished Aristotle's notion of the "aither" or the so-called "fifth element",⁵ and with it the myth of eternal cycles, and unending time,⁶ and throughout advanced a powerful account of the open-structured

⁴ Preserved by Simplicius in *Commentaria in Aristotelem graeca*, vols. 13-17, ed. H. Diels (Berlin: G. Reimeri, 1882-1909). See also *Philoponos Against Aristotle on the Eternity of the World*, trans. C. Wildberg (London: Duckworth, 1987).

⁵ Cf. Aristotle, *De caelo*, 1; and Philoponos, *Contra Proclum* (ed. H. Rabe, 1899), XIII, 485-91.

⁶ Cf. Aristotle, *Physica*, 8.1; Philoponos, *In physica*, *Fragment 108*, & *Con. Proclum*,

nature of the universe as freely created by God and endowed with a contingent rational order of its own. Of particular importance for Philoponos was the idea that God created both matter and form out of nothing, and created it in a non-temporal way, while creating time itself along with the world.⁷

Added to these critical scientific and epistemological arguments against Neoplatonists and Aristotelians, John Philoponos offered a more positive account of the Christian doctrine of creation, in the *De opificio mundi*.⁸ In it he had in mind St Basil's *Homilies on the Hexaemeron*,⁹ but throughout he was concerned to give scientific expression to the biblical doctrine of creation. Here it becomes clear that it was his distinctively Christian understanding of creation that had opened up for Philoponos the possibility of a genuinely scientific account of the world of space and time, freeing it from the philosophical myths of the Greeks. Here also we see that it was his theological understanding of the contingent rational order of the universe of space and time free from necessity that provided him with access to the actual nature of the universe, and helped him to put forward a genuine scientific understanding of the empirical laws of its order.

(2) The theological distinction between uncreated and created light.

The understanding of God as Light, not just in a symbolic sense, was a primary element in the teaching of Athanasius about God as Creator and Logos: God is Light.¹⁰ Due largely to the teaching of St John light had early become a primary element in Christian thought in worship and theology alike, particularly as identified with Christ.¹¹ Like St Basil in his *Homilies on the Hexaemeron*, John Philoponos gave attention to the Biblical account in the Book of Genesis of creation through the majestic fiat of God, including the creation of light: "Let

I.6-8, XI.12.

⁷ Philoponos, *In Physica*, 189, & *Fragment 73*; In *De Caelo*, 136-38; In *Physica*, *Fragment 108-26* & 132; cf. Christian Wildberg, *Philoponos Against Aristotle on the Eternity of the World*, 122ff, 128ff.

⁸ Ed. by G. Reichardt (Leipzig, 1897).

⁹ See my account of this in *The Christian Frame of Mind* (Edinburgh: Handsel, 1989), 1-6.

¹⁰ See, for example, *De decretis*, 27, & *Ad Serapionem*, 1.19.

¹¹ See for example the great hymn Φῶς ἰλαρόν attributed to Gregory the Theologian of Nazianzus.

there be light, and there was light." And he distinguished this created light from the uncreated light of the divine Logos.¹² That was a distinction, similar to that between creative Spirit and created spirit, which became all-important for Philoponos,¹³ for it exercised a major role not only in his theology but in his science, and not only in optics, but in dynamics. It had the effect of reinforcing his rejection of the radical dualism in Hellenic philosophy and science between visible and invisible, tangible and intangible realities, and thus between terrestrial and celestial mechanics. All this called in particular for fresh thinking about the physics of light which he undertook in controversial examination of the teaching of Aristotle, especially as expressed in the *De anima*,¹⁴ which opened the door for something like a dynamic field theory (ἔξις τῆς) of light.¹⁵

In contrast to Aristotle's static notion of light Philoponos put forward a conception of light as a real activity. Thus he spoke of light as an immaterial or incorporeal dynamic force (κίνητικὴ τῆς δυνάμεις, ἐνέργειά τῆς ἀσώματος κίνητικῆς), invisible in a medium like air, which moves directionally and continuously at a timeless or unlimited velocity.¹⁶ As Philoponos wrote in his work against Proclus, the movement or speed of light is so fast that it can be said to be timeless (ταχέια...ἢ ἄχρονος).¹⁷

This concept of light as incorporeal kinetic activity, which Philoponos called φωστικὴ δύναμις,¹⁸ had far-reaching implications for optics, physics and dynamics: it involved a new kinetic theory, in sharp antithesis to that of Aristotle. What Philoponos did, taking his cue from the kinetic propagation of light, was in fact to propound a

¹² Basil, *Hexaemeron*, VI.2. This was a distinction also found in the West as with St Augustine, *Con. Faustum Manichaeum*, 20.7.

¹³ *De Opificio mundi*, ed. by W. Reichardt, 1897, Or. II & III, and cf. 10, 74f, & 76ff. See also John McKenna, *The Life-Setting of The Arbiter of John Philoponos*, Ch. 3, 93ff.

¹⁴ See Samuel Sambursky, *The Physical World of Late Antiquity*, 110ff (Routledge and Kegan Paul, London, 1962); Walter Böhm, *Johannes Philoponos*, 139ff, 182ff & 188ff (München: Verlag Ferdinand Schöningh, 1967).

¹⁵ See Philoponos, *In De anima*, 438 b & 430 a. Cf. Böhm, *Johannes Philoponos*, 176f, 188ff, 195 & 308.

¹⁶ See Böhm, *Johannes Philoponos*, 1185, 187f, 315f & 445; cf. also Sambursky, *The Physical World of late Antiquity*, 115.

¹⁷ *De aeternitate mundi contra Proclum*, I.8.22.

¹⁸ *De aeternitate mundi contra Proclum*, I.8.22.

new theory of impetus (κινητικὴν τινα δύναμιν ἀσώματων) on the analogy between the impetus imparted to a projectile in being hurled and the incorporeal kinetic force or momentum in the movement of light imparted to it by the Creator. Philoponos' light theory and impetus theory together amounted to a radical rejection of Aristotelian physics and mechanics and registered an immense advance in scientific understanding of the universe, approaching that of modern times. This combination of light theory and impetus theory was congenial, as Philoponos realised, to the Christian doctrine of creation out of nothing, for God himself is the creative source of all matter and form, and all light and energy in the universe.¹⁹ Thus for Philoponos light theory and impetus theory together scientifically reinforced and contributed to the unitary view of heaven and earth, matter and form, space and time, freely created by God Almighty out of nothing, for it was through the eternal Word or Logos incarnate in Jesus Christ, the Light of the world, that he has freely endowed them with their active force (κινητικὴ δύναμις) and continues to maintain and hold them together in their rational order.

The combination of Philoponos' dynamic and relational theories of light and motion reinforced the open-structured notions of space and time already developed by theologians, and gave rise to a conception of the universe as governed throughout by an internal cohesion (ἔξις) affecting and unifying all activity within it.²⁰ Thus light theory and impetus theory constituted together a kind of dynamic field theory,²¹ anticipating that of James Clerk Maxwell in the nineteenth century. The immediate effect of this in the fifth century was to liberate science from the closed world of Aristotle, nowhere more apparent than in his quantitative notion of space as the immobile limit within which a body is contained,²² and to replace it with a unified open-structured kind of rational order. The change in the conception of space applies, *mutatis mutandis*, also to Philoponos' relational conception of time in the reciprocal bearing of time and motion upon one another. All this had the effect of profoundly altering the fundamental conception of the

¹⁹ Philoponos, *In de anima*, 330, 21 & 428 b 9.

²⁰ For the use of ἔξις in this way see Philoponos, *In De anima*, 418b & 430a; and cf. W. Böhm, *Johannes Philoponos*, 195 & 308.

²¹ Cf. again John McKenna, *The Life-Setting of The Arbiter of John Philoponos*, 96ff.

²² I have discussed this in *Space, Time and Incarnation*, (Oxford: Oxford University Press, 1969 & 1997), 1-21, and in *Divine Meaning*, 343-73.

nature (φύσις) of things, and consequently of the understanding of scientific inquiry as pursued strictly "in accordance with the nature (κατὰ φύσιν) of things," that is, in accordance with what things really or actually are (κατ' ἀλήθειαν), and therefore in accordance with their dynamic nature or natural force (κατὰ τὴν φυσικὴν δύναμιν). This change toward a radically dynamic and relational conception of the inherent order and nature of the universe carried with it a basic change in the pursuit of objective scientific inquiry itself and correspondingly in the precise meaning and handling of scientific terms. That was nowhere more apparent than in the dynamic conception and meaning of "nature" or φύσις itself, and of "reality" or ἀλήθεια, e.g. in their frequent synonymous relation to one another.²³

We must not overlook the fact that already in the course of Alexandrian theology, particularly through Athanasius and Cyril, there had come about a steady development in the use of theological terms. Thus in their actual use φύσις, οὐσία, ὑπόστασις, πρόσωπον, had already been stretched, changed, and developed under the dynamic impact of the Gospel, so that attention must be given to their actual use in particular contexts rather than to their classical Greek definitions. It was in line with that on-going conceptual, epistemological, and linguistic activity that the changes in the scientific use of terms under Philoponos took place, but the results of his scientific revolution had a feed-back upon Christian theology, giving it a more realist and dynamic slant especially in the Alexandrian tradition which, I fear, the West has not properly appreciated. That change is nowhere more important than in the use by John Philoponos of the expression μία φύσις to speak of the μία ἀλήθεια of the incarnate Son of God. It was because that was not recognised or understood by the Aristotelian establishment in Byzantium that Philoponos was condemned and then anathematised as a monophysite heretic, which had the disastrous effect of condemning and rejecting his revolution in natural science, resulting in its loss for many, many centuries. In fact it was not until the revolutionary change that started with the work of James Clerk Maxwell in the combination of light theory and impetus theory that our modern empirico-theoretical science actually arose.

²³ See Samuel Sambursky, *The Physical World of Late Antiquity*, 96f.

My concern here is not to pursue that further but to discuss the fruitful way in which through John Philoponos, theologian and physicist, Christian theology and natural science can bear fruitfully upon one another. John Philoponos did not intrude his theology upon his science, or his science upon his theology. However, his theological grasp of divine truth opened his eyes to a more realistic understanding of the contingent nature of the world and its distinctive rational order, and exercised a regulative role in his choice and formation of scientific concepts and theories and their explanatory development. At the same time the dynamic character of his physical science, as it arose in this way, had a bearing upon the dynamic character of his theology, and deepened his grasp of its epistemological ground and perspective. He never thought of arguing from the world to the Creator, for that would have presupposed a logically necessary relation between them, No, he regarded the world as created freely by God and endowed with a contingent form of rationality different God's transcendent Rationality, but as such pointing openly beyond itself to the Creator. That is to say, his Christian theology opened up for him access to science, and his science thus understood opened up for him access to God. It was the theological distinction between the uncreated Light of God and the created light of the world that was all-important for him. It impelled him to develop the physics of light in a dynamic open-structured way, which radically changed the foundations of ancient science. In so doing John Philoponos anticipated the kind of empirico-theoretical science in which we engage today on the foundation laid down by James Clerk Maxwell when he brought light theory and impetus theory together in his epoch-making work *A Dynamical Theory of the Electromagnetic Field*.²⁴ It was his concept of the continuous dynamic field that Einstein hailed as the greatest change in the rational structure of science.²⁵ What lay behind that change, however, which Einstein did not realise, was Clerk Maxwell's adaptation to physics of the kind of onto-relations

²⁴ Refer to my edition of this work in 1982, reprinted in 1997; and to my account of his thought in *Transformation and Convergence in the Frame of Knowledge* (Belfast: Christian Journals, 1984), ch. 6, 215-42; in *Senso del divino e scienza moderna*, trans. G. Del Re (Citta del Vaticano: Libreria Editrice Vaticana, 1992), 317-52; and in *Das Verhältnis zwischen christlichem Glauben und moderner Naturwissenschaft. Die geistesgeschichtliche Bedeutung von James Clerk Maxwell* (Paderborn: Deutsches Institut für Bildung und Wissen, 1982).

²⁵ Albert Einstein, Leopold Infeld, *The Evolution of Physics* (London: Cambridge University Press, 1938), "Field, Relativity," 125 ff; also, Einstein, *The World as I See it* (London: J. Lane the Bodley Head, 1935), 156-61; and Einstein's appreciation of Clerk Maxwell, 29-32, in my edition of *A Dynamical Theory of the Electromagnetic Field* (Edinburgh: Scottish Academic, 1982).

expressed in the Christian doctrine of the Holy Trinity, in which the relations between the three divine Persons belong to what they really are.²⁶ That way of thinking out in a non-necessary, non-mechanistic, and non-logical way, the dynamic relations of light particles with one another in the magnetic field, revealed the kind of access which Christian theology can have to natural science, and thereby also revealed the kind of access on *epistemological grounds* that natural science can have for Christian theology. It is, I believe, in this epistemological perspective, in which we engage in the conceptual interface of theological and natural science, that we may rightly ask questions about the way in which natural science, pursued in this dynamic relational way hand in hand with theology, can open for us today a mode of access to God.

II

In the rest of this address I want to discuss the way in which we may consider the kind of access which natural science in relation to theological science may be said to serve access to God. Theologians and scientists live and work within the same empirical world of space and time, which both theologians and scientists have to take seriously, when there is inevitably an overlap in their inquiries, and in the modalities of the reason which they develop under pressure from the different realities with they have to do. How then, in our modern era, may we think of the access of natural science to God?

Of massive significance, of course, is the concept of *contingence*, contingent reality and contingent order,²⁷ upon which all our modern science, particularly since Clerk Maxwell and Einstein, is based.²⁸ As we have already noted it was the Biblical concept of *creatio ex nihilo* radicalised by Christian theology that made empirical science rationally possible and indeed gave rise to its early beginnings. By *contingence* is meant that the whole universe of matter and form was freely created by God and endowed with a rationality of its own utterly distinct from the transcendent rationality of God, but dependent or contingent on it. It is

²⁶ For that he was evidently indebted to Robert Boyd, *Praelectiones in Ephesios*, 1661, cc. 487 et seq.

²⁷ I have discussed this at length in *Divine and Contingent Order* (Oxford: Oxford University Press, 1981) & 1998.

²⁸ Refer to my contribution to *John Paul II On Science and Religion. Reflections on the New View from Rome* (Vatican: Vatican Observatory Press, 1990), 105ff.

a serious error to think of contingency as chance or to equate the contingent with the accidental, but that is what is often being put forward today by scientists, especially in the field of biology. Appeal to chance is a way not to think, but contingency refers to a positive form of rational order which is not self-explicable but points beyond itself to a transcendent ground of order as the ultimate reason for what it is. In the nature of the case contingency is not something that natural science could ever have come up with and cannot explain —and yet all our natural science and the laws of nature which it seeks to formulate have to do with the intrinsically contingent nature of the universe and its contingent form of rationality. This means that natural science cannot explain itself, and that there is no way of arguing from the contingent nature or rationality of the world explored by science to God, for that would presuppose that the world is not contingent but necessary. It cannot be said, therefore, that natural science or the world of nature which it explores and seeks to comprehend, actually gives us access to God. However, because the world is contingent in its rational order, by its very nature it points openly beyond itself, and cries out, so to speak, mutely for the Creator. Far from closing access to God natural science is an open door to a way of knowing God beyond itself. By the very nature of its contingent rational order, natural science reaches out in its formulation of the laws of nature beyond the boundary of being with non-being, in a tacit semantic reference to some form of "law beyond law", to an ultimate *why* or a *transcendent reason* for the laws which it formulates. In virtue of its contingent nature the world is not finally understandable without relation to God.

That was the issue raised by Albert Einstein in his remarkable lecture in Zürich in 1929 on the present state of field theory, when he claimed that science has now reached the point where we cannot remain satisfied with knowing *how* nature is, and *how* its laws operate, for we want to know *why* nature is what it is and not otherwise (*warum die Natur so und nicht anders ist*). He went on to say that to aim at a "logical uniformity" somehow related to God would be a "promethean" undertaking, but here nevertheless science has to do with the "religious basis" of its scientific struggle (*die religiöse Basis des wissenschaftlichen Bemühens*).²⁹ That is to say, there is no way in which science by itself

²⁹ *Über den gegenwärtigen Stand der Feld-Theorie*, Festschrift Prof. Dr. A. Stodola (Orell Füssli Verlag, 1929), 126f. Cf. also C. Lanczos's discussion of this in "Rationalism in the Physical World," *Boston Studies in the Philosophy of Science* vol. III (1954-1956), 185.

can penetrate into the ultimate core of nature's secrets —there can be no ultimate justification for the laws of nature except on a transcendent basis. Expressed otherwise, the concept of order which science assumes and with it operates is not open to scientific demonstration, for order has to be assumed in any proof or disproof. Belief in order is a *sine qua non* for science, as indeed for all rational thought. Einstein's discussion of unified field theory certainly indicated that he had abandoned a positivistic notion of science, but he declined to press on with the question *why* with a view to clarifying understanding of the ultimate ground of rational order on which the laws of nature rest and from which they derive their unity. Instead, he went on trying to find a solution to a unified field-theory through mathematical calculations, and failed. The mathematical texture of the universe which fascinated Einstein is a very important one to which I shall return shortly.

Meanwhile let me ask, What are we to make of the role of a so-called "natural theology"? To answer that question scientifically today two points need to be considered. a) We have to take seriously the nature of "dogmatic science" developed by scientists and theologians alike in the early Christian era, and b) examine the epistemological implications of general relativity theory in our own times.

a) In rigorous science we pursue inquiry in any field in such a way that we allow the nature of the field or the nature of the object to govern how we know it, think about it, formulate knowledge of it, and how we verify that knowledge. That applies equally to natural science and to theological science, in each of which we develop a modality of the reason appropriate to the specific nature of the object. The modality of the reason appropriate to the nature of an inanimate reality is different from what we develop in knowing an animal, and different again from that in our knowing a human person. Here we switch from an impersonal to a personal modality of our reason, but with a person we are not in a position to exercise control over him or her as the object of knowing — a human being is personally other than we are, and is more profoundly objective, for example, than a rock or a cow, for a person would object to our attempts to control him or her. However, when we turn to inquire of God and seek to know him in accordance with his Nature, there is and must be a radical change in our knowing of him in accordance with his divine nature as the Lord God the Creator of our being: we cannot objectify him in the same way. Thus before God as the object of our knowing there takes place an *epistemological inversion* of our knowing

relation. In knowing God in accordance with his ultimate divine nature we can know him only through his self-revelation and grace, and thus only in the mode of worship, prayer, and adoration in which we respond personally, humbly, and obediently to his divine initiative in making himself known to us as our Creator and Lord. How God can be known must be determined by the way in which he is actually known that is, through his self-revelation. Here the modality of the human reason undergoes a radical adaptation in accordance with the compelling claims of God's transcendent nature. That is precisely what *scientific theology*, or dogmatic science, involves: knowing God strictly in accordance with his nature, κατὰ φύσιν and in accordance with his truth or reality, κατ' ἀλήθειαν. And that, in the strictest sense, is *natural theology*, theology in accordance with the *nature* of God, κατὰ φύσιν θεοῦ.

b) Today this way of knowing has been considerably reinforced through the epistemological revolution initiated with general relativity theory in its rejection of dualism, and its finding that empirical and intelligible relations inhere in one another at all levels in nature and in our knowledge of it. This has not a little relevance for traditional natural theology. Let me refer here to Einstein's own account of this in his 1921 lecture on "Geometry and Experience".³⁰ With relativity theory he rejected the Newtonian dualism between absolute mathematical space and time and bodies in motion, between geometry and experience, i.e. between theoretical and empirical factors in scientific knowledge. He argued that in stead of idealising geometry by detaching it from experience, and making it an independent conceptual system which was then used as an external framework within which physical knowledge is to be gained and organised, geometry must be brought into the midst of physics where it changes and becomes a form of natural science indissolubly bound up with physics. Instead of being swallowed up by physics and disappearing, however, geometry becomes the epistemological structure in the heart of physics, although it is incomplete without physics. It is in a similar way, I believe, that natural theology is to be rejected as a *praeambula fidei*, or an independent conceptual system antecedent to actual knowledge of God, which is then used as an epistemological framework within which to interpret and formulate real or actual empirical knowledge of God, thereby subjecting it to

³⁰ *Geometrie und Erfahrung*, Preussische Akademie der Wissenschaften, Sitzungsberichte, 1921 (Berlin: J. Springer, 1921), pt. 1, 123-30.

distorting forms of thought. To set aside an *independent* natural theology in that way is demanded by rigorous scientific method, according to which we must allow all our presuppositions and every preconceived framework to be called in question by what is actually disclosed in the process of inquiry. However, instead of rejecting natural theology altogether, what we need to do is to transpose it into the material content of theology where in a changed form it serves the epistemological structure of our knowledge of God. As such, however, it cannot be used as an external parameter or independent logical structure detached from the actual subject matter of our knowledge of God. This would be in line with a faithful interpretation of St Anselm's *Fides Quaerens Intellectum*,³¹ and, I believe, with a proper understanding of natural science as it arose under the impact of the Christian doctrine of the contingent rational order of the universe.³²

Now let us turn to *mathematics* as the language of the created universe and consider whether a realist coordination of mathematics with the rational structures of nature may open up access to God. Mathematics certainly has a remarkable effectiveness helping to disclose and describe the inherent patterns of order in the created universe. In it we elaborate symbolic systems as refined instruments enabling us to extend the range of our understanding of those patterns beyond what we are capable of without them. The significance of mathematical symbolisms, however, is to be found not in the mathematical equations themselves but in their bearing beyond themselves. Mathematics is effective because it belongs to the actual contingent world, and reflects and expresses the patterned intelligibilities embodied in it, even though they cannot be captured in abstract mathematical form. In this event mathematical propositions and equations share with the universe its contingent character, and reinforce the way in which as contingent its order points beyond itself altogether.

Let it be stressed that mathematics rigorously used does not lead to a closed necessitarian or self-explanatory system of the world, which lends itself to aprioristic thinking, but to an open contingent universe.

³¹ Consult Karl Barth, *Fides quaerens intellectum. Anselm's Beweis der Existenz Gottes*, (Zürich: Theologischer Verlag, 1931 & 1958); Alexander Broadie, *The Shadow of Scotus*, (Edinburgh: T & T Clark, 1995), 9ff.

³² Refer to my discussion "The Transformation of Natural Theology," ch. 4 of *The Ground and Grammar of Theology* (Belfast: Christian Journals, 1980 & 1998), 75-109.

Whenever mathematics is intimately correlated with the structures of the empirical universe it operates with open-textured or incomplete symbols, for in rigorous operation it is found to have reference outside its own system which limits the validity of its formalisation.

What I wish to stress here is the necessary openness of precise mathematical propositions, which Pascal showed long before when he pointed out that in defining anything in one set of terms we must tacitly assume other terms that remain undefined. Even in the strictest mathematical operations we rely upon informal thought-structures. It is impossible to operate with a set of formally complete mathematical propositions or equations—true and effective mathematical formalisations are incomplete in themselves but are open to completion beyond themselves. That truth was established in cognate ways by Georg Cantor and Kurt Gödel. Thus, as Gödel demonstrated, in any arithmetical system of sufficient richness there are, and must be, certain propositions that are not capable of proof or disproof within the given system. That is to say, while formal mathematical systems are inconsistent and incomplete in themselves, they are open to completion and are true and consistent only by reference beyond themselves. Here we have also to take into account the fact established by Alan Turing, the Cambridge mathematician, who demonstrated through an idealised computing machine that there are mathematical functions and intelligible relations in nature that are inherently noncomputable, which reinforces the open reference of the contingent nature of the universe and its rational order beyond itself altogether. Thus, as John Barrow has argued, "If the universe is mathematical in some deep sense, then the mysterious undecidabilities demonstrated by Gödel and Turing are part of the fabric of the universe rather than merely products of our minds. They show that even a mathematical universe is more than axioms, more than computation, more than logic—more than mathematicians can know."³³

I believe that rigorous scientific and mathematical accounts of the universe of space and time have the effect of reinforcing the conception of the universe as an open system of contingent rational order that points beyond itself to a transcendent ground of rationality and order in the Creator. This does not mean that science by itself or on its own independent ground gives us access to God, but that it serves the access to God which he has given us through his Word and Light incarnate in

³³ John Barrow, "The Mathematical Universe," *Natural Science* (May, 1989), 311.

Jesus Christ. It has a very important role in opening up the scientific understanding of the space-time world to God in ways congenial to Christian faith. Thus rigorous scientific understanding of the world in accordance with its actual nature and reality, κατὰ φύσιν and κατ' ἀλήθειαν, harnessed together with the access to God given in Christian theology, has today a very significant epistemic role in opening the minds of people to faith and trust in God as Lord and Saviour.

ABSTRACT

It is because science rests upon an understanding of the contingent nature and order of the created universe established by Christian theology that it is possible today to think of science as serving access to God. The two-way relation between science and theology was exhibited by Philoponos in his revolutionary conception of science, basic to which was a way of thinking strictly in accordance with the nature and reality things under investigation. Christian theology opened up for him access to science, and his science thus understood served his access to God. Of primary importance for him was a) the doctrine of creation out of nothing which demanded a unitary conception of the universe and its contingent rational order, and b) the biblical distinction between uncreated light and created light. This impelled him to develop a physics of light in a dynamic open-structured way which radically changed the foundations of ancient science. Of immense importance was his development and coordination of light theory and impetus theory which gave rise to dynamic conceptions of space and time, and which anticipated the epoch-making work of Clerk Maxwell and Albert Einstein, upon which all modern empirico-theroetical science now rests.

撮 要

本文以菲羅普諾 (Philoponos) 在六世紀整合自然科學及神學的貢獻為引子，指出自然科學可作為通向及認識上帝的途徑。作者在第二部分中，以現代自然科學「或然性」(Contingence) 概念、愛因斯坦的「相對論」，及現代數學研究的發現，指出自然科學的研究皆揭示宇宙的開放性及其理性秩序的或然性，而這些皆指向一超越的理性及秩序——創造者 / 上帝，自然科學就是在這方面，正如成為肉身的道及光——基督，成為人通往上帝的途徑。