THEOLOGICAL and NATURAL SCIENCE

By

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To my dear Wife

Margaret Edith Torrance

and our dear sons and daughter

Thomas Spear Torrance,
Iain Richard Torrance,
and
Alison Meta Elizabeth Torrance

in boundless love and gratitude

Contents

Preface

This book represents a selection of my later lectures and addresses on interrelations between Christian theology and natural science, especially as I delved more deeply into the writings and thinking of James Clerk Maxwell, and then turned back to study the remarkable thought of John Philoponos of Alexandria, the sixth century theologian and physicist of the great Academy in Alexandria. My concern was the interrelation between theological and scientific thinking that had developed there from the second to the sixth century. In my earlier years I had concentrated on the thought of Einstein and Plank aroused when, on the recommendation of Norman Kemp Smith, I read Max Planck's work, *Where is Science Going*? In mid-stream I became fascinated with the Gifford Lectures of Michael Polanyi who took me to his heart after he read my work *Theological Science*, and we became warm friends. After the Vatican Council I was one of the founding members of the International Academy of Theological Science and soon joined its sister institution the International Academy of the Philosophy of Science, both established by Stanislas Dockx, OP, in Brussels at the end of the Vatican Council. It was through the latter particularly that I had the privilege of getting to know some of the leading scientists and mathematicians in Europe, such as Ilya Prigogine, Olivier Costa de Beauregard, Bernard d'Espagnat, Paulette Fevrier, J-L Destouches, André Mercier, I. Gonseth, Giuseppe Del Re, Paul Gochet, Sir John Eccles then in Switzerland, and the great John Archibald Wheeler who joined us from Princeton. Giuseppe Del Re from Rome and Naples and I were also original members of the International Academy for Environmental Questions, founded and directed by the remarkable Helmut Metzner of Tübingen. Del Re became deeply influenced, as I was, by James Clerk Maxwell's work *A Treatise on Electricity & Magnetism*, which as Einstein claimed had radically altered the axiomatic structure of science. I was particularly influenced not only by Clerk Maxwell's light theory but by his analysis and development of scientific method in his great work *A Treatise on Electricity and Magnetism*, which ranks with Newton's *Principia Mathematica* in the foundations of natural science.

When in 1982 Edinburgh University and the Royal Society of Edinburgh were commemorating the fourth centenary of the University of Edinburgh and the second centenary of the Royal Society of Edinburgh, I was horrified to find that they seemed to be overlooking the great work of James Clerk Maxwell. And so I extracted from his Scientific Papers, and published for the first time in a separate form, his epoch making work, *A Dynamical Theory of the Electromagnetic Field*, and dedicated it both to Edinburgh University and the Royal Society of Edinburgh. It has now also been published by Wipf & Stock, in

Oregon, USA. The new physics building in Edinburgh University has now been named after Clerk Maxwell, and a research unit dedicated to Clerk Maxwell has been established in India Street, Edinburgh, headed by Professor David Ritchie, devoted to Clerk Maxwellian mathematics as well as physics.

During my participation in the Faith and Order Movement of the World Council of Churches I met and had discussions with Armenian and so-called Monophysite churchman and theologians and realized that their Christology was in reality far from being heterodox, as claimed by Greek Orthodox and Roman Catholic theologians, and was in fact very close to the teaching of the Council of Chalcedon of decisive importance for Greek and Roman Churches alike. I came to realize that the mischief lay in the rather Aristotelian slant after the Council of Chalcedon in 451 that had been given by the so-called "orthodox" understanding by Greek Orthodox and Roman Catholic theologians alike, of the formula of the Chalcedonian Council about the divine and human natures of Christ. This led me to give deeper critical attention to the contrast drawn by theologians and churchmen between the Alexandrian and Antiochene doctrine of Christ, and in particular to the relation between the teaching of Cyril of Alexandria and Severus of Antioch. My understanding was later to be greatly reinforced by the Oxford dissertation of my son Iain, *Christology After Chalcedon, Severus of Antioch and Sergius the Monophysite* (1998).

This prompted me to give serious attention to the writings of John Philoponos of Alexandria, the sixth century theologian and scientist in his adherence to the teaching of Athanasius and Cyril of Alexandria, and in his trenchant critique of Aristotelian physics, which yielded his astonishing anticipation of Clerk Maxwellian science. Alas, however, when John Philoponos gave a more dynamic theological interpretation of the teaching of Cyril of Alexandria, he was anathematized by the Aristotelian churchmen in Byzantium. That had the disastrous effect of retarding the advance of science for more than a thousand years.

My interest in and study of the works of John Philoponos were greatly quickened by the writings of Professor S. Sambursky, the Jewish scientist, whose scientist brother, Benjamin, was murdered by Japanese terrorists at Lod Airport in Israel. I got to know Professor S. Sambursky in 1976 when he was the President of the Hebrew University in Jerusalem. He directed me to study Philoponos' theory of light, and pointed to the work of Walter Böhm, *Johannes Philoponos Grammatikos von Alexandrien,* 1967. A former student of mine, Dr George Dragas, now Professor in Hellenic College in Massachussetts, helped me to acquire some of the Greek texts of Philoponos' works, in particular the *De Opificio Mundi*, his commentary on St Basil's work on the creation.

One day in 1975, in the weekly discussions by Philosophers in Edinburgh University, when I referred to John Philoponos, Dr Sarah Waterlow (who as Sarah Broadie was to become Professor of Aristotelian Philosophy in Princeton), told me of the interest in the thought of John Philoponos by Richard Sorabji of King's College London. He and some of his friends have since been publishing a number of works dealing with John Philoponos, through the Duckworth Press in London. When delivering the Payton lectures on *Reality and Scientific Theology*

in Pasadena in 1981, and discussing with postgraduate students the thought of John Philoponos, I met John Emory McKenna a Princeton graduate in physics (taught by John Archibald Wheeler), when he was teaching Hebrew at Fuller Theological Seminary. When I spoke about the importance of Philoponos, and the need to translate some of his works which were extant only in Syriac, he responded to my call, learned Syriac and eventually wrote a doctoral dissertation (examined by Sebastian Brock) on *The Arbiter*. In Dr McKenna's edition of that work, now published by Wipf & Stock, John Philoponos is shown to be no monophysite but an orthodox Christian theologian, as well as an innovating scientist.

The ancient theologian from whom I have learned most and value above all others in the foundations he laid for all Christendom, was Athanasius the Great of Alexandria. But it was when I discovered the writings of John Philoponos that I learned in a newer and deeper way the fertile impact of Christian thinking, and Alexandrian theology in particular, not only upon the advance of human life and thought in general but upon the foundations of natural science and our scientific understanding of the world created through the mighty Word of God incarnate in the Lord Jesus Christ. It was particularly in studying the thought and writing of John Philoponos Professor in the great Academy of Alexandria that I discerned the powerful heuristic impact of Christian theology upon the foundations and advance of natural science and of physics in particular. It was not the ancient philosophy, Aristotelian, Platonic and Stoic, taught in Alexandria, that enabled Philoponos to achieve his "break through", but the Athanasian and Basilian doctrine of the creation of the universe out nothing and the contingent nature of its rational order through the dynamic Word of God that shaped his scientific understanding. That is what we find in Philoponos' work *De Opificio Mundi*, a theologico-scientific or philosophical commentary on Basil's account of creation under the guidance of the opening statements of the Book of Genesis. It was the biblical teaching about the role of the Word and Light of God in creation that fascinated John Philoponos so that he gave it primary place in the development of his scientific understanding of the contingent order of the created universe. What became very clear to me as I studied the works of Philoponos was the impact of biblical and Christian theology in the formation and development of scientific theory. Thus I liked to think of his science pursued in this distinctive way as "theological science". That is to say, his theology had a direct as well as a regulative impact on his heuristic scientific thinking, his discoveries and development in natural science. That is what I had already found in the epoch-making advance of physical and mathematical natural science in the work of the great James Clerk Maxwell. And so I like to think of John Philoponos of Alexandria in the sixth century as a forerunner of James Clerk Maxwell of Edinburgh.

This collection of essays largely comprises addresses on the thought of Clerk Maxwell and John Philoponos. But they begin with a lecture I was due to give (but prevented by illness from giving) in Washington, DC, at the invitation of my former student Lloyd Ogilvie, Chaplain to the US Senate, and of James H. Billington, Congress Librarian. Along with the essays on Clerk Maxwell and

John Philoponos, I have included one on Einstein delivered at the Center of Theological Inquiry in Princeton, reprinted from *Reflections*, Volume I, Spring 1998; one on Michael Polanyi contributed to *Tradition & Discovery. The Polanyi Society Journal*, vol. XXIV, vol.1, 1997-98; and my contribution to *John Paul II On Science and Religion*, *Reflections on the New View From Rome 1990*.

Several of my essays and lectures on John Philoponos reproduced here overlap in their argument and content, as they were delivered in lectures in different institutions and places where I was trying to direct attention to Philoponos. However instead of reducing them, I have left them as they were originally composed or delivered. I make no apology for that, for what we now learn about the scientific and theological contributions of Philoponos needs to be carefully assimilated today in theological and scientific thought alike.

I am greatly indebted to my elder son Thomas Spear Torrance for his considerable help in computing and in preparation of this volume.

Thomas F. Torrance
Edinburgh, Scotland,
2nd October 2001

Chapter 1

Theological Science and Scientific Theology, in History and Today

I believe that there is a deep cognitive relation between theology and natural science, if only because, as James Clerk Maxwell and Albert Einstein both in their different ways, there is and indeed must be a fundamental harmony between the laws of the mind and the laws of nature, an inherent relation between how we think and how nature behaves independently of our minds. The more profoundly our scientific understanding penetrates into the rational order of the universe of space and time, the more clearly and fully that pre-established harmony between the mind and nature becomes manifest, and also between the Creator and man. This surely applies to the interrelations between a scientific theology and natural science. They are concerned in different ways with the kind of intelligibility immanent in the created universe - that is with the contingent rational order with which all empirical and theoretical sciences have to do and upon which they are grounded. My concern, here, however, is not just with methodological relations between them, but with the conceptual interface between them, for I believe that rigorously pursued Christian theology and natural science contribute positively to one another, and that the reciprocal impact between them is much more profound and heuristically important than is usually realized by theologians and scientists. That is why here I speak of science developed in this rigorous way as "theological science" (i.e. theologically influenced science), and of Christian theology strictly pursued as "scientific theology" (scientifically influenced theology).

Let me begin by referring to what took place in the first six centuries when Christian thinkers laid the foundations upon which all subsequent empirical and theoretical science has developed. It was in Alexandria that decisive changes were made. There at the turn of the first century scientists arose who were dissatisfied with trying to understand the world in *a priori* abstract theoretical forms in Platonic, Aristotelian, or Stoic ways. They 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, called *physikoi*, were sharply attacked by skeptical thinkers like Sextus Empiricus who called them *dogmatikoi* - not because they were dogmatic in the later sense of that term but because they were

concerned to ask questions that might yield true answers under the positive or dogmatic constraint of nature.

The *physikoi* regarded science as proceeding strictly in accordance with nature, *kata physin*, in order to bring to light the actual nature of any reality under question. This was called *dogmatike episteme* or dogmatic science in which scientific thinking was pursued faithfully under the constraint of what the nature of something really is, and allowed the conceptual assent of the mind to that reality, as it becomes progressively disclosed to it, to determine how they are to think truly of it and express their understanding of it. This scientific method of inquiry (ἡ μέθοδος τῆς εὑρέσεως) was held to apply in every field of knowledge, when an appropriate modality of the reason would be developed under the constraint of the specific nature of the object and the information it yielded.

That was the intellectual milieu in which early Christian thinkers like Clement of Alexandria in the second/third century sought to think out and commend their faith. It was in Alexandria that scientific and theological thinking began to flow together and theology and science interacted with one another, conceptually, epistemologically, and even linguistically, 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 creative Word. And it was there in the Great Academy of Alexandria that careful scientific theological inquiry concerned with the nature and activity of God was developed by the great theologians of the early Church such as Athanasius, and Cyril who spoke of Christian theology as *dogmatike episteme*, or dogmatic science, in which they allowed the nature and activity of God, as he is revealed to mankind through his *Logos* or Word incarnate in Jesus Christ, to determine how they were to think of him. Owing to the fact that immense attention was devoted to the doctrines of the creation and of the incarnation within the created order of space and time, a radical transformation within the foundations of knowledge and in cosmological outlook took place, to which our modern empirical and theoretical science is indebted.

Under the impact of that Christian theology in Alexandria there arose a new scientific conception of the universe of space and time as *contingent* (ἐνδέχομενος, an Aristotelian term re-minted and brought into play by Athanasius) in nature and its rational order which pointed, not necessarily or accidentally, but freely beyond itself to God, the ultimate ground, cause and reason, the ultimate *why* of all the contingent natural order. By its very nature this contingent universe is incomplete (ἀκατασκεύαστος). Far from being self-sufficient or self-explanatory, the universe points beyond itself to the transcendent ground of intelligibility in the Logos or rational Word of God incarnate in Jesus Christ in the time and space of this world.

In that transformation attention must be given to three basic factors.

1. The Judaeo-Christian doctrine of the one God, the Creator of all things visible and in visible, questioned Greek polytheism and pluralism, polymorphism, hylomorphism, and dualism, and demanded a unitary conception of the created universe which called for a scientific way of research and knowledge that answered to its rational order.

2. The biblical view of the goodness of the creation, reinforced by the doctrine of the incarnation of the eternal Word 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 kind, open to scientific investigation and understanding.

3. 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 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 bearers of rational order in the universe.

That was the Christian view of God and the universe which John Philoponos, scientist and theologian of Alexandria in the sixth century, inherited, and set himself to develop and defend against Neo-Platonist and Aristotelian attacks, and on the basis of which to deepen and develop scientific and theological understanding of the created order. As an astronomer he composed a treatise on the *Astrolabe*, a complicated astronomical instrument, the oldest to survive from the ancient world. Then he turned to clarify epistemological issues at stake in contemporary philosophy and science, and became a powerful scientific thinker of remarkable insight who combined empirical and theoretic ways of scientific inquiry evident not least in his critical examination of the prevailing Ptolemaic cosmology and Aristotelian physics. Throughout his life he set himself in particular to carry through a comprehensive examination of the works of Aristotle, and developed a powerful critique of his physics and cosmology, in the course of which he injected into the stream of European thought revolutionary scientific ideas that anticipated those of Clerk Maxwell and Albert Einstein.

My concern now is to show something of the heuristic force of Christian theology in the scientific advance made by John Philoponos and Clerk Maxwell, and to justify the claim that the positive impact of Christian theology and natural science upon one another is rather more subtle, profound and important than is usually realized by theologians and scientists.

1. *John Philoponos "Grammatikos" or Professor at the great Academy of philosophy and science at Alexandria.*

The theology of John Philoponos was biblical and Christocentric, in line with that of Athanasius, Cyril, and Severus of Antioch, in which he developed the Christian conception of the creation of the universe and its rational order out of nothing. His thinking moved from a firm base in Biblical and Nicene theology into physics, dynamics, optics, meteorology and cosmology, and then back into theology in such a way that his theological thinking and his scientific thinking affected, fertilized and deepened one another. His science cannot be adequately understood in abstraction from his theology, while his theology may not be appreciated except in the epistemological depth and precision it gained from his

critical and creative engagement with traditional Hellenistic philosophy and science. Of central importance was the way in which he brought the Hebraeo-Christian doctrine of mighty living God and the creation of the universe of space and time out of nothing to bear in sharp criticism upon Neoplatonic and Aristotelian notions of the eternity of the world. Although many of Philoponos' main works were destroyed or lost, we are able to recover a good deal of his scientific thought from the massive *Commentaries of Simplicius*, the Aristotelian philosopher, who sought to confute him. I shall also take into in account several of Philoponos' works which have survived intact, particularly, *De aeternitate mundi contra Proclum, De aeternitate mundi contra Aristotelem*, together with his biblical account of the creation of the world, *De Opificio Mundi*, and the *Arbiter* or *Diatetes*. The science of John Philoponos is not to be understood in abstraction from his theology, while his theology may not be appreciated except in the epistemological depth and precision gained from his conflict with Greek philosophy and science. They had a profound epistemological and dynamic impact upon each other.

In recent years helpful work has been devoted to the writing and thinking of Philoponos, to which I am indebted. I refer particularly to that of Samuel Sambursky, *The Physical World of Late Antiquity*, 1962; of Walter Böhm, *Johannes Philoponos, Grammatikos von Alexandrien. Ausgewälte Schriften*, 1962; and particularly to Richard Sorabji: *Philoponus and the rejection of Aristotelian science*, 1987; *The Arbiter of John Philoponos*, by John McKenna, 1998. Under the guidance of Richard Sorabji a corpus of Philoponos' works is in process of being published, but the interest of most of those engaged in that enterprise seems to me to bear more on Aristotelian philosophy than on theology and science.

One cannot read Philoponos' work on the creation of the world, *De opificio mundi,* without realizing the importance he attached to the biblical account of the origin of the universe through the creative Word of God which he regarded from a Christological perspective. In Jesus Christ the Wisdom and creative Word of all things (ὁ τῶν ὅλων δημιουργὸς λόγος) became incarnate, through whom information is mediated which we would not otherwise have, but under the guidance of which genuinely scientific account of the world of space and time may be worked out. It was this theological understanding of the created rational order of the universe of space and time that provided him with a grasp of the actual contingent nature of the universe, and helped him to put forward a genuine scientific understanding of the empirical laws of its rational order. Here theological information which was not and could not be gained through natural science itself nevertheless played a positive and effective role in the development of scientific inquiry.

This is very evident in the special importance Philoponos gave to the biblical and theological account of the creation of *light* through the majestic fiat of the divine Logos. "Let there be light, and there was light". That distinction between the uncreated Light, which God himself is, and created light, like that between the creative Spirit of God and created spirit, exercised a major role not only in his theology but in his science, for it called for fresh thinking about the physics of

light, which he undertook in controversial examination of Aristotle's static notion of light put forward in his *De Anima*.

In contrast Philoponos put forward a conception of light as a real activity, an immaterial invisible dynamic force which moves directionally and continuously at a timeless or unlimited velocity (ταχεῖα...ἢ ἄχρονος). This concept of light as dynamic incorporeal activity which he called "light force" (φωστικὴ δύναμις), had far-reaching implications for optics, physics and dynamics: it involved a new kinetic theory (κινητική τις δύναμις ἀσώματος, ἐνέργειά τις ἀσώματος κινητική) in sharp antithesis to that of Aristotle. What Philoponos did then, taking his cue from the kinetic propagation of light, was in fact to propound a new theory of impetus, on the analogy between the impetus imparted to a projectile in being hurled and the incorporeal 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 realized, to the Christian understanding of the creation of the universe out of nothing, for God himself is the source of all matter and form, and all light and energy in the universe. Thus 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. It was through the eternal Word incarnate in Jesus Christ, the Light of the World, that God has freely endowed space and time with their active force (κινητικὴ δύναμις) and continues to maintain and hold them together in their rational order.

The combination of Philoponos's 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 governed throughout by an internal cohesion affecting and unifying all activity within it. Thus light theory and impetus theory constituted together a kind of dynamic field theory (ἕξις τις) of light, in astonishing anticipation of that of James Clerk Maxwell in the nineteenth century. The immediate effect of this in the fifth and sixth centuries was to liberate science from the closed mechanical world of Aristotle, nowhere more apparent than in his quantitative notion of space as the immobile limit within which a body is contained, and to replace it with a relational open-structured kind of rational order. Moreover, this change in the conception of space applied, *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 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 and actually are (κατ' ἀλήθειαν), and therefore in accordance with their dynamic nature and natural force (κατὰ τὴν φυσικὴν δύναμιν). This change toward a radically dynamic and relational