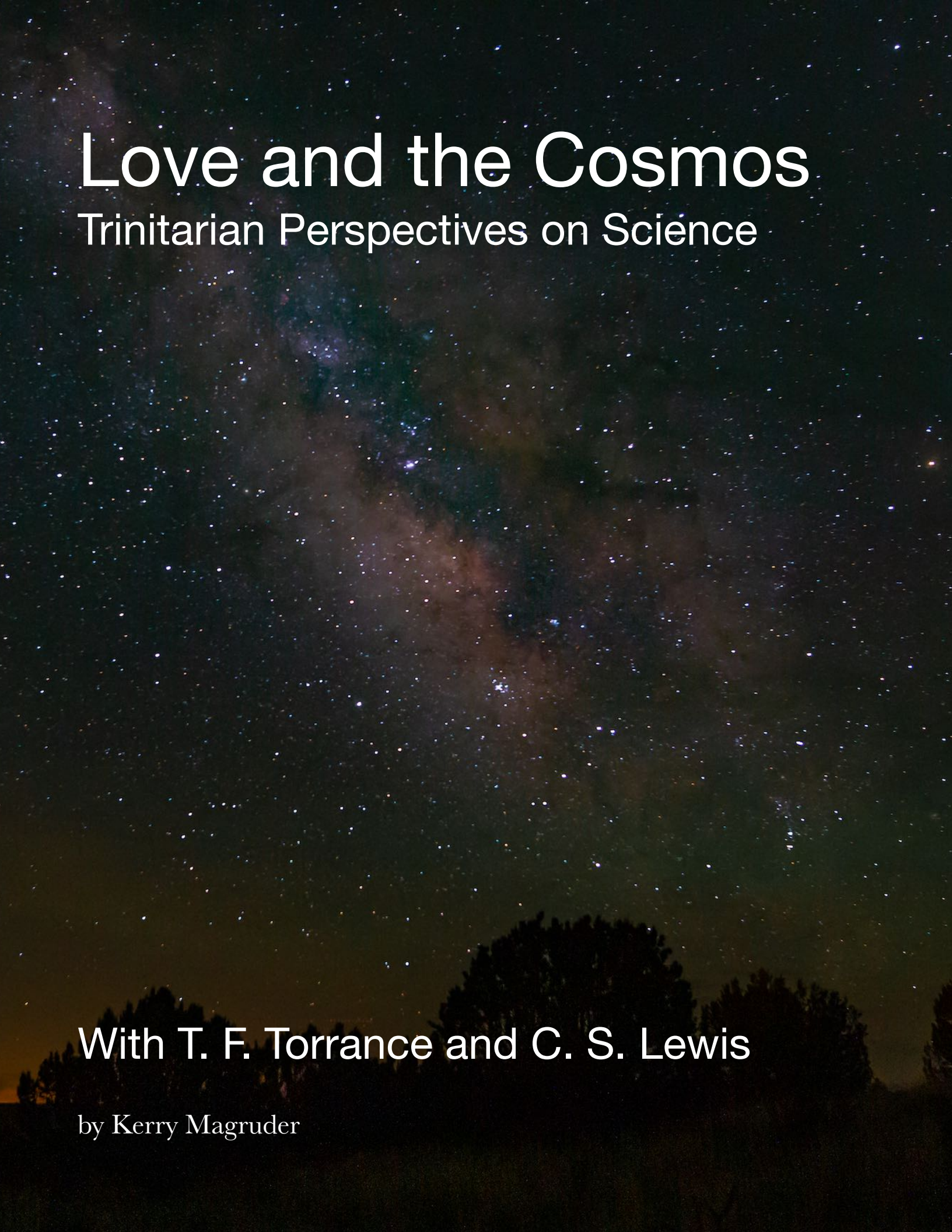

Love and the Cosmos

Trinitarian Perspectives on Science

With T. F. Torrance and C. S. Lewis

by Kerry Magruder

Version date and time: Saturday, May 11, 2024, 2:42:17 PM.

Are you interested in discussing sections of the draft?

Contact kvmagruder@gmail.com for the latest version.

Cover photo: © Stephen Folmar, "Milky Way Over the OK Panhandle" (2015), www.flickr.com/elstevo13. Used with permission.

Prologue	We believe
First article	In one God the Father Almighty Maker of heaven and earth, and of all things visible and invisible;
Second article	And in one Lord Jesus Christ, the Only begotten Son of God, begotten from his Father before all ages, Light from Light, true God from true God, begotten, not made, of one Being with the Father, through whom all things were made. Who for us and our salvation came down from heaven; and was made flesh from the Holy Spirit and the Virgin Mary, and was made man and was crucified for us under Pontius Pilate. He suffered and was buried, and the third day he rose again according to the Scriptures and ascended into heaven, and sits on the right hand of God the Father. And he shall come again in glory to judge both the living and the dead; his kingdom shall have no end.
Third article	And in the Holy Spirit, the Lord, the Giver of Life, who proceeds from the Father, who with the Father and the Son together is worshipped and glorified; who spoke by the prophets. And in one, holy, catholic and apostolic Church. We confess one baptism for the remission of sins; we look for the resurrection of the dead and the life of the world to come. Amen.

Table 1*: The Nicene Creed.*
Cf. Chapter 5, Section 2.6, "The Trinitarian Model" on pp. 264-272.

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Notes

Scripture passages are reproduced from the New Revised Standard Version (NRSV) unless otherwise noted.

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Within quotations, italics formatting is supplied by me for emphasis unless noted otherwise. When I have supplied words or phrases for clarity or context they are enclosed within square brackets; parentheses within quotations are given as in the original text.

Citations in footnotes use an abbreviated format; full references will be found in the bibliography. In the bibliography, works cited by C. S. Lewis and T. F. Torrance are listed separately in chronological order of publication, followed by a general bibliography of other works cited in the text.

Throughout the text, Torrance sources are cited as McGrath numbers. Use any McGrath number (e.g., #1976-331) to find the record for the first edition at *tftorrance.org* (e.g., *tftorrance.org/1976-331*). That record provides links to all known later editions, translations, digital editions, and original audio lectures, as well as to booksellers via LibraryThing, Amazon, Bookfinder and AbeBooks

For Lewis, pagination may vary across different editions, and occasionally the British and American editions may vary slightly in content. For these reasons, for any Lewis work cited, the chapter number or equivalent part is given in addition to the page number of the cited edition. The Bibliography lists the first edition in addition to the actual edition cited, and links to the online catalog of the Marion E. Wade Center of Wheaton College which offers detailed copy information for every edition.

For convenient reference, appendices include a timeline with the names and dates of select figures discussed in multiple chapters, a glossary of scientific and theological terms, and a detailed table of contents. Name, topic, and scripture indices are also provided.

✦ Part I ✦

Beginnings

Think of the two chapters of Part I, "Beginnings," as the first week of class.

Ch. 1: "Introduction"

The first chapter provides an orientation to the book's overall approach and rationale. It explores the meaning of key phrases in the title: "Love and the Cosmos... Trinitarian... Perspectives on science... With T. F. Torrance and C. S. Lewis..." By the end of this chapter you'll have a solid sense of the book's aims and organization, what to expect, and what the book is all about.

Ch. 2: "The Flat Earth Myth"

The second chapter, "The Flat Earth Myth," is the case study for Part I. This curious tale offers, as an initial reference point, a concrete exemplar of the challenges of exploring science and *history*.

Together, the two chapters of Part I begin to prepare us to travel on the road of "love and the cosmos." Later chapters will refer back to the basic ideas and framework introduced here.

Part I ✦ Chapter 1

Introduction

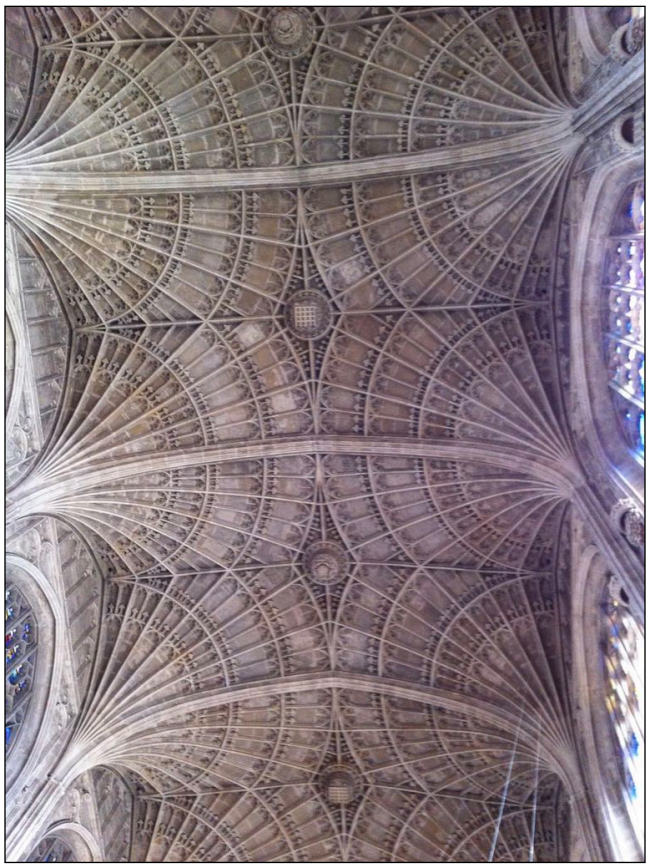

Figure 1: King's College Chapel ceiling.
Cambridge University

The King's College Chapel ceiling takes its inspiration from a forest canopy as seen from the ground. If cathedral architecture generally expresses a human understanding of our place in the universe, how might this be particularly meaningful for a biologist? For a cosmologist? For any scientist or creation worker?

— Scripture —

"And the Word became flesh and lived among us, and we have seen his glory, the glory as of a father's only son, full of grace and truth... (John 1:14 NRSV)

For God so loved the cosmos that he gave his only Son... that the cosmos might be saved through him." (John 3:16-17 NRSV)

— Prayer —

Dear Father, Son and Spirit,

Open our hearts and minds today to see further into the wonder of your creation, through Jesus Christ our Lord.

Amen.

1. PARABLE

> "The Birth of Christ is the *eucatastrophe* of Man's history. This story begins and ends in joy. It has pre-eminently the inner consistency of reality. This story is supreme, and it has entered history. It is pre-eminently (and infinitely, if our capacity were not finite) high and joyous. There is no tale ever told that men would rather find was true, and none which so many sceptical men have accepted as true on its own merits. To reject it leads either to sadness or to wrath." – J. R. R. Tolkien[1]

Imagine that you have just attended in person the annual Christmas Eve *Festival of Nine Lessons and Carols* at King's College, Cambridge. The soaring beauty of the music amplified beneath that vaulted ceiling reflects the astonishing claim of the Christian faith that the God who created the universe entered space and time and was born in a manger, lived among us, and then rose from the tomb to bring us life forevermore. Imagine that you genuinely believe all of this, and that you have spent a good part of your life reflecting on the mystery of Christian faith, that the greatest gift of God comes to us "not as an idea, not as a concept, not as a mere word, but as Word made flesh" to redeem and sanctify this creation.[2]

A few days later you are conversing with a friend at The Eagle pub, the site where Francis Crick and James Watson unveiled their model for the structure of DNA, only a minute's walk east from King's College and just north of the renowned Cavendish Laboratory where James Clerk Maxwell served as the first Director and extended his work on electromagnetism. Later that afternoon you walk by Magdalene College, where C. S. Lewis concluded his distinguished academic career, on your way to view manuscripts of Isaac Newton and Charles Darwin held in the Cambridge University Library.

Now, in the pub with your friend, your conversation touches upon all of these topics, moving seamlessly between faith and science.

Or does it?

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1. Montage of quotes from J. R. R. Tolkien, "On Fairy-Stories," in *The Tolkien Reader* (New York: Ballantine Books, 1966), pp. 33-90, particularly pp. 85-90. Tolkien's neologism *eucastrophe* etymologically means "joy" (*eu-*) + "great disruption" (*-catastrophe*), that is, a great turning around of all things with unexpected joy.

2. *Carols from King's, 60th Anniversary Edition* DVD (Cambridge, The Choir of King's College, 2015). Stephen Cleobury, Director. Filmed 14 December 2014 by the BBC. Quotation from the Bidding Prayer, as transcribed in the enclosed booklet, p. 6. The Bidding Prayer alludes to John 1:14. A recurring theme in the theological essays of Dorothy L. Sayers arises from her discussion of the "shock of the Incarnation" and of enduring belief in it in the modern world. Cf. Sayers, *Creed or Chaos?* (London: Methuen & Co., 1947), and Crystal Downing, *Subversive: Christ, Culture, and the Shocking Dorothy L. Sayers* (Minneapolis: Broadleaf Books, 2020).

Figure 2: The Eagle Pub (above); Magdalene College (right). Cambridge University.

The aim of this book is to show how that might be, and what such unfragmented conversations might look like.

The point of the parable, expressed directly, is that just as this book assumes the broad tradition of Nicene Christianity, so it also assumes a posture of affirming widely accepted and enduring scientific knowledge, in order to throw light on what it means to participate in both communities in the modern world.

The title suggests the scope of the work: "Love and the Cosmos"... "Trinitarian"... "Perspectives on Science"... "With T. F. Torrance and C. S. Lewis."

2. "Love and the Cosmos..."

A Trinitarian vision of natural science (and what we are here for) is one of *love and the cosmos*.

At the most fundamental level, the Triune God so loved the cosmos that he came into the world (John 1:14, 3:16-17). The ultimate reason we care for nature, even to the point of pouring our lives into science or creation care, is because God loves it. We are called to participate in his love.

As we seek to deepen our understanding of and care for the creation, we express our love in at least four inter-related dimensions:

- *Doxological love*: Is the daily experience of the reality of every creature and every aspect of the natural order, when received with wonder, humility, awe, and gratitude, a practice of love?
- *Cognitive love*: Is the way we come to know something more deeply, according to its own reality and nature, an exercise of love?
- *Ethical love*: Is what we do with our knowledge a practice of love?
- *Eschatological love* (or, the hope of love): Is the natural world, the cosmos in which we live, a school in which we might learn to love? And a place that will end in love?

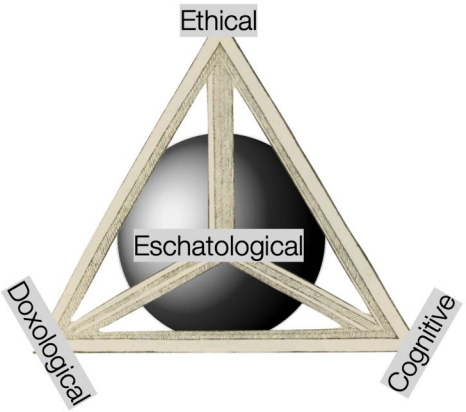

Figure 3: Four inter-related loves: Doxological, Cognitive, Ethical, and Eschatological.
Imagine our participation in "love and the cosmos" as a tetrahedron with these four loves as its vertices. Throughout the cosmos (i.e., the globe inside the tetrahedral solid), they are never experienced in isolation.[3]

Far from being merely an emotion, love is an openness and a commitment to embrace what is real other than ourselves. Each of the four dimensions of love listed above describe our openness to understand the reality of nature as it is outside ourselves and to embrace it for its own sake. In the same way, the three Persons of the Triune God made us real, not just a projection of themselves, and in freedom turned outward from themselves to embrace us, along with all creation, in order to bring us to share in their divine communion.

The mystery of *love and the cosmos* is the musical score accompanying the entire book.[4]

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3. Tetrahedron drawing by Leonardo da Vinci, published in Luca Pacioli, *Divina proportione* (1509).

4. Don't read with the soundtrack on mute; keep returning to the chapel at King's College. We will return to this discussion in Chapter 3, Section 4: "Love and the Cosmos," on pp. 102-104.

3. "... Trinitarian ..."

Although Trinitarian theology reached an ancient pinnacle with Athanasius and the Councl of Nicaea in the fourth century, from the standpoint of the history of Christian theology, the 20th century witnessed a "Renaissance of Trinitarian theology" following the work of Karl Barth.[5] Trinitarian theology does not denote a mental assent to the Trinity as an abstract doctrine or secondary belief. Nor does it refer to approaching the Trinity as an intellectual puzzle or a speculative argument in metaphysics. Rather, Trinitarian theology refers to an ineradicably personal approach to theology that arises out of the revelation of God in Christ. Through the Incarnation God reveals himself as an eternal communion of love between the Father, Son, and Spirit. Trinitarian thinking is Christ-centered, with the Incarnation as the starting point. Every area of doctrine organically connects to, and is grounded upon, the Trinitarian communion of God revealed in the Incarnation of Jesus Christ. The Trinity therefore serves not as an isolated doctrine but as a grammar of theology, a way of thinking that searches out the natural connections between every doctrine and the revelation of God in Christ.

The renewal of Trinitarian theology has not proceeded without significant reflection on its ramifications for the natural sciences. Some of the perspectives on science we explore are the following:

1. The goodness of the physical, material creation.
2. Relational being; that things are what they are not in and of themselves but as embedded in relations with others.
3. Stratified reality; a holistic vision of a multi-level reality with such depth and scientific imagination that it transcends reductionism.
4. Contingent order and contingent history; that the natural order is not necessary but contingent, and ultimately an arena of divine action in faithful lovingkindness.

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5. Some of the leading theologians in the Trinitarian renewal after Barth were Dietrich Bonhoeffer, Karl Rahner, Hans Urs von Balthasar, Jürgen Moltmann, Robert W. Jenson, John Zizioulas, Catherine Mowry LaCugna, Elizabeth Johnson, Lesslie Newbigin, Colin Gunton, Thomas F. Torrance, and James B. Torrance. Although not theologians, C. S. Lewis and Dorothy L. Sayers also played prominent public roles. For the complex currents of 20th-century Trinitarian theology, see Christoph Schwöbel, "The Renaissance of Trinitarian Theology: Reasons, Problems, Tasks," in *Trinitarian Theology Today* (Edinburgh: T&T Clark, 1995); Stanley J. Grenz, *Rediscovering the Triune God* (Minneapolis: Fortress, 2004); Thomas A. Noble and Jason S. Sexton, eds., *The Holy Trinity Revisited: Essays in Response to Stephen R. Holmes* (England: Paternoster, 2015); and Veli-Matti Kärkkäinen, *The Trinity: Global Perspectives* (Louisville: Westminster John Knox, 2007). For examples of Trinitarian theology before Barth, see Elmer M. Colyer, *The Trinitarian Dimension of John Wesley's Theology* (New Room Books, 2019) and Thomas F. Torrance, *Scottish Theology: From John Knox to John McLeod Campbell* (#1996-598). For a classic examination of the ancient theology of Nicaea, see Thomas F. Torrance, *The Trinitarian Faith: The Evangelical Theology of the Ancient Catholic Church* (#1988-489).

5. *Kata physin* knowing, which literally means knowing "according to nature" (*kata* = "according to"; *physis* = "nature"); that is, developing a method of knowing according to the nature of the object being known.
6. Semantic realism; that actual knowledge of reality outside ourselves is possible, however difficult it may be to attain or put into words.

Such perspectives are "Trinitarian" in that they are associated, for the Christian, with reflection on Trinitarian faith, as illustrated in Table 2:

Trinitarian affirmations which resonate with each perspective	**Perspective on science**
The perspective of the goodness of the physical, material creation resonates with the Trinitarian affirmation that the eternal Son of God assumed a physical body in the Incarnation, raised a physical body to a new creation of indestructible life in the Resurrection, and includes all creation with him in his Ascension and Second Advent.	Goodness of the physical, material creation.
The perspective of relational being resonates with the Trinitarian affirmation that the three persons of the Trinity cannot be defined in isolation, but have their very being in relation with one another. They have their being in communion. Similarly, in the revelation of God in Christ, when we know the Son we also know the Father and Spirit, for they are in one another.	Relational being; that things are what they are not in and of themselves but as embedded in relations with others.
The perspective of stratified reality resonates with the Trinitarian affirmation that Jesus of Nazareth is fully human and yet also fully divine. His presence with us as fully human does not diminish his transcendence as deity. Trinitarian theology requires an exercise of faith, an imaginative apprehension of reality, which perceives beneath the surface phenomena and goes beyond merely analytical and reductive reasoning.	Stratified reality; a holistic vision of a reality with such depth and scientific imagination that it transcends reductionism.
Divine freedom to love: The perspective of contingent order and contingent history resonates with the Trinitarian affirmation that the natural order was freely established by the three persons of the Triune God who together in love not only freely created it from nothing but sustain it and are even now working in it in covenant faithfulness, and will bring it to loving fulfilment in a New Creation.	Contingent order and contingent history; that the natural order is not necessary but contingent, and ultimately an arena of divine action in faithful lovingkindness.

The perspective of kata physin resonates with the methodology of early Trinitarian theologians. Torrance, citing use of the term *kata physin* by the Nicene theologians, adopts it as the fundamental principle for scientific realism.	*Kata physin* knowing, which literally means knowing "according to nature" (*kata* = "according to"; *physis* = "nature"); that is, developing a method of knowing according to the nature of the object being known.
Real knowledge of God: The perspective of semantic realism resonates with the Trinitarian affirmation that once we realize that we have come to truly know the Eternal God in his Incarnate Son, we are compelled to acknowledge that we are called to know and love all that is real, including his creation (and including his teachings on ethical love such as the Sermon on the Mount in Matthew 5-7).	Semantic realism, that actual knowledge of reality outside ourselves is possible, however difficult it may be to attain or put into words.

Table 2*: The resonance of Trinitarian theology with several perspectives on science.*

These perspectives on science and others are developed throughout this book.[6]

An under-appreciated historical phenomenon is that the early church developed its doctrine of creation not on its own as an isolated topic in theology, but through sustained theological reflection on the Incarnation. For example, reflection on the singularity of the Incarnation made plausible the corollary tenet of the singularity of *creatio ex nihilo*. A Trinitarian doctrine of creation is understood in light of the Incarnation, rather than as a prologue to it.[7]

This book explores what it might mean today for Christians again to ground their thinking about science and nature in the foundational theological perspectives of the Incarnation, Resurrection, and Trinity. Rather than focusing on current issues *per se*, our objective is to articulate deeper perspectives that arise from a Trinitarian theological instinct for science.

A Trinitarian approach to natural science regards the Nicene achievement in theology as paradigmatic for theological science in both *content* and *method*:

- *Substantively*, it explores how a Christian understanding of creation is deepened when we begin with a Christological focus. It is in the Person of Christ, anointed with the Spirit, that the divine nature was joined to human nature. The Incarnation reframes the relations between God and nature, placing all creation on a new basis. It then searches out creaturely analogies, echoes, or resonances with the Triune communion of love.

6. Cf. Appendix D: "Perspectives," beginning on p. 1119.

7. Thomas F. Torrance, *The Ground and Grammar of Theology* (#1980-369); and Thomas F. Torrance, *The Christian Frame of Mind: Reason, Order, and Openness in Theology and Natural Science* (#1989-505).

- *Methodologically*, it identifies aspects of theological science that are evident in the Incarnational and Trinitarian theology of Nicaea, and then considers whether those aspects of theological science have counterparts in how the natural sciences work.[8]

To approach the natural sciences in view of inquiries like these is a way of developing a Trinitarian theological instinct for science. To help Christians develop such an instinct is the chief aim of the book.[9]

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8. A prime example is the principle of *kata physin* knowing; see above.
9. We will return to this discussion of Trinitarian theology in Chapter 3, Section 4 on pp. 102-104.

4. "... perspectives on science..."

Figure 4: Night sky at Black Mesa. © Stephen Folmar, "Milky Way Over the OK Panhandle" (2015), www.flickr.com/elstevo13. Used with permission.

> "The heavens are telling the glory of God;
> and the firmament proclaims his handiwork.
> Day to day pours forth speech, and night to night declares knowledge.
> There is no speech, nor are there words; their voice is not heard;
> yet their voice goes out through all the earth,
> and their words to the end of the world.
> In the heavens he has set a tent for the sun,
> which comes out like a bridegroom from his wedding canopy,
> and like a strong man runs its course with joy.
> Its rising is from the end of the heavens, and its circuit to the end of them;
> and nothing is hid from its heat." (Psalm 19:1-6 NRSV)

For believers, our experience of the night sky, as at Black Mesa in Figure 4, may prompt a hymn of praise like we find in the first half of Psalm 19. An ancient metaphor describes the Bible and nature as two books: the book of God's Word and the book of God's Works. The

Psalmist expresses the two books on an experiential level by associating in a single song verses 1-6 on the order of the heavens (quoted here), and verses 7-14 on the "law of the Lord." The implication of these verses appearing in a single Psalm is that, in the experience of the Psalmist, there is no disharmony between the two books. Let's call this openness to the sheer reality of the two books "doxological love" (Table 3). It is the arena spoken of above as the daily experience of openness to the reality of every creature and every aspect of the natural order, received with wonder, humility and gratitude.[10]

God's Word (Psalm 19)	<– Doxological Love –>	God's Works (night sky at Black Mesa)

Table 3*: Doxological love conjoins the Two Books*

The worshipper who enjoys this unity of the two books on the day-to-day experiential level of doxological love will be concerned to demonstrate, whenever possible conflicts arise, that the two books are not in fact contradictory as may first appear, but are actually compatible as doxological experience suggests (Table 4). This is a traditional function of Christian apologetics.[11]

God's Word	<– Doxological Love –> (Compatibility)	God's Works

Table 4*: In light of doxological love, believers seek to show that the two books are compatible*

But are the two books related on a level beyond that of doxological experience? Rightly understood, do the two books speak in harmony? Is there more that might be said other than that they are compatible and not contradictory? If so, how do we go about rightly understanding them and reading them together?

Concordist	Perspectival
Two Books, One Language of information	Many Books, Many Languages
The two books are related by direct correspondence of information	The two books are related by meta-level perspectives

Table 5*: Perspectival vs Concordist approaches*

Two strategies for reading the Books in harmony are the concordist and perspectival approaches, contrasted in Table 5.

10. We will return to discuss this further in Chapter 3, Section 5: "Doxological Love," on pp. 104-115.

11. See, for example, Bernard Ramm, *The Christian View of Science and Scripture* (Grand Rapids, Michigan: William B. Eerdmans Publishing Company, 1954).

For concordism the book of God's Word and the book of God's Works are written in the same language, perhaps on facing pages, such that statements from one may be directly collated with statements from the other. The Bible, in effect, becomes a direct adjunct to science textbooks. Consider God's promise to Abraham recorded in Genesis 22:17:

> "I will indeed bless you, and I will make your offspring as numerous as the stars of heaven and as the sand that is on the seashore." (Genesis 22:17 NRSV)

In commenting on this verse, the preeminent young Earth creationist Henry Morris displayed a concordist habit of mind when he wrote that

> "the stars and the sand are of about the same order of magnitude in number. This fact could not have been discovered by men without the telescope; so it constitutes one of the many remarkable examples of modern scientific truth found in the pages of the Bible long before scientists could have learned them by the scientific method."[12]

As in this example, concordism aims to positively correlate biblical statements directly with scientific information. Concordism seeks to discern a direct correspondence between the language of the Bible, on the one hand, and the content of science, on the other, as amplified in Table 6.

God's Word (Bible statements)	<– Information –> (Concordism)	God's Works (Science statements)
• Number of Abraham's offspring (Genesis 22:17)		• Number of stars (astronomy) • Number of grains of sand on the seashores (geology)

Table 6*: With concordism, information on the same level mediates the Bible and science*.

By juxtaposing information from the two books, as if they were statements on one and the same level, concordist approaches confuse the *language* of both books with the *realities* to which they refer.[13] We will encounter many examples of concordism gone awry in our historical case

12. Henry Morris, *The Genesis Record* (San Diego: Master Books, 1976), p. 384. The same equivalence was noted by Hugh Ross, an old Earth creationist, in a number of his writings.***

13. In Part VI, "Knowing Reality," we will introduce a distinction between truth of being (reality) and truth of statements (language, equations, or other representations), as we explore how the perspective of semantic realism leads us to acknowledge the limitations of statements in isolation from the realities to which they point.

studies, for concordist thinking fails to remain open to the depth of actual reality in either domain and thus falls short of the way of love.[14]

On a closer look, Psalm 19:2-3 offers a clue that things are not so simple:

> 2"Day to day pours forth speech, and night to night declares knowledge.
> 3*There is no speech, nor are there words; their voice is not heard*."
> (Psalm 19:2-3 NRSV, italics added)

Verse 2 affirms that the natural order of the heavens pours forth speech, yet verse 3 obscures the matter by implying that it does so without words that can be heard, at least in the same way as the law of the Lord expounded later in the Psalm. In what I interpret as an interesting take on the two books metaphor, and an implicit allusion to verses 2-3, Torrance habitually comments that the natural order offers "mute speech" in praise of the Creator. The creation's speech must be interpreted by natural science (in this case, astronomy), on the one hand, and in dialogue with theological science, on the other. The scientist and theologian in concert act to give voice to the creation's silent praise, as intimated in this Psalm. To give voice to the creation's silent praise is a central aspect of humanity's role as priest of creation, in Torrance's view.[15]

This leads us to the perspectival approach to reading the two books, which seeks harmonies or resonances between the book of God's Word and the book of God's Works not only on the doxological level, but also by articulating perspectives that may be shared between them on a meta level. This meta level goes beyond mere compatibility yet without resorting to concordist correlation of information. The resonance of a perspective between theological science and natural science establishes a place of common ground on this meta level where genuine mutual dialogue between them may occur. Both theological science and natural science retain their disciplinary integrity, and yet discover (perhaps to their surprise) that a mutually beneficial, critical and constructive dialogue may open up between them, mediated by the meta-level perspectives. Developing these perspectives and engaging in such a dialogue is an expression of the *cognitive love* spoken of above, *i.e.*, coming to know something according to its own reality and nature.

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14. One of the hallmarks of compatibilist approaches to the two books is a humility that welcomes multiple competing interpretations. When this is missing, it is an indicator that one has slipped into a concordist rather than a compatibilist mode of interpreting biblical references to natural phenomena. See below, Chapter 14, Section 5: "Genesis 1," on pp. 614-638; and Chapter 8, Section 5: "Galileo, the Bible, and Science," on pp. 381-386.

15. Cf. Thomas F. Torrance, "Man, the Priest of Creation," in *The Ground and Grammar of Theology* (Charlottesville, Virginia: The University of Virginia Press; Belfast: Christian Journals, 1980), 1-14; #1980-369b. This chapter incorporates the address Torrance delivered on receiving the Templeton Foundation Prize for Progress in Religion in March 1978. For Torrance's comments on the mute speech of the creation see, for example, his *Calvin's Doctrine of Man* (#1949-022), pp. 35, 40, 42, 170; *The Christian Frame of Mind* (#1989-505), pp. 34, 113; *Divine and Contingent Order* (#1998-623), p. xi; *Theological and Natural Science* (#2002-TFT-3), pp. 91, 116; *When Christ Comes and Comes Again* (#1957-109), p. 88; *Christian Theology and Scientific Culture* (#1980-368), p. 111, 117-118; and *Reality and Scientific Theology* (#1985-450), pp. 52, 59, 90. For a relevant discussion, see *Ground and Grammar of Theology* (#1980-369), pp. 111-112.

In contrast to concordist readings, an approach based on perspectives cautions that the books are written in different languages (Table 5, right column). Indeed, there may be as many books as there are sciences, each science reading the language of creation in its own tongue. Torrance cited Albert Einstein:

> "We are in the position of a little child entering a huge library filled with books written in many languages. The child knows someone must have written those books. It does not know how. The child dimly suspects a mysterious order in the arrangement of the books but doesn't know what it is. That, it seems to me, is the attitude of even the most intelligent human being toward God.…"[16]

In a perspectival approach, complex acts of reading, interpretation, and translation are required to bring the books to bear upon a common story. For both theology and natural science to flourish, as we attempt to read across the two books, we need to nurture a deep-seated instinct, disciplined intuition, or scientific imagination, shaped by long practice and deep reflection. That is all part of drawing out the meta-level perspectives in the first place, and of bringing them into dialogue across domains.

In other words, instead of simply juxtaposing information from the books, as if they were statements on one and the same level, reflection and investigation in theology and the natural sciences will be required to discover, on a meta-level, perspectives which jointly illuminate and connect the books. A meta level provides a "reason why" for the knowledge gained on a lower level. We can diagram these two levels in Table 7 as level A, in green, and level B, in blue.

B. Theological science	<– Perspectives –>	B. Natural science
A. God's Word (Bible)	<– Doxological Love –>	A. God's Works (Natural phenomena)

Table 7*: Perspectives mediate mutually beneficial dialogue between different domains on a meta level. Level A in green; Meta Level B in blue*.

In Table 7, on the scientific meta-level B, the middle column represents any perspective on science mentioned above.[17] The top left, in meta-level B, might be any understanding of Trinitarian theology with which the perspective resonates.[18] The top right, in meta-level B, might be any natural science with which the perspective resonates.

16. Albert Einstein; quoted in T. F. Torrance, "Einstein and God," in *Theological and Natural Science* (#2002-TFT-3), p. 24. See below, pp. ***

17. Cf. pp. 12-15.

18. Cf. Table 2 on p. 14, where theological science was similarly represented in blue.

B. Theological science: *Trinitarian being-in-communion*	<– Perspectives –> *Relational being*	B. Natural Science: *Field theories & Relativity*
A. God's Word (Bible)	<– Doxological Love –>	A. God's Works (Natural phenomena)

Table 8*: Meta level: Relational being.*

For the example shown in Table 8 we see that the perspective of "relational being" resonates with Trinitarian being-in-communion in theological science (top left), and with the field theories of Michael Faraday and James Clerk Maxwell and the theory of relativity of Albert Einstein in natural science (top right).[19] In another example, shown in Table 9, the perspective of contingent order and contingent history resonates in theological science with "divine freedom to love," and in the natural sciences with the contingent history of the universe, of life on Earth, and of the Earth itself.[20]

B. Theological science: *Divine freedom to love*	<– Perspectives –> *Contingent order*	B. Natural Science: *Geology Evolution Big Bang cosmology*
A. God's Word (Bible)	<– Doxological Love –>	A. God's Works (Natural phenomena)

Table 9*: Meta level: Contingent order.*

Perspectives facilitate back-and-forth dialogue between disciplines on a horizontal level. On Level B the two books engage as interpreted by the sciences on either side, which are acknowledged as equally committed to understanding the full circumference of reality. There is a unity of truth in which both books investigate an incrementally-disclosed and ultimately-coherent reality. This is why movements between the two books might go in either direction. For instance, the discovery of a perspective like relational being or contingent history in natural science might prompt theologians to give greater attention to an area of theological science which was lying in relative neglect at the time, or vice versa. As we read the two books, the discovery that there happens to be an overlap of shared perspectives is a manifestation of the surprising intelligibility of the universe. Case studies will prove of heuristic value, and in-depth historical studies are crucial.

19. We explore the theological perspective of being-in-communion in ch. 13, "Perspective: Being and Relation"; and the corollaries of relational being in the natural sciences in ch. 14, "Case Studies: Relational Physics (and Genesis 1)."

20. The theological perspective of "divine freedom to love" is explored in ch. 15, "Perspective: Divine Freedom and Contingent Order." The perspectives of contingent order and contingent history in the natural sciences are explored in ch. 14, "Case Studies: Relational Physics (and Genesis 1)"; ch. 24, "Case Study: Evolutionary Creation"; and ch. 16, "Case Study: Geohistory."

Development of the perspectives, as noted above, is a process of ongoing *cognitive love*, a personal commitment and openness to understanding realities other than ourselves, requiring disciplined scientific imagination and continual epistemological repentance in fidelity to what is real. This is why movements between the two books cannot be specified by rules, or be determined *a priori*, but require development of a trained instinct in each science, *a posteriori*. Perspectives arise not from some higher metaphysical realm but within each domain, after the fact. They must be worked out within the practices and norms of the particular areas of science involved. Similarly, any association between a perspective and its correlate understanding in another science is not a simple collation of statements, nor a logical implication, nor is it necessarily a conscious or deliberate research strategy. Rather, the cross-level correlations, resonances, or harmonies, are established after the fact.[21]

In addition to deepening a dialogue between different sciences on a horizontal level, a perspective on a scientific meta level will also resonate vertically, enriching the level of doxological experience. Given successful articulation of perspectives, the development of science on a meta level will not diminish a sense of wonder; rather, a sense of wonder on the level of the phenomena of daily experience will only increase as discoveries proceed on a meta level. Aristotle opened his *Metaphysics* by declaring, "All humans by nature desire to understand." For Aristotle, all inquiry begins with wonder; i.e., the questions we ask on a doxological level.[22] Yet the wonder continues as progress is made with the discovery of causes on the meta level. As Aristotle admonishes:

> "We therefore must not recoil with childish aversion from the examination of the humbler animals. Every realm of nature is marvellous...."[23]

For Aristotle, even the lowliest animals are beautiful and full of wonder if one understands their causes. In that spirit, we seek to hold any meta level perspective, developed through the exercise of *cognitive love*, closely together with the day-to-day experience of *doxological love*. The loves spoken of above are reinforcing and deeply inter-related. We will have much more to say in later chapters about the roles of perspectives in their horizontal and vertical relations.[24]

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21. Given that perspectives on science arise within and belong to multiple domains, whether theological science or natural science, it might be misleading to refer to them as "theological perspectives." For clarity, when I refer to a "Trinitarian perspective on science" I am not wishing to imply that the perspective belongs exclusively to theology, but only mean that I am focused on explicating resonances between perspectives on science and Trinitarian theological affirmations. The perspective does belong to theology, just not exclusively, for it also belongs to other sciences, arising from each domain *kata physin*. To make our language more confusing, the word "perspectives" has other usages as well. For example, I will refer to "historical perspectives on science" when exploring light thrown on science by case studies in the history of science. I trust which use of "perspective" is intended will be clear from the context.

22. Aristotle, *Metaphysics*, Book I, ch. 1, 980a20-22, 982b11-23.

23. Aristotle, *Parts of Animals*, Book I, ch. 5, 645a5-25. Translated by W. Ogle. In *The Complete Works of Aristotle: The Revised Oxford Translation*, ed. Jonathan Barnes, Bollingen Series (Princeton: Princeton University Press), vol. 1, p. 1004.

24. We will resume this discussion of perspectives in Chapter 3, Section 6: "Meta Levels," on pp. 115-

5. "… WITH T. F. TORRANCE AND C. S. LEWIS"

T. F. Torrance, at the University of Edinburgh, was one of the 20th-century's leading Trinitarian theologians. C. S. Lewis, at Oxford and Cambridge, was one of the century's most distinguished literary scholars. One was a Scot, one was Irish; both were trained in philosophy and the history of ideas. Both interacted with numerous scientific contemporaries, although neither was a scientist *per se*. Their perspectives on science are helpful for many reasons:

- They are two of the most highly regarded 20th-century Christian writers.
- Each wrote in the Nicene theological tradition of Athanasius.
- Each wrote prolifically on Christianity and natural science.
- Each engaged in what Lewis called "rehabilitation," a sympathetic reading and recovery of writers through the ages.
- Each brings into our view an illuminating intellectual context – Lewis with Oxford, Cambridge, and the Inklings, and Torrance with his Scottish and ecumenical traditions.
- Their books are not textbooks, but classics, for life-long learning and enjoyment.
- Many report that reading their books is an intellectually exhilarating, life-changing experience.
- Each spoke anchored in the Church, for the sake of the world.

Torrance and Lewis model a constructive engagement with the natural sciences which can be of help to many today. Despite marked differences in life experiences, professions, church participation, and modes of writing, their perspectives on science mutually reinforce one another to a remarkable degree. Throughout this book, each perspective is illustrated from the writings of both. Lewis and Torrance serve as concrete exemplars, in their own distinctive ways, of how to appreciate and practice each one. Sustained conversation with Torrance and Lewis throws vivid light on each perspective. As if on a walking tour with them, we will view each hill and dale from several varied angles.

Learning to look at science with Torrance and Lewis will benefit anyone interested in theology and science, including not only scientists and students in scientific disciplines but also seminary students and pastors who work with scientists and creation workers in their congregations.[25]

Like Christianity, natural science is an inescapable part of our global culture. Yet few graduate students in the sciences enjoy an adequate opportunity to integrate their faith and learning in a holistic way, and few seminary students enjoy an adequate opportunity to

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126, in Chapter 12, "Case Studies: Interdisciplinary Relations," and in Chapter 19, "Perspective: Stratified Reality."

25. By "creation worker" I mean any activity or occupation involving regular contact with nature, from someone who loves gardening to an amateur astronomer, bird-watcher, mountain hiker, avid fly-fisher, or aquarium keeper. The nurse or farmer, wildlife painter or park ranger may not be considered scientists by many definitions, but are included as conversation partners here.

prepare themselves for the pastoral issues they will encounter involving faith and the natural sciences. Some Christian leaders today imagine the relations between the natural sciences and Christian faith only in terms of co-opting science for apologetic use, or of constructing some form of foundationalist natural theology, or of conducting a separatist program of confessional science. Worse still, some promote confrontation as the normative Christian stance toward natural science. Even if we set aside the more egregious caricatures of science and Christian faith, we often fail to imagine what integration and coherence might look like.[26]

C. S. Lewis and T. F. Torrance are of immense help in crafting a more holistic vision. They themselves engaged in profound and sustained dialogue with science old and new. For both of them, the Christian life entailed an ongoing personal and intellectual repentance, an evangelism of the mind, in which we develop and refine a Trinitarian theological instinct. Theology does not occur in an intellectual or cultural vacuum, but in God's world in critical and constructive partnership with natural science. We who are Christians are called to think Christianly about all of life, which includes engaging in mutual dialogue with the natural sciences in light of our Trinitarian faith.[27]

6. Readership

With such an approach, then, Christians may comprise the majority of those who choose to read this book. Nevertheless, it is also written for scientists and others, *whether Christian or not*, who genuinely seek to understand what the Christian faith might mean for the pursuit of natural science.[28]

The book is not written to persuade non-believers, whether secularists or adherents to other religious traditions, to convert to the Christian faith, nor does it argue for the pursuit of science along separate confessional lines.[29] This is a work of integration, not apologetics. For

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26. The popular television show "Young Sheldon" frequently highlights how ill-prepared many pastors are today to engage a culture in which the natural sciences play an integral role. Similarly, many scientists today find themselves ill-prepared to engage deeply religious communities in the modern world.

27. We will resume this introduction of Lewis and Torrance in Chapter 3, Section 7: "Why Focus on T. F. Torrance and C. S. Lewis?," on pp. 126-140.

28. In this approach, I am encouraged by Nicholas Wolterstorff, *Religion in the University* (New Haven: Yale University Press, 2019), and Miroslav Volf and Matthew Croasmun, *For the Life of the World: Theology that Makes a Difference* (Grand Rapids, Michigan: Brazos Press, 2019).

29. An operational definition of confessionalism in this sense (which is *rejected*) might be if a scientist who is a Christian would seek to form a scientific research team comprised on the basis of whether the members are Christians in preference to the quality of their work as scientists *per se*. To the contrary, diversity of faith perspectives should be acknowledged as of value among scientific research teams along similar lines as diversity of gender, race, class, and nationality. This is not relativism or tribalism; rather, the pursuit of objective reality is best served by a pluralistic strategy in which teams with diverse perspectives strive to reach a common consensus that overcomes the blind spots and filters of each participating community. See "Reversing Incurvatus in se," pp. 438-442. An analogous point arises with multidisciplinary research teams; cf. Chapter 12, "Case Studies: Interdisciplinary Relations."

that reason it may interest many in evangelical Christian circles who are looking for an alternative framework to a culture-wars approach to science. It is an endeavor intended to foster a mutually supportive dialogue between Christians, scientists, and people of any faith – populations whose members overlap to an oftentimes under-appreciated degree.[30]

Nearly a quarter of the world's population claim allegiance to some form of Christianity in the Nicene tradition.[31] Professing Christians residing outside of Europe and the United States number more than twice as many as those living within those two continents.[32] Thus it may be expected that Christians will make up a significant portion of the scientists of the future, particularly in the Majority World. Rather than dismissing Christianity outright as either hostile to or irrelevant for science, or as likely simply to disappear amidst a rising tide of science-fueled atheism, it is worthwhile for scientists, science educators, and science administrators to consider what resources this historic and global faith offers for the benefit of science.

This book assumes something like Charles Taylor's account of our secular age as arising not as a triumph of atheism due to the ongoing subtraction of religious belief from modern society, but rather as the historical emergence of a public sphere characterized by religious and non-religious pluralism.[33] Given such an understanding of the religious complexity of the modern age, an acute need arises for dialogue in the public sphere about the relations between science and the religions of the world. This book contributes to that dialogue from the standpoint of Trinitarian Christianity. It is intended to be read by people of any faith and by those without any religious tradition who are interested in that dialogue.

Ideally, this book would take its place alongside "Perspectives on Science" volumes comprised of insider accounts from other religious traditions. For indeed, none of the perspectives on natural science listed above are exclusively Christian. To take three examples: first, that the physical universe was created good is a tenet of many indigenous religions; second, a holistic

30. Cf. Elaine Howard Ecklung, David R. Johnson, Brandon Vaidyanathan, Kirstin R. W. Matthews, Steven W. Lewis, and Robert A. Thomson, Jr., *Secularity and Science: What Scientists Around the World Really Think About Religion* (Oxford, Oxford University Press, 2019). One of the four major claims of this sociological study is that (p. 8): "Around the world, there are more religious scientists than we might think. The scientific community is more religious than many people believe."

31. As of mid-2019, perhaps 1,864,141,000 people profess Christianity, compared with a total global population of 7,714,577,000. Center for the Study of Global Christianity (CSGC), Gordon-Conwell Theological Seminary, https://gordonconwell.edu/wp-content/uploads/sites/13/2019/04/StatusofGlobal Christianity 20191.pdf (accessed May, 2022).

32. As of mid-2019, the number of Christians in Europe (550 million) and North America (231 million) totals 781 million, compared with 1,635 million elsewhere – Africa (620 million), Asia (390 million), Latin America (600 million), and Oceania (25 million). "Status of Global Christianity, 2019."

33. Charles Taylor, *A Secular Age* (Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 2007). For an overview of Taylor's complex argument see James K. A. Smith, *How (Not) to be Secular: Reading Charles Taylor* (Grand Rapids, Michigan: Wm. B. Eerdmans Publishing, 2014). Space does not permit us here to debate Taylor's thesis nor to rehearse the immense literature to which it has given rise, but we will return to some of its ramifications in "Charles Taylor, Social Imaginaries," pp. 748-749. This book regards pluralism as an expression of the Trinitarian perspective of contingent freedom. Pluralism reflects the contingent freedom which God bestowed on the creation as a reflection of his own divine freedom to love. In this perspective, belief cannot be coerced but is a free response.

vision of reality that transcends reductionism receives widespread support from diverse faith traditions[34]; and third, a commitment to epistemological realism of some kind, however arduous it may be to achieve, is shared in common with practically all humanity on at least a practical level. In addition, atheists and non-Trinitarian theists may similarly emphasize relational being or the contingency of the natural order. Here we explore how for Christians these and other perspectives resonate with the theological instinct of Trinitarian faith, but they may also arise on non-Trinitarian grounds and be partly or fully shared by adherents of other religious and non-religious traditions.

While perspectives are not exclusively Trinitarian, neither are they homogenous or univocal. A hum of metaphysical ambiguity surrounds them.[35] Important variations arise in how they are put into actual practice across intellectual traditions.

Consider the ancient question of whether God had any choice when creating the universe. In Part VIII, we explore how Theists and Trinitarians have alike answered yes to that question, affirming a perspective of contingent order over against necessitarian views (Table 10). Yet the Trinitarian emphasis on divine freedom to love differs in interesting ways from a mere assertion of the almighty will of the Creator.

Did God have a choice when creating the universe?		
Deist, Pantheist, Pagan	**Theist**	**Trinitarian**
No. Natural order is necessary. Mind of God.	Yes. Natural order is contingent. Will of God.	Yes. Natural order is contingent. Divine freedom to love.

Table 10*: Perspectives vary across intelletual traditions, 1.*

34. Including the interesting examples of secular humanism and dialectical materialism. See, respectively, Stephen P. Weldon, *The Scientific Spirit of American Humanism* (Ithaca, New York: Johns Hopkins University Press, 2020); and Richard Levins and Richard Lewontin, *The Dialectical Biologist* (Cambridge, Massachusetts: Harvard University Press, 1987). See below, pp. 134-136.

35. Even what is meant by "metaphysics" is ambiguous. I have refrained from calling the perspectives on science "metaphysical perspectives" because of widespread and conflicting usages of that phrase in the historiography of science, which would make it misleading to adopt here. Moreover, in the present discussion, perspectives must be rooted in both sciences which they connect, and from which they arise *a posteriori*. In contrast, writers on "metaphysical principles" in science often regard them as prior somehow to any scientific inquiry. Perspectives on science in this work are not essentially philosophical or metaphysical in that sense, yet they do create a space for multidisciplinary dialogue which is of interest to philosophers and metaphysicans as well as scientists, theologians, and historians of science. All are welcome to the public house; none may claim to be the exclusive proprietors of it. In "The Foreigner at Home," Robert Louis Stevenson wrote of the "hum of metaphysical divinity" surrounding "the very cradle of the Scot" who grew up ready to debate the meaning of "to glorify God and enjoy him forever," the Westminster Catechism's obscure but noble answer to the meaning of life. Stevenson, *The Scottish Stories and Essays*, ed. Kenneth Gelder (Edinburgh: Edinburgh University Press, 1979), p. 238.

A similar example arises with the question of whether there is any meaning for our place in the universe. While Deists, in the company of Pagans and Pantheists, affirm a perspective of general design, Trinitarians and Theists alike discern a hidden, historical providence extending even to the particulars of existence (Table 11, as we explore in Part XI).

Is there meaning for our place in the universe?		
Atheist	**Pagan, Pantheist, and Deist**	**Theist and Trinitarian**
No. There is no meaning (except what we make of it)	Yes. Design (General Providence)	Yes. Historical Providence (Particular Providence)

Table 11*: Perspectives vary across intelletual traditions, 2.*

Such subtle differences in meaning may prove quite significant in the history of science.[36]

36. The terms Atheist, Pagan, Pantheist, Deist, and Theist (upper-case) are here used in a non-pejorative sense to refer to models of reality (or models of God and nature). These models are explored in Chapter 5, "Perspective: Approaching Science and Religion." As noted there (p. 275), "members of religious traditions may hold views attributed to the different models in various combinations; for example, a Jewish or Muslim theist (lower case) may hold to perspectives here labeled Trinitarian, or a Christian theist may hold to perspectives here labeled Deist, Pagan, or Pantheist, while an avowed atheist may share much in common with the Pantheist or Pagan models. The models provide a heuristic set of conceptions and terms not to sidestep but to clarify the complexities found in every religious (and non-religious) tradition."

7. Outcomes

Christian readers may resolve to work toward the following outcomes from this book:

1. Converse with scientists and creation workers about their vocational callings in order to gain experience that will help make churches safe and welcoming places for those who practice, or who wish to pursue, any of the fields of the natural sciences, including geology, evolutionary biology, healthcare, technology and engineering, agriculture, and conservation.
2. Critically analyze misconceptions that underlie the most common caricatures of an allegedly inevitable conflict between religious faith and modern science such as the flat Earth myth, science and superstition in ancient Babylonian astronomy, Copernicus and the Earth's motion in the heavens, the trial of Galileo, the immensity of the universe, the plurality of worlds, the age of the Earth, Darwin and evolution, magic and technology, and the Church and ecology, in order to learn from the church's past mistakes and also to be able to assist persons, unbelievers and believers alike, who are working through analogous issues today.
3. Develop and demonstrate a practice of thinking theologically about God and nature, or faith and reason, according to a Trinitarian theological instinct that reasons from a Trinitarian basis and goes beyond responding in an ad hoc manner to misconceptions about Christianity and science.
4. Develop and articulate a "relational natural theology" which arises naturally and organically from the nature of the gospel and the doctrines of the Incarnation and the Trinity. That is, to practice drawing out the implications of the Incarnation and the Trinity for a Christian perspective on love and the cosmos.
5. Describe and explain select perspectives on faith and science held in common by T. F. Torrance and C. S. Lewis.
6. Practice reading well by adopting strategies appropriate to the nature of the text, such as close reading for the dense prose of T. F. Torrance and brisk literary reading for the Ransom Trilogy of C. S. Lewis.
7. Enter into discussions with others, believers and non-believers alike, in a science and religion reading group.

Regarding #7, given the historical association of evangelical renewal and increasing literacy, one sign of a healthy local church or faith community would be the presence of active reading groups. My hope is that this book might inspire readers to launch discussion groups devoted to science and religion. Specific reading recommendations are suggested along the way. In addition, at the end of every chapter, questions for reflection are provided to promote discussion. These questions would be ideal for interdisciplinary reading groups comprised of practitioners and students spanning the natural sciences, the humanities, and ministry in faith communities.

8. Overview

The overall structure of the book is sequenced in parts designated by Roman numerals. Each part contains two chapters which together comprise a single thematic unit. In most cases, the first chapter of each part introduces a perspective with its theological context. The second chapter of each part illustrates that perspective with one or more case studies, past or present. As you read, establish a breathing rhythm: inhale (perspective) and exhale (case studies). The book is designed around repeated dialogue between Trinitarian perspectives and various case studies in the natural sciences.

The parts also follow an overall sequence. Later chapters refer back to and build upon earlier parts. The various chapters are best read in sequence.

Parts I and II comprise an introduction to the book. Chapter 1, "Introduction," and chapter 3, "Trinitarian Theological Instinct," introduce the book's overall approach and rationale. Read together, they form the essential prologue. Think of Chapter 1 as the orientation on the first day of class. Then Chapter 3 picks up the main themes of the Introduction and fleshes them out a little more. The case studies for Parts I and II offer, as initial reference points, concrete exemplars of the challenges of exploring science and *history*, science and *religion*, and science and *scripture*. Chapter 2, "The Flat Earth Myth," challenges us to rethink what we believe about science and *history*; Chapter 4, "Babylonian Astronomy," challenges our assumptions about science and *religion*; and a final long section in that same chapter on the magi and the Messiah's star will place the complexities of science and *scripture* before us. Together, the first four chapters prepare us to travel on the road of "love and the cosmos."

In Part III, "First Steps in Science and Religion," we clarify some common terms and introduce several different "models of reality" (that is, of God and nature). In the case study chapter, we explore Copernicus and the motion of the Earth to consider what difference our perspective makes.

In Part IV, "Semantic Realism: Thinking from Language to Reality," we look at the nature of language and other representations, including mathematical equations, and consider their relation to reality. Then we apply those insights to biblical interpretation and the life, works, and trial of Galileo.

In Part V, we consider popular accounts of "the scientific method" and find them wanting. We then reflect on "incurved science," how science can go bad despite the best of methods. We consider how to begin to reverse the "incurving" and recover a path of *cognitive love*.

In Part VI, we dive into realist epistemology, or how we know, which Torrance called *kata-physin* knowing, that is, knowing "according to nature," or adapting our ways of knowing to the nature of what we are trying to know. We will see that this manner of knowing is ineradicably personal, requiring an ongoing practice of *cognitive love* that is continually open to the reality of the other as it becomes more adequately disclosed to us. We then illustrate *kata-physin* knowing by returning to the world of Galileo and looking more closely at interdisciplinary relations between art, astronomy, music, and theology in Tuscany about 400 years ago.

In Part VII, we look at *being* in light of the doctrine of creation from nothing, and *relation* in light of the Trinity. We apply those perspectives to modern physics and cosmology, to the

work of James Clerk Maxwell and Albert Einstein, and the Big Bang, with a side-glance at lessons learned from historical efforts to interpret the first chapter of Genesis.

In Part VIII, we examine divine freedom to love and its ramifications for contingent order and contingent history, noting the corollaries of contingent intelligiblity and contingent freedom. We then explore how those perspectives were expressed in the discovery of geohistory, that is, the contingent history of the Earth.

In Part IX, we explore the role of the imagination not as an escape from reality but as a means of perceiving reality in all its many dimensions. We consider what a scientific imagination looks like, and how it may function in relation to worldviews, paradigms, social imaginaries, and other cognitive and cultural filters. We apply these insights by reading the Ransom trilogy by C. S. Lewis, with special attention to the first volume, *Out of the Silent Planet*.

Part X is devoted to the stratified or multi-leveled nature of reality, which we encountered above and will introduce further again in Chapter 3. A meta level explains the "reason why" for what we already know on an experiential basis. The perspective of stratified reality explains how the reality given to us possesses astonishing depth across many vertical levels or dimensions, even before we begin to search out those dimensions through appropriate disciplinary investigation, as the disciplines emerge through an open-ended historical process of differentiation. The perspective of stratified reality equips us to explore a full circumference of reality, and to avoid the impoverishment of vision brought on by a deficiency of scientific imagination or various forms of scientism and reductionism. Expressed another way, thinking in terms of levels and meta levels helps us maintain a close connection between *cognitive* and *doxological love*.

In Part XI we consider dualism, that insidious root of so many cultural splits. We seek a deeper understanding of how it is manifested in the dilemma of design versus historical providence in nature.

In Part XII, we bring together the many strands of previous weeks to reconsider in a Trinitarian light the often contested issues of natural theology and evolution. Natural theology becomes transformed in light of Part VI, "Knowing Reality," Part X, "Multilevel Reality," and Part XI, "Overcoming Dualism." A view of evolutionary creation draws together the theologically attractive perspectives of Part VIII, "Contingent Order and Contingent History," and Part XI, "Overcoming Dualism."

Finally, in Part XIII, we explore the related concepts of how Jesus of Nazareth – and in him, all of humanity – are the image of God and the priest and king of creation. In light of *ethical love*, we consider science and stewardship, the nature of technology, and the church and ecology, while revisiting the alleged Christian roots of modern science. We conclude on an Easter note of the Resurrection and the New Creation, the hope of *eschatological love* which animates all our knowing and underlies each of the other loves.

Parts	
Perspectives	Case Studies
Part I: Beginnings	
Ch. 1. Introduction	Ch. 2. The Flat Earth Myth
Part II: Thinking Theologically	
Ch. 3. Trinitarian Theological Instinct	Ch. 4. Babylonian Astronomy
Part III: First Steps in Science and Religion	
Ch. 5. Approaching Science and Religion	Ch. 6. Copernicus
Part IV: Semantic Realism, Thinking from Language to Reality	
Ch. 7. Language and Reality	Ch. 8. The Galileo Affair
Part V: About Method	
Ch. 9. "The Scientific Method"	Ch. 10. Incurved Science
Part VI: Knowing Reality	
Ch. 11. Knowing *Kata-physin*	Ch. 12. Interdisciplinary Relations
Part VII: Being, Relation, and Genesis 1	
Ch. 13. Being and Relation	Ch. 14. Relational Physics (and Genesis 1)
Part VIII: Contingent Order and Contingent History	
Ch. 15. Divine Freedom & Contingent Order	Ch. 16. Geohistory
Part IX: The Scientific Imagination	
Ch. 17. Imagining God and nature	Ch. 18. Reading *Out of the Silent Planet* and The Ransom Trilogy
Part X: Stratification of Reality	
Ch. 19. Stratified Reality	Ch. 20. Reality in Many Dimensions
Part XI: Overcoming Dualism	
Ch. 21. Dualism	Ch. 22. Dilemmas of Design
Part XII: Natural Theology and Evolution	
Ch. 23. Reconstructing Natural Theology	Ch. 24. Evolutionary Creation
Part XIII: The Priest of Creation and the New Creation	
Ch. 25. Priest and King of Creation	Ch. 26. The Resurrection and New Creation

Table 12*: Organization of the Book*

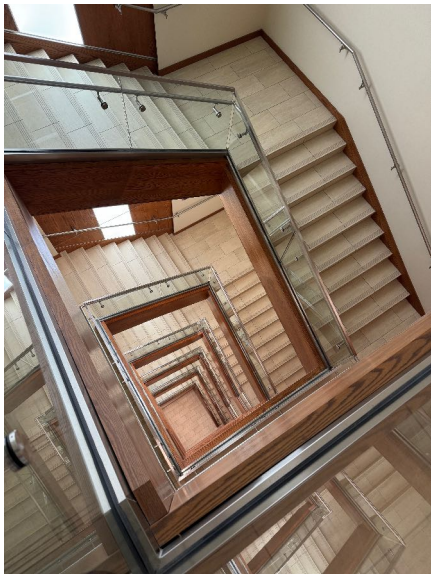


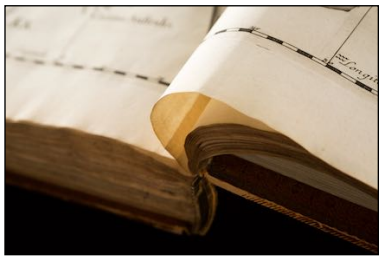
Figure 5: Staircase to the OU History of Science Collections

Think of each part as a single level on a staircase. A given topic, like *kata-physin* knowing or stratified reality, may be introduced in one part but wait to receive full attention in a later chapter. So the parts and chapters are best read in sequence, as every chapter builds upon the perspectives introduced in previous parts, creating an ever-climbing spiral of inter-linked, holistic understanding. Just as this Introduction anticipates Chapter 3, which circles back around the same topics in greater depth, so no chapter or part stands on its own. By the end of the book, you will have acquired and put into practice a Trinitarian theological instinct for the natural sciences.

Chapters open and close with several standard elements. Each chapter begins with an icon, a scripture, and a prayer, all intended to prepare one's heart and mind to be receptive to the reading of the text.[37] Each chapter concludes with an "After Words" section with subsections for "Classic Texts," "Further Reading," "Reflect and Discuss," and a "Doxology." Classic Texts suggest a practical place to begin reading relevant works of enduring value.[38] After the list of Classic Texts, items highlighted in Further Reading suggest a few next steps to follow to advance beyond the basic discussion in this book. Then each chapter offers questions for individual reflection and group discussion. Finally, a liturgical prayer, a hymn, or a song invites us into a concluding moment of worship and meditation.

Close Reading #1: C. S. Lewis, "Preface" to *Mere Christianity, pp. 5-12.*

When this close reading icon (right) appears, it indicates passages from classic texts which are meant to be closely read alongside this book.[39]



37. In order not to hastily read past the scripture and prayer, try reading them aloud before going on.

38. For some chapters, a classic text may be designated as a "doxological classic" intended to convey an appreciation for the foundational level of daily experience of creation and science, in a subject area discussed in that chapter.

39. The Close Reading icon is a photograph of Elisabeth and Johann Hevelius, *Firmamentum Sobiescianum sive Uranographia* (Gdansk, 1690; "The Firmament of King Sobiesci, or Map of the Heavens"), courtesy the History of Science Collections, University of Oklahoma Libraries.

The list of Classic Texts at the conclusion of every chapter also indicates any writings by Torrance and Lewis that are given close readings. Wherever they occur in a chapter, they are indicated by a tag such as "Close Reading #1," accompanied by an open book icon in the right margin. Following along those closely-read passages is integral to the logic of this book, but the long passages are not reproduced here. Keep such titles open on a rotating book wheel beside you (Figure 6). Why not notify your local library, and order your own copies now? A subsidiary objective of this book is preparation for life-long reading of Lewis and Torrance.

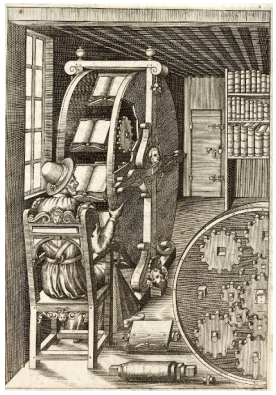
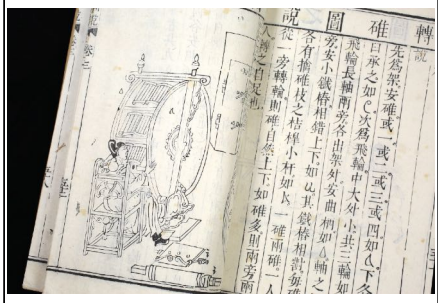
		
Book wheel in Ramelli (1588)[40]	Book wheel in Schreck (1630, reprint 1830)[41]	Harvard astronomer Harlow Shapley at his rotating table[42]

Figure 6: Rotating book wheels

With which classic texts should you start?

For Torrance, begin with "Theological Instinct" (#2002-TFT-4); *Space, Time and Resurrection* (#1976-331); and *The Trinitarian Faith* (#1988-489). After those, add *The Ground and Grammar of Theology* (#1980-369) and *Divine and Contingent Order* (#1998-623). These are the titles that will receive closest attention here. In general, Torrance sources are cited by "McGrath number" (e.g., #1976-331). Use any McGrath number to find the record for the first edition at *tftorrance.org* (e.g., *tftorrance.org/1976-331*). That record provides links to all known later editions, translations, digital editions, and original audio lectures, as well as to booksellers via LibraryThing, Amazon, Bookfinder and AbeBooks.[43]

For Lewis, begin with the Ransom Trilogy (*Out of the Silent Planet*; *Perelandra*; *That Hideous Strength*); *The Problem of Pain*; *The Abolition of Man*; *Mere Christianity*; *God in the Dock*; *Miracles*; *An*

40. Agostino Ramelli, *Le diverse et artificiose machine* (Paris, 1588). Ramelli's book wheel is reminiscent of the Buddhist prayer wheels developed centuries earlier in China; cf. pp. 227ff.

41. Johannes Schreck, *Marvellous Machines of the Far West* (Japan, 1830); reprint of 1630 Chinese edition. Schreck brought a copy of Ramelli with him when he traveled to Beijing.

42. Mildred Shapley Matthews, *Shapley's Round Table: A Memoir by the Astronomer's Daughter* (Bookbaby, 2021). *** Need credit and permission to use this image***

43. "Torrance Sources Bibliography," tftorrance.org (select the Bilbiographies tab).

Experiment in Criticism; and *The Discarded Image*. See the "Wade Center Podcast Index" website for citations as well as enthralling and insightful conversations about these and other works by Lewis.[44] Each of these are available in multiple editions.

Obtaining all these titles may seem a bit of a stretch, but think of it as obtaining a set of well-crafted, heirloom pieces of furniture to renovate the room of your mind. Passages from these works are closely read here not only for their own sake in this context, but also to prepare you to engage these works in their entirety throughout your lifetime. They are classics of enduring value not merely because of information they impart, but because they will reward patient and repeated reading with ever-new levels of understanding. This book is your initial guide to help you get started on your own long journey with them.

44. "Wade Center Podcast Index," wadecenterpodcast.org.

9. Caveats and Clarifications

This book may appear rather long for an introduction to its topic, but I hope it is not as intimidating as it may appear. The length is in part due to the effort made to keep it accessible. Pausing to explain technical jargon which is tacit for any discipline necessarily imparts to multi-disciplinary texts a greater length than texts addressed to a single disciplinary readership. As the Oklahoma statesman and wit Will Rogers put it, "We're all ignorant, just of different things." Consequently, this book is written at a more demanding level than popular writing. Instead of being written for non-experts, it is written for experts in different fields who wish to better appreciate one another. Additionally, it is written in varied formats drawn from public lectures and exhibitions rather than specialist writing. In public lectures, the most effective presentation is often holistic, where concepts are briefly introduced and then developed with ever-increasing depth in a spiral progression. Rather than trying to explain every idea all at once, complex ideas are apprehended and put into practice over multiple chapters in a more holistic manner of presentation. In exhibitions, abundant visual objects (or, in exhibit catalogs, illustrations) are accompanied by concisely-worded text. The abundant illustrations not only make the book more approachable, but are to be taken seriously in their own right as virtual exhibit objects conveying cognitive content visually in and of themselves.[45] These approaches are adopted here in preference to the format of a typical academic monograph. Take a piece of blank card stock and use it to hide the footnotes as you turn each page! The text may be read through without reference to the footnotes.[46]

Nevertheless, diverse readers may wonder at the short-schrift accorded their favorite topics. Theologians may be frustrated that the theology is elementary and introduced with infinitessimal speed. Scientists, similarly, may feel frustration mount that the scientific concepts remain at a most basic level, explained in only a cursory fashion, and leave off with an account that is hopelessly out of date. Both would be correct, as also any philosophers or historians with similar impressions!

The goal of a synthetic work like this is *not* to present cutting-edge developments in the participating fields. Indeed, that strategy might pose a positive distraction if the aim is to create lasting pathways between them that invite readers from diverse disciplines to begin to explore beyond their own areas of expertise. Indeed, the whole work is intended as a way to *start* rather than to finish *multi-disciplinary* conversations characterized by mutual respect and attentive listening. Imagine the convening of a reading group comprised of a theologian, a philosopher, an artist, a historian, and several practitioners all of different natural sciences; this book then represents their mutual introductions and conversations over the first year or so of meetings. If this book persuades any readers that it would be worth their time to seek out

45. For a discussion of visual thinking, when images play a cognitive rather than a merely ornamental role, when both texts and visual representations must be read together in combination, see my "Galileo's Telescopic Discoveries: Thinking Visually in the History of Science," October 21, 2022, invited keynote presentation, IEEE Vis 2022 conference, Oklahoma City, Oklahoma, https://youtu.be/DF7kt4R-Llk.

46. Those more academically inclined may read the footnotes, which are supplied rather than endnotes to facilitate entry into scholarly discussion. Consider adopting a hybrid reading strategy by going back to explore select footnotes of interest after completing a first reading of any chapter without them.

conversation partners from other disciplines for ongoing dialogue, then it will have achieved a major purpose.

Rather than trying to impose a uniform writing style, I have retained the original character and format of each chapter as much as possible in the belief that a variety of writing styles is appropriate to our holistic approach. We approach a mountain in a variety of different ways. We don't comprehend it all at once or in a single manner – impossible! By its very nature, we take this drive around it, or that trail beside it, one at a time, experiencing multiple partial views and angles, sometimes nearer or farther away, sometimes climbing up one side for a while, all under varying conditions of light and weather. Many of the case studies originated as public presentations, or as rare book exhibits, or as lectures for history of science courses (or in most cases, all three together). The perspective chapters originated as presentations to Christian university audiences, as lectures to seminary students, or as presentations at Christian retreats. Some readers might even decide to read through all the perspective chapters first, or all the case studies first, depending on their interests. Think of the variety of formats as different kinds of trails or roads or ways of approaching the mountain.

Much of the substantive content comes from the history of science. This material may be new to both scientists and theologians, so each may feel in this respect that they are on an equal footing, or at least an equally disadvantaged one. But this belies a larger question: why pay so much attention to the past? While positive answers to this question are offered in Chapter 3,[47] it is not out of place here to observe that historical perspectives on science are cultural in character rather than chiefly technical. The history of science views the arts and sciences in all of their culturally-rich and mutually-shaping relations. Nowhere is this more evident than in elucidating the manifold relations of science and religion. Conversations on faith and science are impoverished whenever such historical perspectives are deficient. In addition, drawing frequent applications to the history of science helps make concepts more concrete and more instructive than discussions in the abstract tend to be. Moreover, there are advantages for critical thinking when one proceeds unencumbered from entanglement in the distracting polemics of the current moment.

One caveat that should be clear from from all this nevertheless deserves explicit mention at the outset. Although I am by profession a historian of science, and this work draws upon the history of science for many case studies, it is not a monograph in the history of science any more than it is a work of theology or of natural science. Rather, this is a work of multi-disciplinary integration.[48]

With respect to the history of science, most of the case studies are presented on the level of a public presentation or an undergraduate honors course. While they are all grounded in a familiarity with primary sources (particularly with the original rare books in the History of Science Collections), very little is based on new specialized research. Rather, I here seek merely to make the more modest contribution of crafting a high-level overview of some of

47. We will return to this discussion in Chapter 3, Section 3: "Why Study the Past?," on pp. 96-102.

48. We will return to this discussion in Chapter 3, Section 2: "What Kind of Book is This?," on pp. 91-96.

the Trinitarian perspectives on science that were shared by T. F. Torrance and C. S. Lewis. I hope that bringing these perspectives together in one place might provide a springboard for future in-depth historical studies, by myself and others, which to this point are made more difficult by the lack of a synthetic framework or general thematic overview. So to my professional colleagues I would simply suggest that they read this study as a prolegomenon intended to stimulate future and badly-needed in-depth historical research.[49] It is a remarkable oversight that few studies of Lewis or Torrance in their contemporary intellectual contexts exist in the literature of the history of science.[50] If this work should spur any future student to further investigations in the history of science and religion, I would be delighted.

Finally, another caveat arises with the term *evangelical*, for which there are at least three different meanings: American, historical, and Trinitarian.

First, evangelical here is not used in the American political sense in which it refers to a neo-Fundamentalist church associated with nationalist and white-supremacist ideologies.[51]

Second, in a more expansive historical and global context, evangelicalism encompasses reform movements through the ages including the Reformation, the 18th-century Great Awakening, and the 19th-century abolitionist and global missionary movements.[52]

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49. An example of such an in-depth historical study is Bruce Ritchie, *James Clerk Maxwell: Faith, Church, Physics* (Edinburgh: Handsel Press, 2024).

50. The academic literature of the history of science is indexed by the Isis Critical Bibliography, ed. Stephen P. Weldon, sponsored by the History of Science Society and updated annually. It is available online at *isiscb.org*. In August 2022, excluding primary sources and considering only secondary studies, there were only 2 hits for C. S. Lewis and 1 for Torrance. This oversignt is currently being rectified.

51. In 20th-century America, evangelicalism positioned itself as occupying a third way between fundamentalism on one side and modern liberalism on the other. It tended to be a more northerly movement in tension with a more southerly fundamentalism, but the boundary was continually contested and blurred until the movement was largely co-opted by fundamentalists at the end of the century. See Tim Alberta, *The Kingdom, the Power, and the Glory: American Evangelicals in an Age of Extremism* (New York: HarperCollins, 2023); Kristin Kobes Du Mez, *Jesus and John Wayne: How White Evangelicals Corrupted a Faith and Fractured a Nation* (New York: Liveright Publishing, 2020); and Russell Moore, *Losing Our Religion: An Altar Call for Evangelical America* (New York: Sentinel, 2023).

52. A usual historical starting point is the five-volume History of Evangelicalism Series edited by David W. Bebbington and Mark A. Noll; e.g., David W. Bebbington, *The Dominance of Evangelicalism: The Age of Spurgeon and Moody* (Downers Grove, Illinois: InterVarsity Press, 2005), which describes historical evangelicalism as a "quadrilateral" of activism, conversionism, biblicism, and crucicentrism. More recently, see Mark A. Noll, David W. Bebbington, and George M. Marsden, *Evangelicals: Who They Have Been, Are Now, and Could be* (Grand Rapids, Michigan: Wm. B. Eerdmans Publishing, 2019). On the global evangelical church, see Lamin O. Sanneh, *Disciples of All Nations: Pillars of World Christianity* (Oxford: Oxford University Press, 2008); Philip Jenkins, *The New Faces of Christianity: Believing the Bible in the Global South* (Oxford: Oxford University Press, 2006); and Mark A. Noll, *The New Shape of World Christianity: How American Experience Reflects Global Faith* (Downers Grove, Illinois: InterVarsity Press, 2010). It is important to note that denominational affiliation is not an indicator of evangelicalism in this second sense. For example, on any account, John Stott would rank as one of the most prominent leaders of evangelicalism in the second half of the 20th century, and he remained an Anglican all his life. (For an introduction to Stott, see Thomas A. Noble and Jason S. Sexton, eds., *British Evangelical Theologians of the Twentieth Century: An Enduring Legacy* [London: Apollos, 2022], which also includes a chapter on Torrance.) In a global context, to abandon the term "evangelical" in this second historical

Third and more fundamentally, however, evangelical is an ecumenical description of the Nicene tradition in which doctrine and prayerful devotion are entertwined.[53] At its root, it refers to the *evangelium*, the good news of the Incarnation, the *eucatastrophe* to which Tolkien referred, and the gospel which Lewis and Torrance served.[54] Karl Barth writes:

> "What the word 'evangelical' will objectively designate is that theology which treats of the *God of the Gospel*.... Evangelical theology is concerned with Immanuel, God with us! Having this God for its object, it can be nothing else but the most thankful and *happy* science!"[55]

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sense because of its corruption and co-option by white American nationalist neo-fundamentalists would constitute an act of imperialist linguistic hegemony, a further act of colonial exploitation, depriving self-described evangelicals outside of America and in the Majority World of their own history and identity. As part of its ongoing repentance, in solidarity with the global church, American evangelicalism needs to reclaim the term evangelical while confessing its many failures and oversights with respect to the injustices of uncritical accumulation of wealth, the injustices of racism which divide evangelicalism from black and indigenous churches, and the injustices of colonialism which corrupt global missions. In addition to seeking reconciliation in these areas, American evangelicals need to repent of deep-seated habits of conspiracy thinking, patriarchy, and Christian nationalism, and also a generally superficial posture toward the natural sciences. It is my belief that Trinitarian theology offers a way forward for renewal of the evangelical movement.

53. Torrance devotes his entire first chapter, "Faith and Godliness," to this theme in Thomas F. Torrance, *The Trinitarian Faith: The Evangelical Theology of the Ancient Catholic Church* (#1988-489). Cf. p. 17: "An outstanding mark of the Nicene approach was its association of faith with 'piety' or 'godliness' (εὐσέβεια or θεοσέβεια), that is, with a mode of worship, behaviour and thought that was devout and worthy of God the Father, the Son and the Holy Spirit. This was a distinctively Christian way of life..."

54. Greek εὐαγγέλιον (*euangelion*) is etymologically "joy news." For "eucatastrophe" see Tolkien's epigram to this Introduction. In his "gospel" (Old English for "good news"), Luke echoed the Priene Calendar Inscription which employed the term *euangelion* to proclaim the universal peace of the reign of Caesar Augustus. For evangelical Christians thereafter, the joy at the heart of the Incarnation has been seen as the true source of peace in contrast to worldly kingdoms and powers. Evangelicalism in this sense cuts across Christian traditions; one may speak of evangelical Lutheran, Reformed, Anglican, Orthodox, and Roman Catholic believers. Thus, Tolkien's essay "On Fairy Stories" represents an evangelical sensibility toward literature in the sense used here for an evangelical approach to science. On Tolkien's Roman Catholic faith, see Holly Ordway, *Tolkien's Faith: A Spiritual Biography* (Elk Grove Village, Illinois: Word on Fire Academic, 2023); and Ralph C. Wood, *The Gospel According to Tolkien: Visions of the Kingdom in Middle-Earth* (Louisville, Kentucky: Westminster John Knox Press, 2003). For an interesting reflection on the Priene Calendar Inscription and the gospel of Luke see "The Historical and Theological Framework of the Nativity Story in Luke's Gospel" by Pope Benedict XVI in *Jesus of Nazareth: The Infancy Narratives* (New York: Image Press, 2012), pp. 58-66. C. S. Lewis' *Mere Christianity* represents this evangelical and ecumenical focus on the Nicene tradition rather than church affiliation more narrowly conceived (see Close Reading #1, on p. 32). Although Torrance was rooted in the evangelical movement in the second sense, Lewis and Torrance were both solidly evangelical in this third sense.

55. Karl Barth, *Evangelical Theology: An Introduction* (New York: Holt, Rinehart and Winston, 1969; reprinted Grand Rapids, Michigan: Wm. B. Eerdmans, 1979), p. 5 and 12. See also Thomas F. Torrance,

A church, people, or community is evangelical, Incarnational, or Trinitarian in this third sense, then, to the precise extent to which it expresses the holistic vision of a world charged with the glory of God manifest in the manger, incarnate in human flesh, and proclaimed to the shepherds by the angels on that first Christmas night.

How to do science in such a world is the subject of this book.

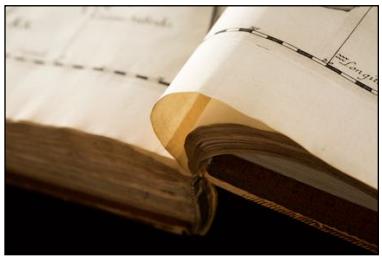
> "Welcome, all wonders in one sight!
> Eternity shut in a span,
> Summer in winter, day in night,
> Heaven in earth, and God in man!
> Great little One, whose all-embracing birth
> Lifts earth to Heaven, stoops Heaven to earth."
>
> Richard Crashaw, "In the Holy Nativity of our Lord"[56]

Karl Barth: Biblical and Evangelical Theologian (#1990-517).

56. Richard Crashaw (1612/3-1649), *The Complete Poetry of Richard Crashaw, Edited With an Introduction and Notes By George Walton Williams* (New York: W. W. Norton & Company, 1970), p. 83. Spelling modernized.

10. AFTER WORDS

— Classic Texts —



• C. S. Lewis, "Preface" to *Mere Christianity*, pp. 5-12. Does this Introduction chapter have any points of convergence or overlap with what Lewis writes there?

— Further Reading —

• Which references cited in the footnotes appear most interesting or relevant to you?

— Reflect and Discuss —

1. How do you interpret the King's College Chapel ceiling (p. 7) in light of these things?
2. How would you write a prayer to introduce this chapter?
3. What scripture passage would you select to introduce this chapter?
4. In your own words, what are the four dimensions of love? How are they inter-related?
5. Why are perspectives described as operating on a "meta level"?
6. What seems most interesting at this point to you about T. F. Torrance? About C. S. Lewis? What do you already know about them? What about them excites your interest?
7. Will exploration of Trinitarian perspectives on science cut off "insiders" in the Nicene tradition from conversation with the world outside that tradition, or open up conversation on a deeper level?
8. Which of the outcomes listed on p. 28 seem most attractive or relevant to you?
9. What are the implications of this chapter for "Love and the Cosmos"?

— Doxology —

Meditate upon the poem of Richard Crashaw in worship of Father, Son and Holy Spirit (p. 39).

Part I ✦ Chapter 2

Case Study: Flat Earth Myth

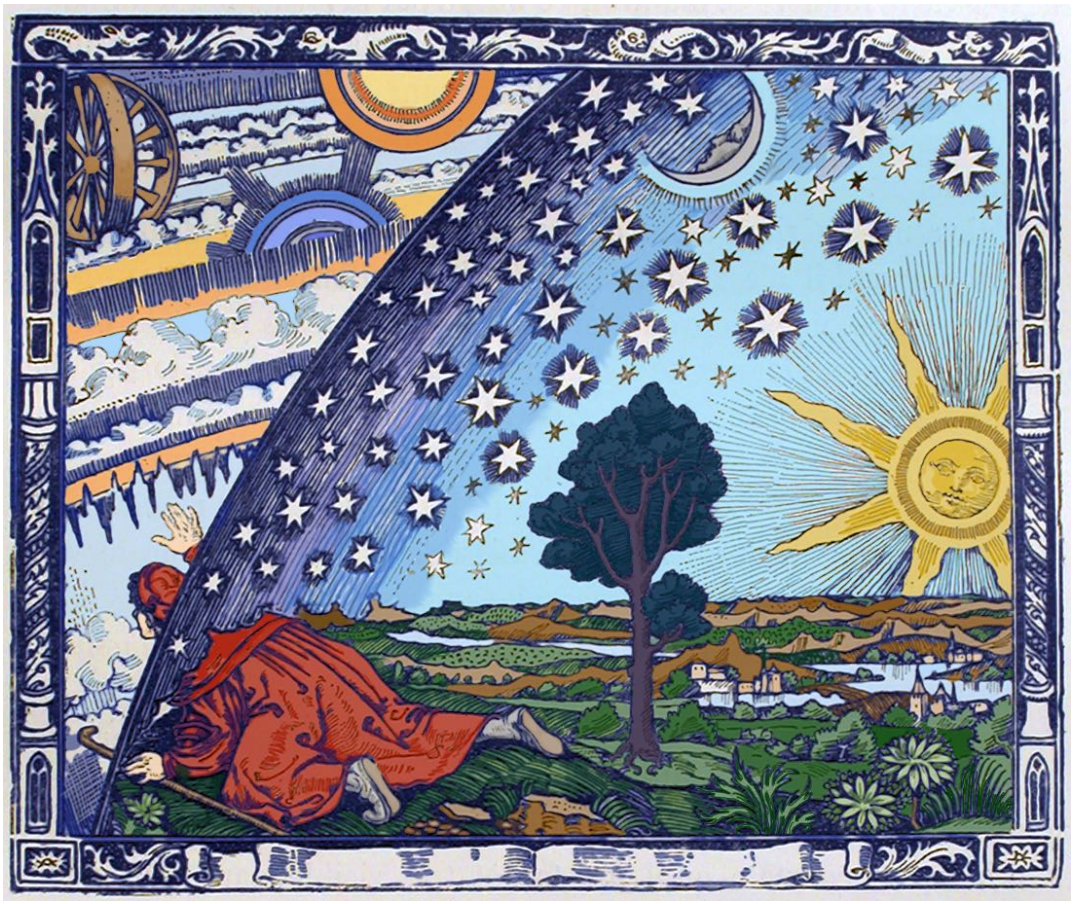


Figure 7: Woodcut colorized by Susanna Joy Magruder.

Have you seen this woodcut before?

What does it mean to you?

What might it mean with respect to science and history?

— Scripture —

"Lord, you have been our dwelling place in all generations.

Before the mountains were brought forth, or ever you had formed the Earth and the world, from everlasting to everlasting you are God....

So teach us to count our days that we may gain a wise heart."

(Psalm 90:1-2, 12 NRSV)

— Prayer —

Dear Father, Son and Spirit,

Among all the swift and varied changes of our world, open our minds to discern the wisdom you have given those who have come before.

Guide us by the compass of Trinitarian perspectives as we journey further into the wonder of your creation, through Jesus Christ our Lord.

Amen.

1. Chronological Snobbery

The interesting tale of the flat Earth challenges some of our common misapprehensions about science and *history*.[1] One of the most comfortable beliefs of modern people in the 20th-century was that medieval people, particularly Christians, believed the Earth is flat.

Speaking generally, focusing upon the illusions held by others long ago reassures us of the correctness of our own views. After all, we represent the latest and most up-to-date understanding on everything, so our views therefore deserve the presumption of truth. While C. S. Lewis was still an atheist, Owen Barfield accused him of having adopted this comfortable historical fallacy. In *Surprised by Joy*, Lewis recounts that:

> "In the first place he made short work of what I have called my 'chronological snobbery,' the uncritical acceptance of the intellectual climate common to our own age and the assumption that whatever has gone out of date is on that account discredited."[2]

Lewis strove all his life to overcome chronological snobbery; in later life, by the time of his inaugural address accepting the chair of Medieval and Renaissance Literature at Cambridge in 1954, Lewis could describe himself as a "dinosaur," that is, as a "native" rather than a "foreigner" to the texts he would be teaching.[3]

Something of that fallacy persists for the rest of us, however, in referring to the Middle Ages, the period which saw the birth of the universities, as the "Dark Ages." The irony is that the comforting modern belief that the medievals asserted the Earth is flat is itself an illusion, a modern myth.

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1. The original version of this chapter was prepared for my undergraduate survey course in the history of science at the University of Oklahoma; cf. https://youtu.be/pMw6Bj7Idis?si=zFSVPI7kNEUJKjyP. I have also presented it in numerous public lectures. Earlier, I drew upon the same content to create "The Shape of the Earth," a 47-minute DVD which I wrote and produced for The OBU Planetarium as part of "The Cosmology and Cultures Project" of Oklahoma Baptist University, sponsored by the American Council of Learned Societies, released in 2005 under a CC-by license; vimeo.com/ 28673444. I wish to thank my then-OBU colleague, Mike Keas, for his collaboration in developing and teaching this material. Cf. Michael Newton Keas, *Unbelievable: 7 Myths About the History and Future of Science and Religion* (Wilmington, Delaware: ISI Books, 2019).

2. Lewis continues: "You must find why it went out of date. Was it ever refuted (and if so by whom, where, and how conclusively) or did it merely die away as fashions do? If the latter, this tells us nothing about its truth or falsehood. From seeing this, one passes to the realization that our own age is also 'a period,' and certainly has, like all periods, its own characteristic illusions. They are likeliest to lurk in those widespread assumptions which are so ingrained in the age that no one dares to attack or feels it necessary to defend them." *Surprised by Joy: The Shape of My Early Life* (New York: Harcourt, Brace & World, 1955), ch. 13, pp. 207-208.

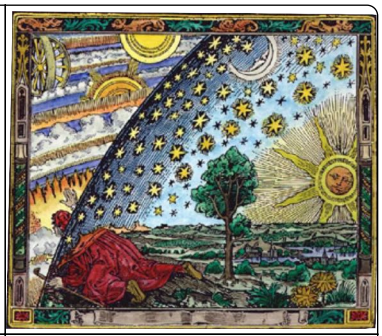
3. C. S. Lewis, "De descriptione temporum," in *Selected Literary Essays*, ed. Walter Hooper (Cambridge: Cambridge University Press, 1969), p. 13. In this address Lewis blurs the boundary between the late Middle Ages and the Renaissance, arguing that the distinction betweeen the two has outlived its usefulness. In response to this address, Dorothy L. Sayers, Lewis' friend and a translator of Dante, signed a letter to Lewis as "your... fellow dinosaur." Lewis addressed her as "Sister Dinosaur" and suggested that they form a "Dinosaurs' Club." See Gina Dalfonzo, *Dorothy and Jack: The Transforming Friendship of Dorothy L. Sayers and C.S. Lewis* (Baker Books, 2020), pp. 142-143.

Flat-Earthers today are a modern phenomenon, not a movement of medieval origin. They arose in reaction to polarizing rhetoric in the late 19th century.[4] One aspect of that rhetoric was a remarkably durable illustration created in the style of a medieval woodcut.

2. This is Not a Medieval Woodcut

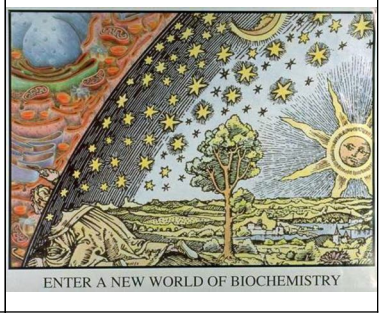
Left: This striking depiction of the flat Earth was colorized for a poster by Roberta Weir, 1970.

Right: Adam McLean sells his colorized version of the same woodcut on his website, The Alchemical Web Bookshop.



Left: The 1970's recording artist Jimmie Spheeris used the woodcut as envelope art.

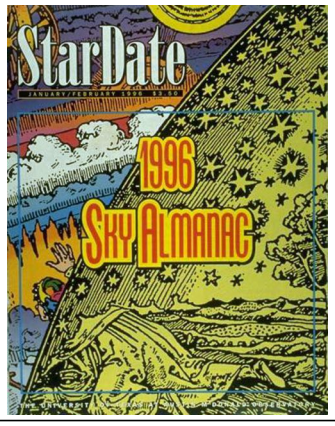
Right: The Dept of Biochemistry, Univ. of Minnesota, adapted the extra-cosmic portion to resemble the organelles of a cell.

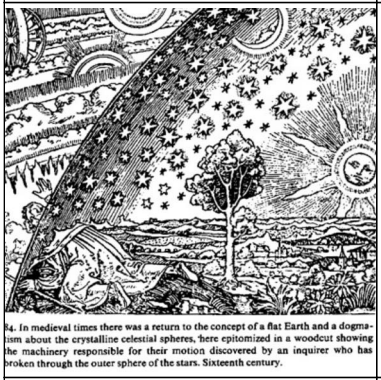


4. Some may mistakenly take the existence of 20th- or 21st-century flat Earthers as evidence of pre-modern belief in a flat Earth. Not so; an immense historical discontinuity separates them. Modern flat-Earthers must be understood on their own terms, I was very happy a few years ago when the OU History of Science Collections acquired a complete run of *The Zetetic Society Journal*, their official early 20th-century mouthpiece. For the modern flat Earth movement, see Brent Orrell, *Off the Edge: Flat Earthers, Conspiracy Culture, and Why People Will Believe Anything* (Algonquin Books, 2023).

Left: Suzanne Rich changed the extra-cosmic portion into a computer-world for an article on astronomical computing; *Sky and Telescope* (April 1996, p. 82).

Right: *StarDate* featured a colorized version on their January/February 1996 issue, described as a "medieval woodcut colored by Tim Jones."

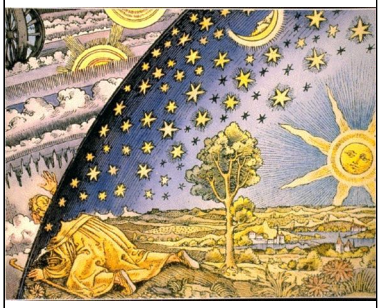




54. In medieval times there was a return to the concept of a flat Earth and a dogmatism about the crystalline celestial spheres, here epitomized in a woodcut showing the machinery responsible for their motion discovered by an inquirer who has broken through the outer sphere of the stars. Sixteenth century.

Left: J.D. Bernal used the woodcut to illustrate his best-selling survey of the history of science.

Right: This colorized version adorns the jacket cover of *The Discoverers*, written by the former Librarian of Congress, Daniel Boorstin.



Left: Another colorized version of the woodcut, courtesy Science Graphics in Tucson, AZ, was included in a NASA publication called *Exobiology in Earth Orbit*.

Right: The version used as the icon for this chapter was colorized by Susanna Joy Magruder.

Figure 8: Flat Earth variations

What is the original source of this woodcut? Its provenance is notoriously difficult to track down.[5] *Stardate* magazine, affiliated with the McDonald Observatory of the University of Texas, called it a "medieval woodcut." In the book by J. D. Bernal, it appears with a caption attributing it not to the Middle Ages but to the 16th century:

> "In medieval times there was a return to the concept of a flat Earth and a dogmatism about the crystalline celestial spheres, here epitomized in a woodcut showing the machinery responsible for their motion discovered by an inquirer who has broken through the outer sphere of fixed stars. Sixteenth century."[6]

5. Cf. "This is NOT a medieval woodcut" originally 1996; kerrymagruder.com/flatEarth/.

6. J. D. Bernal, *The Emergence of Science* (Cambridge, Massachusetts: MIT Press, 1969), vol. 1 of the

Despite Bernal's widely copied caption, the illustration credits at the end of his book offer no traceable source for the woodcut. The Daniel Boorstin dust jacket attributes it to an unnamed "early 16th century woodcut," citing only the Bettmann Archive, so they didn't know where the original came from either.[7] The NASA publication described it as

> "A famous early 20th century engraving (1911) erroneously thought to be a 17th century woodcut of a medieval astronomer passing through the sphere of the stars to see the mechanisms of the Ptolemaic universe beyond."[8]

The NASA caption again, like so many others, gives no specific source. How did the NASA writers know that it originated in 1911 without specifying a source? "First" is one of those dangerous words, as every historian knows, for how can one be sure one has found the "first" occurrence of anything?

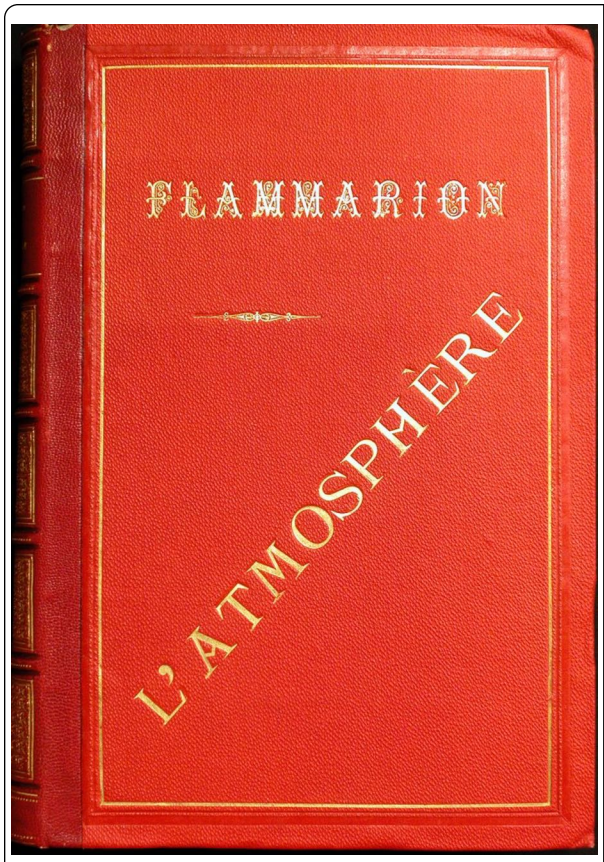
As it turns out, the woodcut first appeared in a book by Camille Flammarion, one of the most popular science writers of the 19th century (Figure 9). Flammarion, a French astronomer, established the Juvissy Observatory just south of Paris.[9] He and his brother published more than a dozen best-selling popular science books, all abundantly illustrated. The Flammarions employed artists to create the custom-made drawings they needed. Flammarion prepared the woodcut to propagandize the Flat Earth Myth.

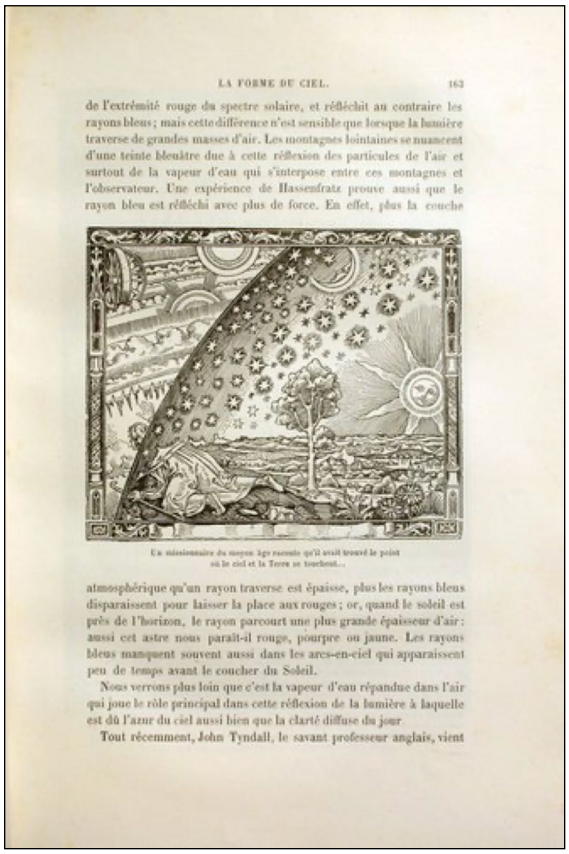
4-volume series *Science in History*.

7. Daniel J. Boorstin, *The Discoverers* (Littlehampton Book Services, 1984). Boorstin himself did not discuss the woodcut, but he did perpetuate the erroneous myth about medieval belief in a flat Earth.

8. NASA, *Exobiology in Earth Orbit* (NASA SP-28, 1989), p. ***.

9. The observatory is now the Observatoire Camille Flammarion, administered by the Ministère de la Culture.





LA FORME DU CIEL. 163

de l'extrémité rouge du spectre solaire, et réfléchit au contraire les rayons bleus; mais cette différence n'est sensible que lorsque la lumière traverse de grandes masses d'air. Les montagnes lointaines se nuancent d'une teinte bleuâtre due à cette réflexion des particules de l'air et surtout de la vapeur d'eau qui s'interpose entre ces montagnes et l'observateur. Une expérience de Hassenfratz prouve aussi que le rayon bleu est réfléchi avec plus de force. En effet, plus la couche

Un missionnaire du moyen âge raconte qu'il avait trouvé le point où le ciel et la Terre se touchent...

atmosphérique qu'un rayon traverse est épaisse, plus les rayons bleus disparaissent pour laisser la place aux rouges; or, quand le soleil est près de l'horizon, le rayon parcourt une plus grande épaisseur d'air: aussi cet astre nous paraît-il rouge, pourpre ou jaune. Les rayons bleus manquent souvent aussi dans les arcs-en-ciel qui apparaissent peu de temps avant le coucher du Soleil.

Nous verrons plus loin que c'est la vapeur d'eau répandue dans l'air qui joue le rôle principal dans cette réflexion de la lumière à laquelle est dû l'azur du ciel aussi bien que la clarté diffuse du jour.

Tout récemment, John Tyndall, le savant professeur anglais, vient

Figure 9: Camille Flammarion, L'Atmosphère: Météorologie Populaire (Paris, 1888). Cover and p. 163.

Most medieval people knew the Earth was round, at least roughly so; they also knew roughly how large it was. The mistaken modern belief that medieval people thought the Earth was flat is the real "Flat Earth Myth."

But if this flat-Earth story we've all heard is false, then how did the ancient and medieval scholars know the Earth is a globe? How could we be so wrong about them?

3. ARGUMENT FROM AESTHETICS

While presocratic natural philosophers debated the shape of the Earth, the ancient Pythagoreans (6th and 5th centuries BCE) settled upon the belief that the Earth is spherical. For them, the sphere is the most beautiful shape. What is beautiful must be true. Therefore,

the Earth is a sphere. Based on aesthetics, that's an elegant argument!

How many scientific theories then and now are developed with a conviction that beauty and truth go together?[10] We might say that "Pythogoreans," then and now, give great weight to beauty when assessing scientific theories (cf. Thomas Burnet, Figure 10).

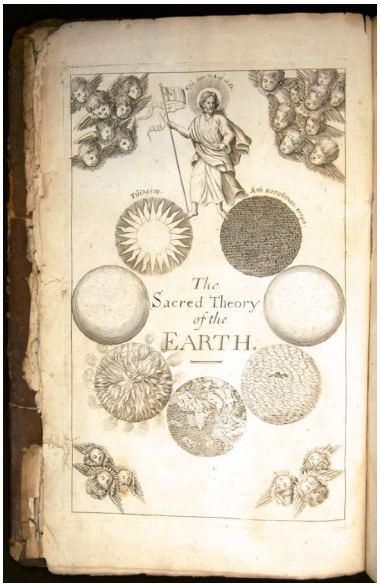


Figure 10: Thomas Burnet, Theory of the Earth (1684). Burnet, sympathetic to the Pythagoreans, argued for a spherical Paradisical globe unmarred by mountains, valleys, or seabeds. In this famous frontispiece, the Paradisical globe is the white circle second in line on the right side, clockwise from Jesus' left foot.

But in response to the Pythagoreans, one might ask: why does the Earth not appear spherical to our senses? Surely, they would reply, the Earth must be too large to observe its curvature. Through geometry we will apprehend true knowledge, and correct the errors of ordinary sensory experience. If there is a conflict between the appearances of natural phenomena and mathematical understanding, we should give priority to mathematical understanding. To the Pythagorean community, the study of mathematics was the key to understanding the Earth and cosmos. To the Pythagoreans, the study of mathematics was above all a religious obligation: "The search for knowledge is the greatest purification." Through mathematical contemplation, e.g., in geometry and astronomy, we not only gain true knowledge of the universe and of the shape of the Earth, but tend the harmonies of our souls.[11]

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10. Thomas F. Torrance, "The Transfinite Significance of Beauty in Science and Theology," in *L'Art, la Science et la Métaphysique: Études offerts à André Mercier*, ed. Luz Garcia Alonso, Evanghelos Moutsopoulos and Gerhard Seel (Berne, Berlin, New York: Peter Lang, 1993), 393-418; #1993-584.

11. For the presocratic natural philosophers, see my undergraduate course unit at kerrymagruder.com/hsci/03-Egypt-Aegean/presocratics/index.html; and for the Pythagoreans, kerrymagruder.com/hsci/04-Pyth-Plato-Aristotle/pythagoras-525.html. See also Catherine Osborne, *Presocratic Philosophy*, in the Very Short Introduction series of Oxford University Press (2004). A handy source of extant textual fragments is G. S. Kirk, J. E. Raven and M. Schofield, *The Presocratic Philosophers* (Cambridge University Press, 1984). The classic survey by G. E. R. Lloyd, *Early Greek Science: Thales to Aristotle* (Norton, 1974) introduced countless historians of science to the presocratics. On presocratic debate about the shape of the Earth, see Dirk L. Couprie, *When the Earth Was Flat* (Springer, 2018).

4. Argument from Analogy: The Macrocosm-Microcosm

The Pythagoreans also gave weight to an argument from analogy: The cosmos is a globe, so the Earth should be a globe, too. The Earth is a miniature cosmos, or microcosm, corresponding to the macrocosm or cosmos as a whole.

To the eye, the cosmos is obviously a sphere, as appears evident from the patterns of the swiftly turning stars that pass overhead and trace circles around us every 24 hours. All the stars are bright points of light stuck on the inside of this giant, transparent celestial sphere that rotates around the Earth once a day. We can model the motions of the stars relative to the Earth using a celestial globe (right).

In this well-ordered cosmos, the planets, similarly, are carried on their own spheres within the great starry sphere. Generations ever since have approached the study of astronomy as an intellectual attempt to hear the "music of the spheres."[12]

To them, this was all common sense. But why? What observational evidence supported the idea that the cosmos is a sphere? One place to start is the *diurnal* motion or daily turning of the stars, including *circumpolar* motion, the rotation of stars around the north and south celestial poles.

12. Plato attributes the "music of the spheres" to the Pythagoreans in the Republic ***; cf. Aristotle, *On the Universe*, Book II, Part 9. In *On the Universe*, iii.1; 300 a 15, Aristotle reported that the Pythagoreans "construct nature out of numbers." In *Metaphysics*, i. 5 ; 985b23 to 986b8, Aristotle wrote that "they assumed that the elements of numbers were the elements of all things, and that the whole heavens were harmony and number."

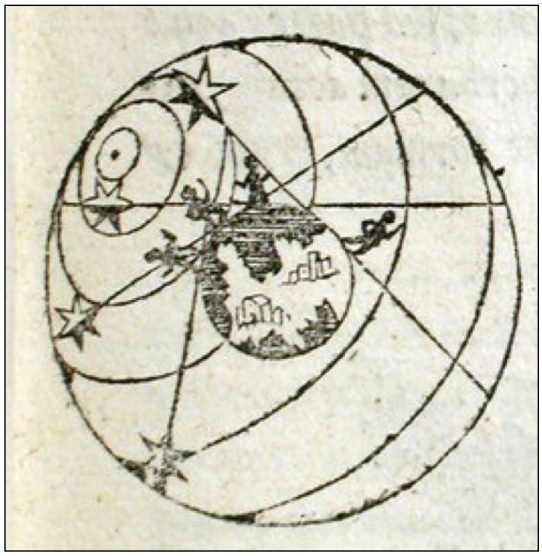


Figure 11: Cosmos a sphere: Diurnal rotation of the sphere of stars. Sacrobosco (1534), p. B6r.[13]

Diurnal motion: Every night stars rise in the east, move overhead, then set in the west. All the stars trace circles around the sky, and come back to the same place every 24 hours. This is their diurnal or daily motion. The sphere of fixed stars has a north pole, a south pole, an axis, and an equator. Every 24 hours, each star traces a circle at a constant distance from the poles. Stars that rise on the celestial equator turn in a giant circle exactly between the north and south poles (Figure 11).

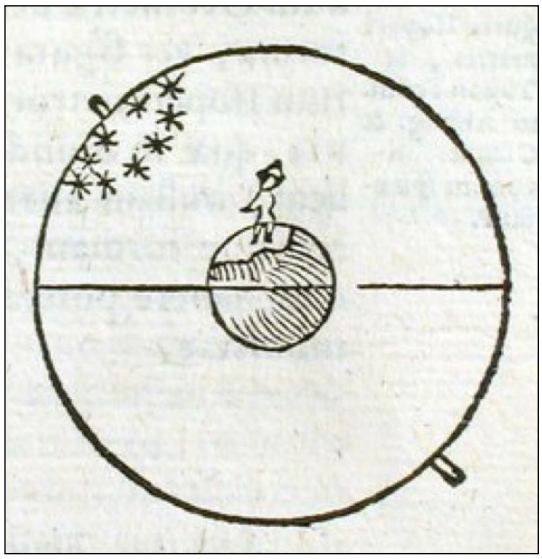


Figure 12: Cosmos a sphere: Northern circumpolar stars. Barozzi (1585), p. A7r.[14]

Circumpolar motion: Let's step outside and watch the circumpolar motion of stars near the north pole. All the stars in the northern sky appear to turn in circles around Polaris, a star very near the north pole. The stars move together just as if they were fixed to a giant transparent sphere (Figure 12).[15]

Think of the Big Dipper as stuck on the inside of the giant turning celestial sphere, and it's easy to tell time by the Big Dipper when you're outside at night. To find the Big Dipper (or Plough, or Wagon, as it may be called), face north.[16] Four

13. Sacrobosco, *De sphera* (Wittenberg, 1534). Hereafter "Sacrobosco (1534)." The *Sphere* of Sacrobosco was the most common introduction to astronomy during the Middle Ages and Renaissance. For an introduction with Latin text and English translation, see Lynn Thorndike, ed. and trans., *The Sphere of Sacrobosco and Its Commentators* (Chicago: University of Chicago Press, 1949).

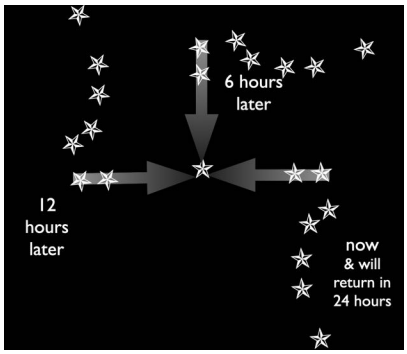
14. Francesco Barozzi, *Cosmographia* (Venice, 1585). Hereafter "Barozzi (1588)."

15. Because the altitude of the north star equals one's latitude on Earth, surveyors and navigators have always relied upon measurements of the former. If you are a resident of the northern hemisphere, try using a protractor to measure the altitude of Polaris above your northern horizon.

16. The Big Dipper is an asterism in the constellation Ursa Major the Big Bear. For images from historical star atlases, see The Sky Tonight, skytonight.org/uma.

stars make a bowl, and three stars make its handle. The Big Dipper is part of the constellation Ursa Major or Big Bear, and the handle is the Bear's tail. Two stars on the pouring side of the bowl point to Polaris, the north star. So imagine that we go outside many times tonight and note where the Big Dipper has moved to, hour by hour. How will the Big Dipper move?

Figure 13: Telling time by the Big Dipper



A line from the pointer stars of the Big Dipper moves like the hand of a clock, turning counterclockwise around the north star (Figure 13). In 24 hours, the pointers will return to the orientation they have now. In 12 hours, they will line up on the opposite side of the north star. In 6 hours the pointer stars will make one quarter turn. Remember that any star goes all the way around the sky every 24 hours, then you can think it through.

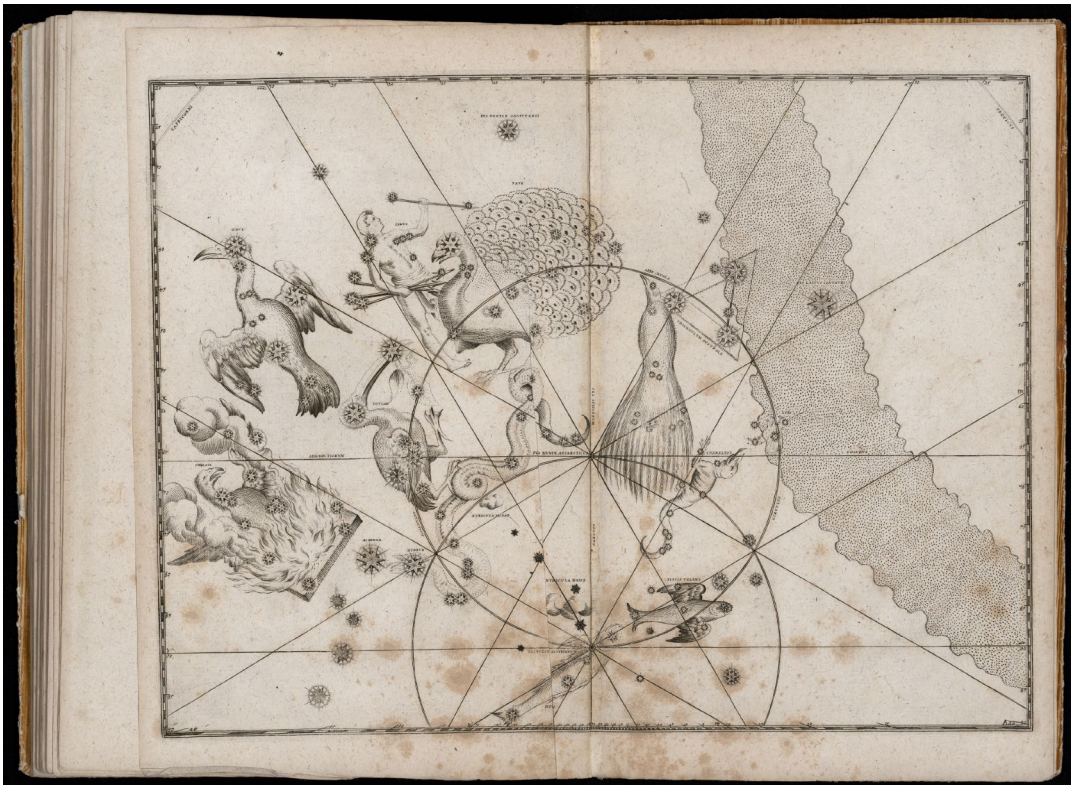


Figure 14: Southern stars. Johann Bayer, Uranometria (1661). The upper circle is centered on the south pole; the lower circle is centered on the pole of the ecliptic.[17]

17. Bayer's atlas, first published in 1603, consists of 51 double-page copperplate engravings, including 2 planispheres, one star map for each of the 48 Ptolemaic constellations, and this map for 12 new

In the southern hemisphere, there is no single, relatively bright star like Polaris to mark the location of the south pole. Rather, observers triangulate to the pole based on a variety of bright stars and constellations, as shown in Figure 14. The technique of telling time by the Big Dipper, as described above, applies to southern constellations turning clockwise around the southern pole.

From a location at 35° south latitude, if we face south and look at the constellations surrounding the south celestial pole, some of the brightest stars in the entire sky enter our view. Discounting bright stars near the equator, which are visible from both northern and southern hemispheres, proportionately many more bright stars are found in the southern circumpolar region than in the northern.

Figure 15: Crux the Southern Cross, and Centaurus. Bayer (1661).

For the southern skies let's use the constellation Crux, the Southern Cross, in an analogous manner as the Big Dipper for the northern hemisphere (Figure 15).[18] Once part of the constellation Centaurus, now Crux is itself one of the 88 modern constellations (albeit the

constellations of the southern skies reported by 16th-century explorers. Cf. skytonight.org/Bayer-1661 for Bayer, and skytonight.org/49-Bayer-1661 for the southern plate. Hereafter "Bayer (1661)."

18. Cf. "Crux the Southern Cross," skytonight.org/cru.

smallest). The axis of Crux points down in Figure 15 toward the south celestial pole. Acrux, the star nearest the pole, lies about the same distance from the south pole as the end of the Big Dipper is from the north pole. From 35° south Crux grazes but does not dip below the horizon, just as from 35° north latitude, the Big Dipper grazes but does not dip below the horizon. Crux moves around the south celestial pole in a clockwise direction, while the Big Dipper moves around the north pole counterclockwise. If the Big Dipper is the northern star clock, Crux is the southern star clock.

The *diurnal* and *circumpolar* motions of the stars suggest that the universe is one giant transparent sphere. The planets, similarly, turn in their own solid spheres. By analogy, the Earth must also be spherical. But the macrocosm-microcosm analogy was not the only evidence for the shape of the Earth available from the stars.

5. THE EARTH IS CURVED FROM NORTH TO SOUTH

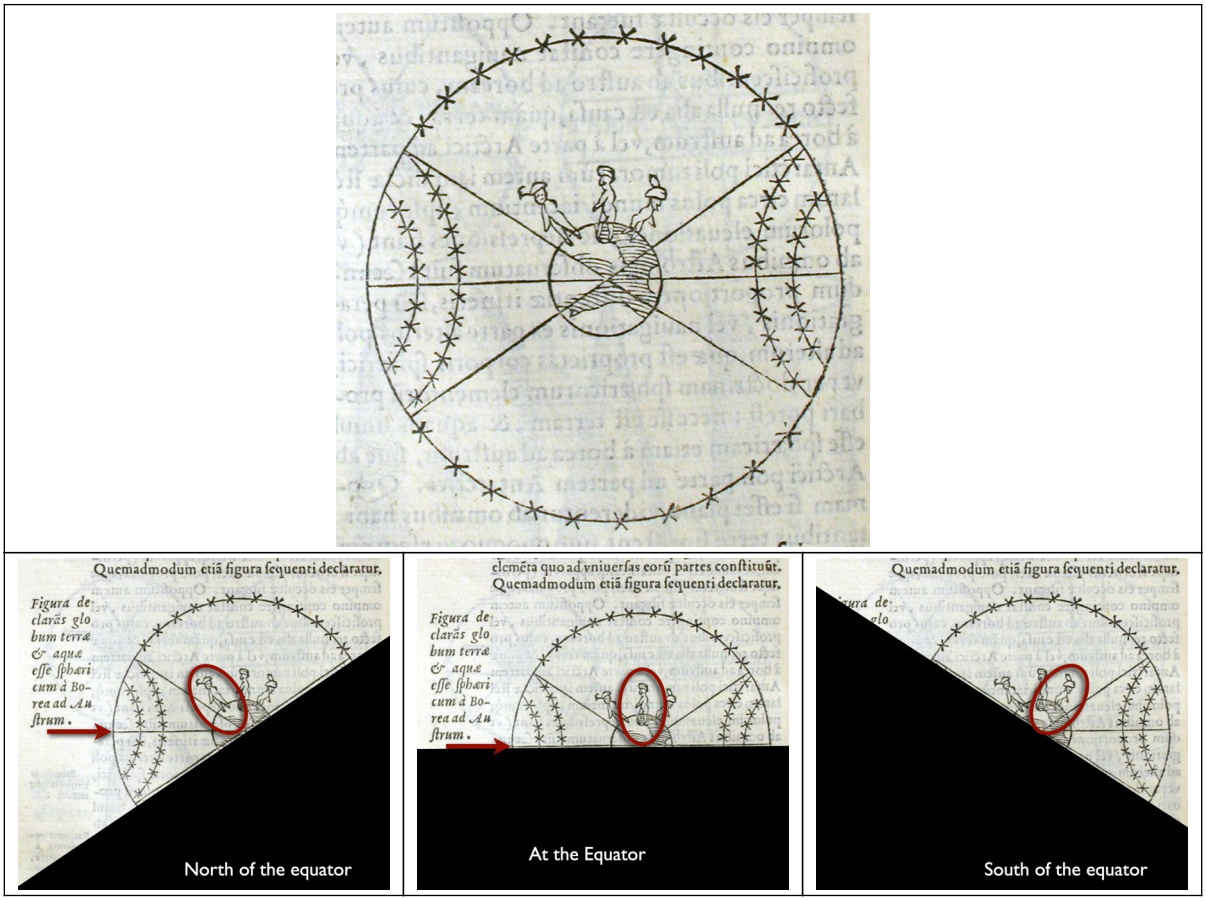


Figure 16: Variation of star altitude with observer latitude. Barozzi (1585), p. B4v.

Exactly which stars appear circumpolar changes as one travels north or south. These changes prove that the Earth is curved from north to south. Imagine an observer at the equator (Figure 16). The north pole will lie exactly on the northern horizon, and the south pole exactly on the southern horizon (center). But if that observer travels northward, the north pole will rise above the horizon, and circumpolar stars will appear (left). In the same way, an observer traveling south of the equator will observe stars circling the south celestial pole (right).

Let's take the Big Dipper again as an example for northern skies. In Athens, north of the equator, the four stars in the bowl of the Big Dipper are circumpolar; they circle around the pole without ever dipping below the horizon, although the tip of the handle dips below the

horizon. If we travel north to Paris, the pole star rises higher in the sky and new circumpolar stars appear. From Paris, even the handle is circumpolar![19]

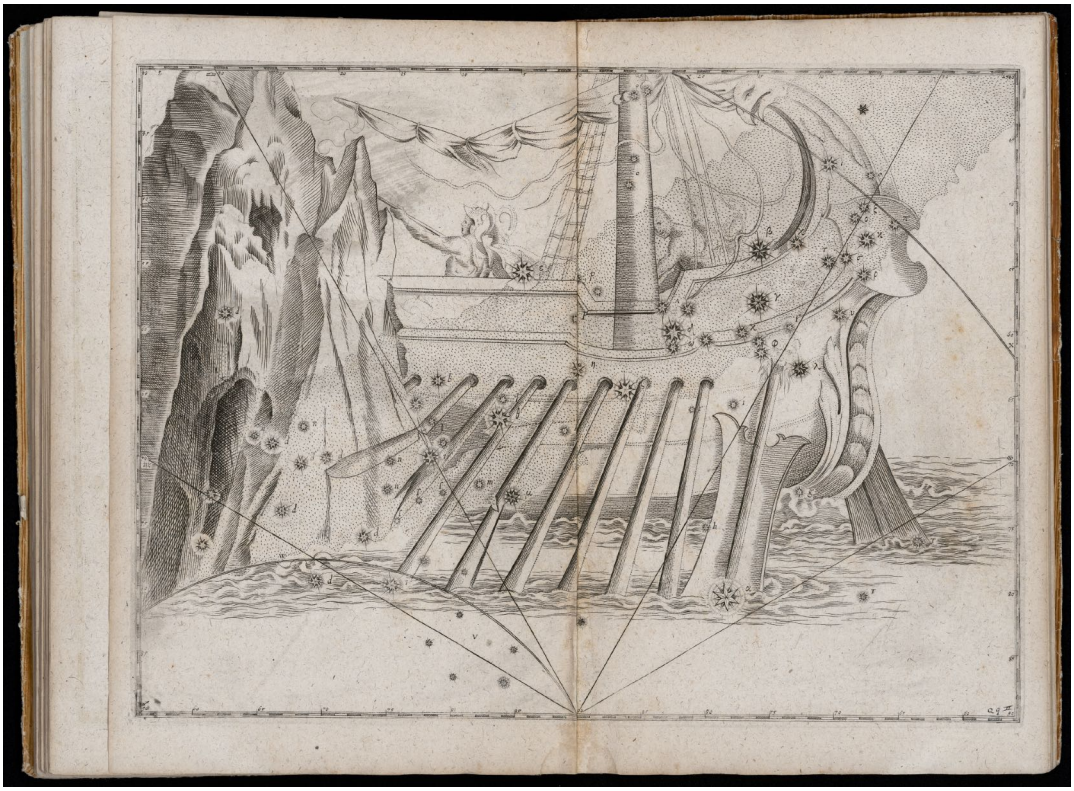


Figure 17: Canopus. Bayer (1661).[20]

For the southern hemisphere, the standard ancient example was Canopus, the second-brightest star in the nighttime sky. Argo Navis, the Ship of the Argonauts, was one of the 48 Ptolemaic constellations. In Bayer's plate, Canopus represents the keel of the ship, located in the lower right quadrant (Figure 17). "Alpha" signifies that it is the brightest star in the constellation. Named by Eratothenes ca. 250 BCE, it was also known as the "bright star of

19. A star in the northern hemisphere will be circumpolar if the observer's co-latitude plus the star's co-declination does not exceed 90; i.e., (90-Latitude)+(90-Declination) < 90. Declinations: Tip of Big Dipper handle (Alkaid): 49° N. Lowest star of bowl: 54° N. The latitude of Athens is 38°N. Athens/Bowl: (90-38)+(90-54) or 52+36=88 (circumpolar). Athens/Alkaid: (90-38)+(90-49) or 52+41=93 (not circumpolar). The latitude of Paris is 49°N. Paris/Bowl: (90-49)+(90-54) or 41+36=77 (circumpolar). Paris/Alkaid: (90-49)+(90-49) or 41+41=82 (circumpolar).

20. Argo Navis is an ancient constellation, the only one of Ptolemy's 48 no longer used. In the 18th century, the French astronomer Nicolas Lacaille dismantled Argo Navis into three smaller constellations: Carina the Keel, Puppis the Stern or Poop, and Vela the Sail. Canopus is now known as alpha-Carinae. For more on Argo Navis see skytonight.org/Argo.

the Egyptians." Because of its location south of the celestial equator, Canopus was not visible in Greece but rose above the horizon when one traveled south to Egypt.[21]

If you think about it, the change in which stars are circumpolar as you travel toward a pole proves that the Earth must be curved from north to south. The changing number of stars that are circumpolar proves that the Earth is curved both northward and southward. So we've proved the first step, that the Earth is curved from north to south.

6. THE EARTH IS CURVED FROM EAST TO WEST

Now we need to prove that the Earth is curved from east to west. The shape of the Earth from east to west is proven by the risings and settings of stars as they rotate around the Earth every 24 hours. As we saw above (pp. 49-53), each night stars rise in the east, move overhead, and set in the west.

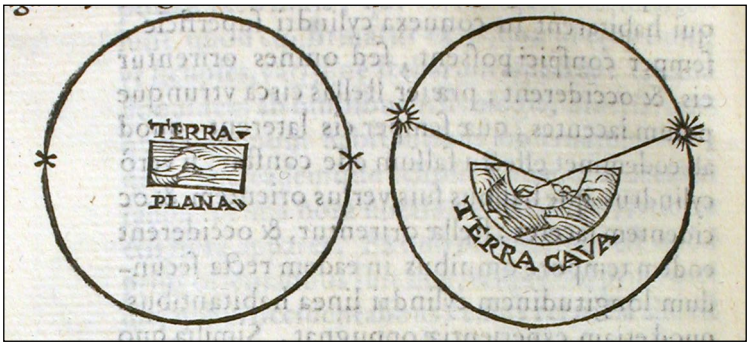


Figure 18: Earth cannot be flat or concave. Barozzi (1585), p. B3v.

These rising and setting observations prove that the Earth cannot be flat (Figure 18, left). For if the Earth were flat, stars would rise and set at the same moment regardless of where we are east or west on the Earth. But in reality, if we see a star rising on our horizon, our friend who has traveled far west of here will not see that star rise until later. This means that the surface of the Earth between us is curved from east to west. These phenomena also disprove the notion that the Earth might be concave, as if it were only the Mediterranean basin (Figure 18, right). If the Earth were concave, rising stars would be seen first at western longitudes, and only later in eastern locales.

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21. James Evans, *The History & Practice of Ancient Astronomy* (Oxford University Press, 1998), p. 48. A star in the southern hemisphere will be circumpolar if the observer's co-latitude plus the star's co-declination is greater than 90; i.e., (90-Latitude)+(90-Declination) > 90. The declination of Canopus is: 53°S. The latitude of Athens is 38°N. Athens/Canopus: (90-38)+(90-53) or 52+37=89 (not circumpolar). The latitude of Cairo is 30°N. Cairo/Canopus: (90-30)+(90-53) or 60+37=97 (circumpolar).

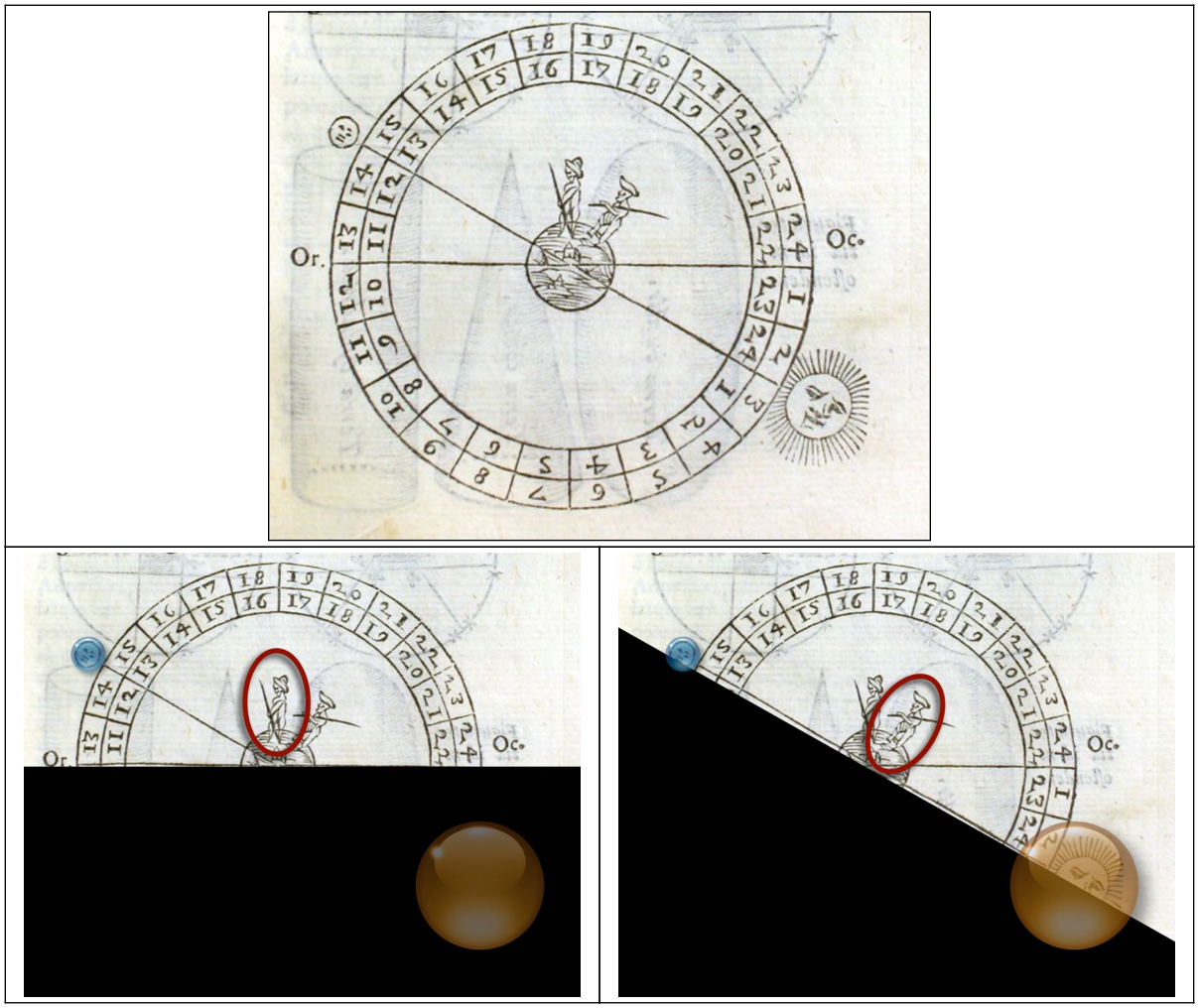


Figure 19: Two observers are located at different longitudes (time zones). Left: The Sun has already set in the west (Occident). The Moon has already risen in the east (Orient). Right: The Moon rises opposite the setting Sun. Barozzi (1585), p. B3r.

These observations lead us to an interesting discovery. Suppose that on a given night, some time after sunset, we observe the Full Moon well above the horizon in the east. Let's suppose that at this moment the Moon enters into the shadow of a lunar eclipse (Figure 19, left). But we have a friend who lives far away to our west. To her, the Moon begins to be eclipsed just as it is rising on the eastern horizon, opposite the setting Sun (Figure 19, right). In other words, in different places from east to west upon the Earth, simultaneous celestial events like the lunar eclipse occur at different hours, local time, relative to sunset. This proves the Earth must be curved from east to west.

A famous example of this kind was the lunar eclipse of September 30, 331 BCE. It occurred 11 days before the battle of Arbela, where Alexander the Great defeated the Persian king Darius III. Greek historians noted that the lunar eclipse occurred at the fifth hour in Arbela, but the same eclipse was observed three hours earlier (at the second hour, local time) in Carthage, farther west in northern Africa. The three-hour time difference reported by the Greek historians was erroneously inflated, but this lunar eclipse established a documented

case of an event observed simultaneously at different local hours for different east-west locales.[22]

First we saw that the changing of circumpolar stars proves the Earth is curved from north to south. Second, we saw that different rising and setting times in different time zones prove the Earth is curved from east to west. And if the Earth is curved both north to south and east to west, then it must be a sphere!

A spherical cosmos is a common-sense explanation of the motions of the stars. A starry sphere and a spherical Earth go well together.

7. Terrestrial Evidence proves the Earth is a Sphere

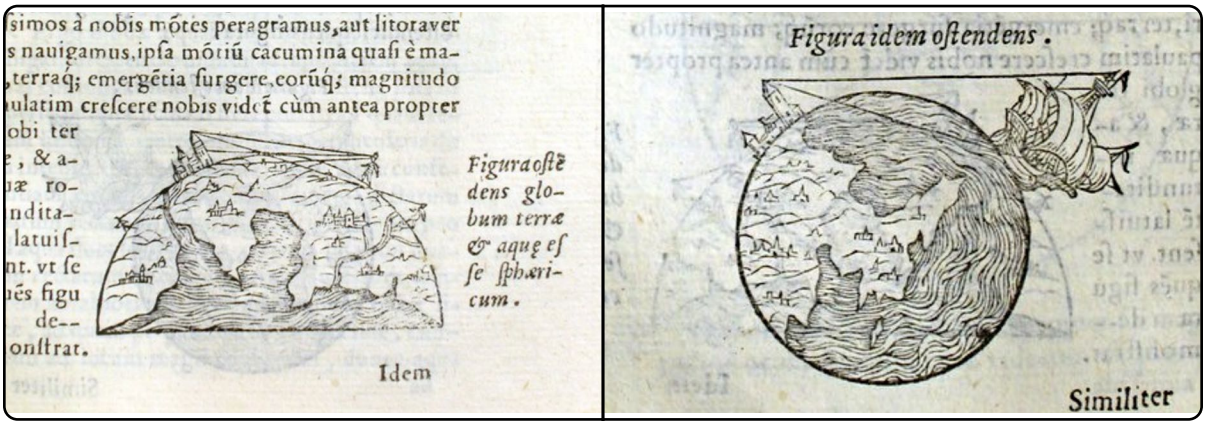


Figure 20: The Earth is curved. Barozzi (1585), pp. B5r, B5v.

Ancient writers also invoked the sphericity of the Earth to explain why watchers from a tall tower can spy travelers by land before they can be seen from the gates of the city (Figure 20, left). Similarly, as a ship draws near to a harbor, the lookout at the top of the mast is the first to call out land-ho (Figure 20, right). At that time the hull of the ship is too far down in the water to see the shore.

22. James Evans, *The History & Practice of Ancient Astronomy* (Oxford University Press, 1998), p. 51.

8. PLATO: THE EARTH IS ROUND

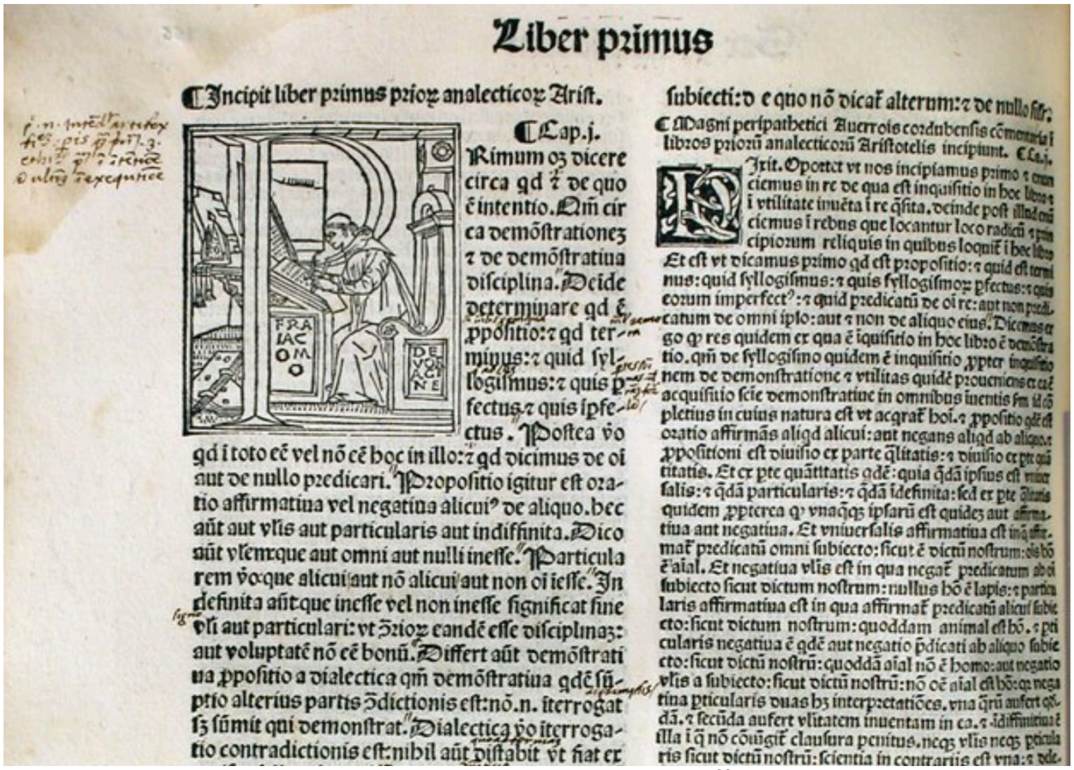


Figure 21: Plato, Timaios (1517).[23]

For reasons like these, Plato (fl. 400 BCE) adopted the views of the Pythagoreans and taught that the Earth is a sphere. In the *Phaedo*, he described the Earth much like a soccer ball:

> This is what I believe, then, said Socrates. In the first place, if the Earth is spherical and in the middle of the heavens, it needs neither air nor any such force to keep it from falling; the uniformity of the heavens and the equilibrium of the Earth itself are sufficient to support it.... Next, said Socrates, I believe that it is vast in size, and that we who dwell between the river Phasis and the Pillars of Hercules inhabit only a minute portion of it – we live around the sea like ants or frogs round a pond – and there are many other peoples inhabiting similar regions.... My dear boy, said Socrates, the real Earth, viewed from above, is supposed to look like one of these balls made of twelve pieces of skin, variegated and marked out in different colors [like the Mediterranean Sea]....”[24]

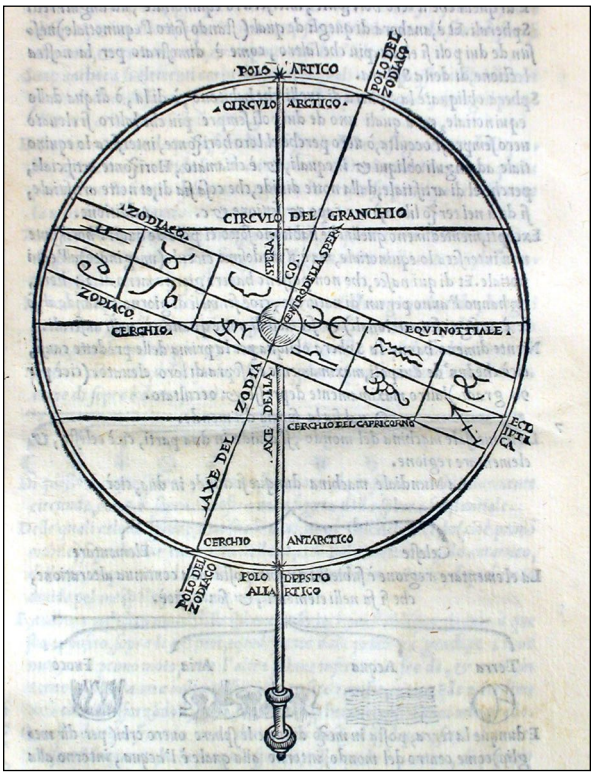
23. Plato, *Platonis opera* (Venice, 1517)? Confirm correct edition.***

24. Plato, *Phaedo*, 108e through 110c. Quotation from the English translation by Edith Hamilton and Huntington Cairns, *The Collected Dialogues of Plato, Including the Letters* (Princeton: Princeton University Press, 1961), pp. 90-91; hereafter “Plato (1961).”

Plato argued that an extensive subterranean circulation of water carves out vast caverns. Eventually, catastrophic earthquakes result from collapse of the overlying crust. Such a collapse, he supposed, had swallowed the advanced civilization of Atlantis. With these ideas Plato founded a major tradition in thinking about the geological processes of the Earth.[25]

But more than that, Plato encouraged the development of astronomical science based on the assumption of a spherical Earth. In his dialogue called the *Timaios*, Plato distinguished between the celestial equator and the path of the Sun, two great circles inclined to each other by 23.5 degrees.[26]

Figure 22: The Celestial Equator and Ecliptic. Sacrobosco (1537), p. C1r.[27]



The *celestial equator* is a circle on the starry sphere projected out from the Earth's equator, determined by the apparent daily rotation of the stars. That is, for an observer on the equator, the celestial equator lies directly overhead, rising due east and stretching to due west. The *ecliptic*, the apparent annual path of the Sun, is the great circle traced by the Sun against the background of fixed stars, as it journeys through the sky over the course of a year. In Figure 22, the celestial equator is shown horizontally ("equinottiale"). The ecliptic ("ecliptica") is shown as an inclined line, within the band of zodiac constellations ("zodiaco"). A zodiac constellation is any constellation which includes the ecliptic.

25. For Plato's enduring significance for the geosciences see Kerry V. Magruder, "Understanding a Contested Print Tradition: Bourguet's Mosaic, Platonic and Aristotelian Theories of the Earth," *The Compass: The Earth-Science Journal of Sigma Gamma Epsilon* 81(2008): 9-25.

26. The *Timaios* (its Greek title) is also known as the *Timaeus* (its title in Latin). For an English translation see Plato (1961), pp. 1151-1211. For Plato's significance in Greek astronomy, start with David Lindberg, *The Beginnings of Western Science* (Chicago, Chicago University Press, 2007). Classic studies include G. E. R. Lloyd, "Plato as a Natural Scientist," *Journal of Hellenic Studies* 88 (1968): 78-92; and Francis McDonald Cornford, *Plato's Cosmology: The Timaeus of Plato Translated With a Running Commentary* (London: Routledge and Kegan Paul Limited, 1937). In the *Timaios*, Plato discusses the starry sphere in 33a-b, and the celestial equator and ecliptic in 36b-d.

27. Sacrobosco, *Sphera* (Venice, 1537). Images courtesy History of Science Collections, University of Oklahoma Libraries. Hereafter "Sacrobosco (1537)."

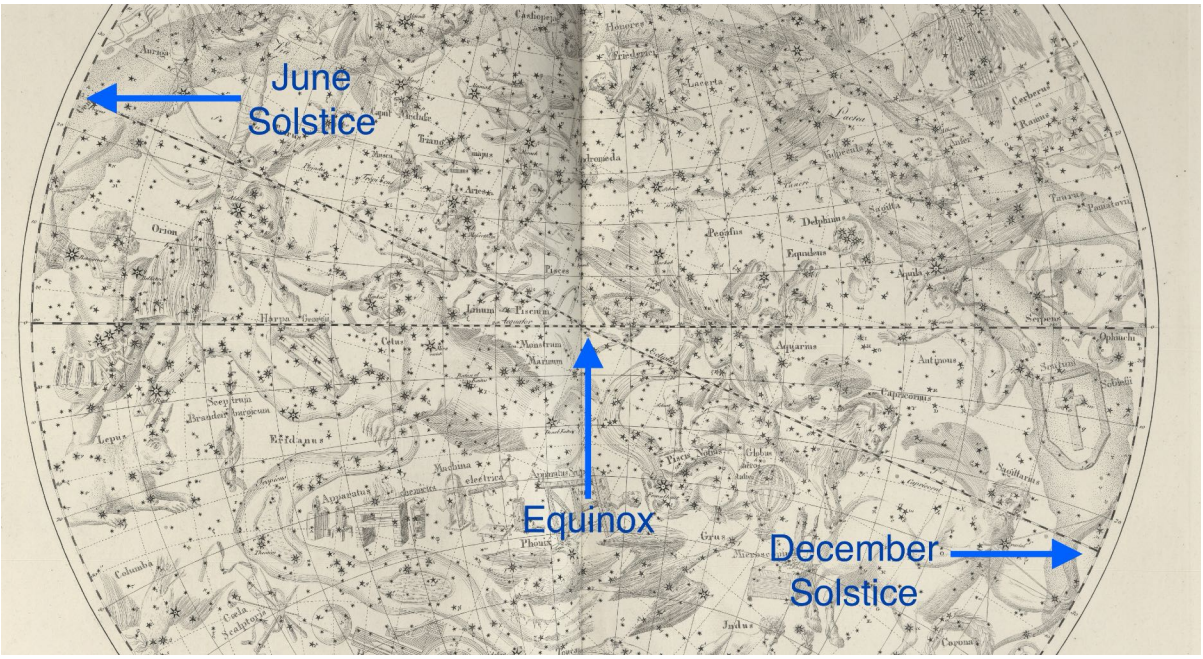


Figure 23: Bode (1801), Aries Planisphere. The March equinox is in Pisces (center). The June solstice is in Gemini (upper left). The December solstice is in Sagittarius (lower right).[28]

Imagine that you are examining a model celestial globe. On the globe, the two great circles of the ecliptic and celestial equator intersect in two points. These points are where the Sun will be located against the background of fixed stars on the days of the September and March equinoxes. Equinox (literally "equal night") means that daytime and nightime are of equal length. On the equinoxes the Sun rises due east and sets due west. The equinoxes mark the first day of spring and autumn.

On a model globe, the two points which mark where the ecliptic rises farthest northward, or farthest southward, at greatest distance from the celestial equator, are the solstices. These points are where the Sun will be located against the background of fixed stars on the days of the solstices in June and December, which mark the first day of summer and winter. On the solstices the Sun rises not on the eastern horizon, but at its most northern or southerly distance from due east. The solstices are the longest and shortest days of the year.

Thus the seasons are correlated with the tilt between the celestial equator and the ecliptic. From our Sun-centered perspective, seasons are explained as resulting from the tilt of the

28. Johann Bode, *Uranographia* (Berlin, 1801), *Tab I. Stellatum Hemisphaeri um Arietis*. Bode's atlas includes two planisphere plates. They are not southern and northern hemispheres; each one has Polaris at the top and the south pole at the bottom. Each one is centered upon an equinox point (where the ecliptic or path of the Sun and the celestial equator intersect). The March equinox point was in Aries in antiquity; by Bode's time, due to the precession of the equinoxes, it had shifted to Pisces. The September equinox point was in Libra in antiquity; by Bode's time it had shifted to Virgo. Bode titled the plates as the Aries and Libra planispheres. For the Aries planisphere, see skytonight.org/Planisphere-1-Bode-1801. For the Libra planisphere, see skytonight.org/Planisphere-2-Bode-1801. For Bode's atlas, see skytonight.org/Bode-1801.

rotating Earth with respect to the plane of the Earth's orbit around the Sun. But the appearances are exactly the same as with a static Earth in the geocentric cosmos.

Plato challenged astronomers to explain all apparent motions of heavenly bodies as resulting from combinations of various rotating spheres, moving with uniform circular motions. Astronomy became a geometrical science. After Plato, Greek astronomy proved remarkably successful for centuries to come.

9. ARISTOTLE: THE EARTH IS ROUND

9.1. THE ARISTOTELIAN UNIVERSE

Figure 24: Aristotelian cosmos. Cosmic section from Apian (1540).[29]

Far from advocating a flat Earth, both Plato and Aristotle (4th century BCE) assumed the Earth is a sphere. For Aristotle as for Plato, the spherical Earth lies in the center of the universe. Surrounding the Earth are giant celestial spheres. The large sphere containing the fixed stars rotates around the Earth every 24 hours, while the planets are carried around at different rates on their own individual spheres. Don't confuse an Earth in the middle of the

29. Peter Apian, *Cosmographia* (Antwerp, 1540). Hereafter "Apian (1540)."

Universe with a flat Earth; the Aristotelian cosmos was centered upon the Earth, but the Earth is a globe.[30]

9.2. LUNAR ECLIPSES PROVE THE EARTH IS A SPHERE

Figure 25: Aristotle's argument from lunar eclipses. Apian (1540).

In Aristotle's day, the nature of lunar and solar eclipses was well understood.[31] In a lunar eclipse, the Sun, Earth and Moon fall on a straight line, with the Earth in the middle (Figure 25, top row). The Sun casts the Earth's shadow on the Moon. By the 4th century BCE, continuous lunar eclipse observations available to Greek astronomers from Babylon went back several centuries. In every lunar eclipse, for observers located anywhere north or south, or in different locations east and west, the Earth's shadow on the Moon always appears curved, as shown in the top row. If the Earth were flat or any shape other than a globe, at least some of those eclipse shadows would be straight or angular, as shown in the other rows. The curved shadow tells us that the edge of the Earth is curved, no matter how the Earth's shadow is cast onto the Moon, from any angle as seen from north/south/east or west. Therefore the Earth must be a three-dimensional globe. We see the Earth's silhouette on the

30. Aristotle, *On the Universe*; 297b24ff.

31. Crowe, Evans...*** Cf. Dirk L. Couprie, "Aristotle's Arguments for the Sphericity of the Earth," in *When the Earth Was Flat* (Springer, 2018).

face of the Moon. Lunar eclipses prove that the far side of the Earth is curved. It is not necessary to sail around the globe to behold with our own eyes that the Earth is a sphere.[32]

9.3. GRAVITY PROVES THE EARTH IS A SPHERE

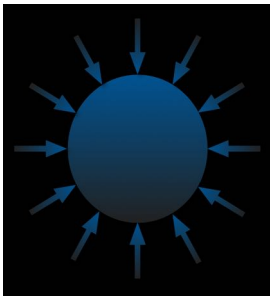


Figure 26: Aristotle's argument from gravity

Aristotle took another argument for the sphericity of the Earth not from astronomy, but from his physics. For Aristotle, all things naturally strive toward their natural place. Four elements – earth, water, air, and fire – make up everything beneath the sphere of the Moon.[33] Each of the four elements constantly move either up or down toward their natural place. The natural place of earth as an element is the center of the universe; earthy things are always striving to reach the center. This is Aristotle's theory of gravity. That is, earth falls down toward the center from all sides, as does water (which is lighter than earth). Unlike earth and water, the elements of air and fire have levity, and rise outwards from the cosmic center. Aristotle's physics of natural motion exerted widespread influence through the time of Shakespeare, until it was eventually displaced by the physics of Galileo over the course of the 17th century. In Aristotle's physics, natural motion explains why the Earth must be spherical.

Surprisingly, modern writers sometimes do not understand the basic facts about Aristotelian physics. The great 20th-century physicist George Gamow, a founder of Big Bang cosmology, wrote:

> "In the days when civilized men believed the world was flat they had no reason to think about gravity. There was 'up' and there was 'down.' All

32. Aristotle, cite***. Some modern readers may not appreciate the fact that lunar eclipess, lunar phases, and the seasons were fully understood in antiquity. Indeed, it is safe to say that every student at a medieval university would have been able to explain their causes. In contrast, a justly-acclaimed documentary film, "A Private Universe" (1987), created and produced by Matthew H. Schneps and Philip M. Sadler, Harvard Smithsonian Center for Astrophysics, demonstrated that most undergraduate seniors at Harvard University, while standing in a commencement line, could not explain them correctly. In short, the phases of the Moon are not caused by the Earth's shadow upon the Moon (that's a lunar eclipse) but by how much of the Moon's illuminated side is turned toward the Earth. And the seasons are not caused by how close the Earth is to the Sun, but by the tilt between the celestial equator (determined by the apparent daily rotation of the stars) and the ecliptic (the apparent annual path of the Sun). View the 20-minute "A Private Universe" video at the Annenberg Learner website, www.learner.org/series/a-private-universe/1-a-private-universe/. A brief survey of ancient and medieval astronomy which I have used in undergraduate classes is Michael J. Crowe, *Theories of the World from Antiquity to the Copernican Revolution*, 2d ed. (Dover Press, 2001).

33. Uppercase is used for Earth as a globe, a body, while lowercase "earth" refers to the element. The most incisive and illuminating introduction to Aristotle's universe remains the classic book by C. S. Lewis, *The Discarded Image* (Cambridge: Cambridge University Press, 1964).

> material things tended naturally to move downward, and no one thought to ask why. The notion of absolute up and down directions persisted into the Middle Ages, when it was still invoked to prove that the Earth cannot be round."[34]

Gamow should have known better, and so should the reviewers and editors of *Scientific American*. In reality, Aristotle's theory of gravity contradicts a flat Earth! Anyone who accepted Aristotle's theory of natural motion, with its absolute up and down directions, was logically compelled to accept that the Earth must necessarily be round.

Gamow illustrates the superficiality that arises when we focus on the errors of the past. If we are seeking historical understanding, the most dangerous question to ask about major historical figures is what they got right or wrong. To approach the past in those terms obscures understanding of a figure's historical significance, that is, whether, given the circumstances at the time, the person advanced important conversations in a meaningful way. Yet in the case of Plato and Aristotle, their approach to the shape of the Earth was both correct, from an ahistorical point of view, and of unparalleled historical signifcance from a contextual point of view.

10. A Round Earth was a Buttress Against Skeptics

After Plato and Aristotle, did this knowledge of the sphericity of the Earth endure? The answer is a resounding yes. Once Plato and Aristotle agreed that the Earth is a sphere, few Europeans found reason to disagree.

It's true that if one looks hard, one can find some who denied it. A few Latin writers made a point of disputing the shape of the Earth, but they did so because they were skeptics and they wanted to make a philosophical point. If something as widely accepted as the sphericity of the Earth might turn out to be uncertain, then all knowledge about anything would be suspect. Some of these skeptics were Epicureans. A few were atomists like Lucretius (1st century BCE), who denied Aristotle's arguments from natural place and expected to find randomly shaped bodies scattered around the universe.

One flat-Earther was the theologian Lactantius (fl. 300 CE), who on principle rejected nearly everything Greek. Lactantius was not influential in the early Church, and was for other reasons declared a heretic. Later on, in the Renaissance, he became more widely known when his style was admired by humanist scholars. But he was not taken seriously on the shape of the Earth.[35]

Another flat-Earther was Cosmas Indicopleustes, a Greek writer from the 6th century. Cosmas thought the universe was a huge, rectangular vault above a flat Earth lying on its floor. But Cosmas was neither typical nor influential.[36] He was refuted by contemporaries

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34. George Gamow, "Gravity," *Scientific American* (1961): pp. ?***

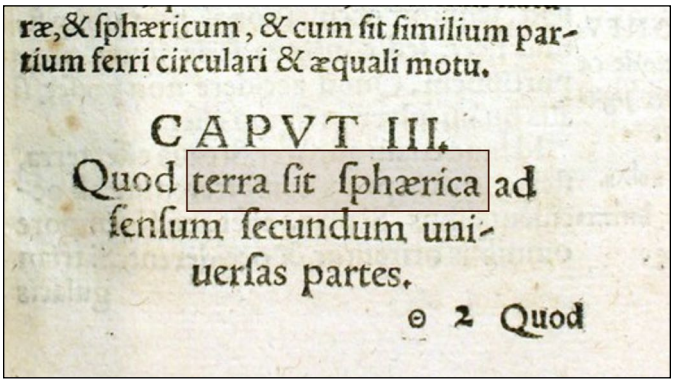
35. Russell***

36. Cosmas' views may have reflected the ideas of a contemporary Sanskrit cosmological tradition, developing apart from the western traditions influenced by Plato and Aristotle. David Pingree.***

such as John Philoponos. His work survives in only three manuscripts, and his book wasn't translated into Latin until the 18th century. He had scant if any medieval influence.

Despite a miniscule number of doubters, the spherical Earth was upheld without significant debate.

11. Ptolemy, Pliny the Elder, Cicero: The Earth is Round


ræ,& ſphæricum, & cum ſit ſimilium par-
tium ferri circulari & æquali motu.

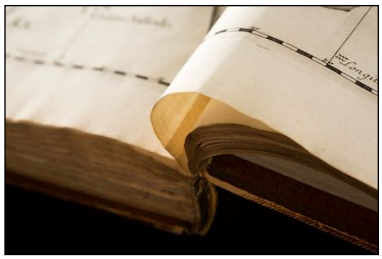
CAPVT III.

Quod terra ſit ſphærica ad
ſenſum ſecundum uni-
uerſas partes.

ϴ 2 Quod

Figure 27: "That the Earth is spherical, according to the senses, taken as a whole." Ptolemy, Almagest (1549), Book I, chapter IV, L50.[37]

Close Reading #1: Ptolemy, Almagest. Bk I, Preface & Ch. 4.



About 150 CE, Claudius Ptolemy wrote the standard work of late ancient and medieval astronomy, usually known from its Arabic title, *Almagest*, which means "The Greatest." In Book I, Chapter 4, Ptolemy listed the arguments for the sphericity of the Earth that persuaded earlier Greeks including Plato and Aristotle, which we have rehearsed above. Ptolemy's discussion was, of course, never forgotten, nor seriously contested.

Similarly, Cicero, a Stoic philosopher and ethicist (1st century BCE), described the spherical Earth:

37. Claudius Ptolemy, *Mathematicae Constructionis* (Wittinberg, 1549). Hereafter "Ptolemy (1549)." This is the first Greek printed edition of the *Almagest*. It contains the Greek text followed by the text in Latin, separately paginated. "L50" refers to p. 50 of the Latin text. The chapter is numbered as "III" in this edition; in standard editions it is actually Book I, Chapter 4. The authoritative English translation is G. J. Toomer, ed. and trans., *Ptolemy's Almagest* (Berlin: Springer-Verlag, 1984).

> "Humans were created with the understanding that they were to look after that sphere called Earth, which you see in the middle of the Temple of the Universe."[38]

Even Latin writers working in non-mathematical traditions, like Pliny the Elder, a natural historian (1st century CE), knew the Earth was spherical.[39]

12. AUGUSTINE: THE EARTH IS ROUND

Figure 28: Augustine in his study. Augustine (1489), frontispiece.[40]

The Church Fathers knew the Earth was round and did not teach otherwise. Augustine makes a good example, because in his commentary on the *Literal Meaning of Genesis* he assumed that the Earth is a globe. The question he addressed was this: Does the alternation of day and night in Genesis 1 contradict the sphericity of the Earth? A spherical Earth requires that day and night do not in fact alternate in a strict sense, but exist opposite each other on the globe continuously and simultaneously.

> "At the time when it is night with us, the Sun is illuminating with its presence [other parts of the world....] For the whole twenty-four hours of the Sun's circuit there is always day in one place and night in another....
>
> But had God perhaps made light in that region in which He was going to make man? In this theory, it can be said that, when light had left that region,

38. Cicero, *Dream of Scipio*, in Macrobius, *Commentary on the Dream of Scipio*, trans. and ed. William Harris Stahl (New York: Columbia University Press, 1952), p. 142.

39. Pliny, *Natural History* 2.72-73, 75. The sphericity of the Earth in ancient writers such as Ptolemy, Cicero, and Pliny is considered again below in light of the miniscule size of the Earth relative to the immensity of the universe; see "Filters in Action: Cosmic Immensity" on pp. 753-760.

40. Augustine, *De civitate Dei* (Venice, 1489; *City of God*). Hereafter "Augustine (1489)."

> evening was made, even though the light, which had passed from there, still existed elsewhere and was due to rise in the morning with the completion of its circuit."[41]

Augustine preferred another interpretation of the succession of light and darkness. True to habit, he entertained multiple competing interpretations. The important point is that Augustine assumed the sphericity of the globe as taught by the science of his day. After Augustine, the option of interpreting Genesis 1 as perceived from the standpoint of a particular location on Earth (e.g., the Garden of Eden) became widely recognized. The legacy of Augustine and other ancient commentators on Genesis 1 is that the language of scripture was regarded as irrelevant for the question of the shape of the Earth.

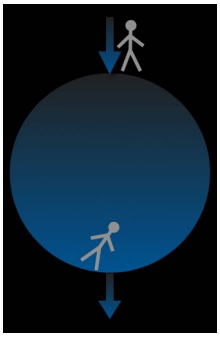


Figure 29: Misrepresentation of the Antipodes

Yet Augustine is sometimes cited as denying the existence of the antipodes. Does this mean that he thought that, if the Earth is a globe, then people in the southern regions of the Earth would fall off? Not at all. That would misrepresent ancient knowledge of geography.

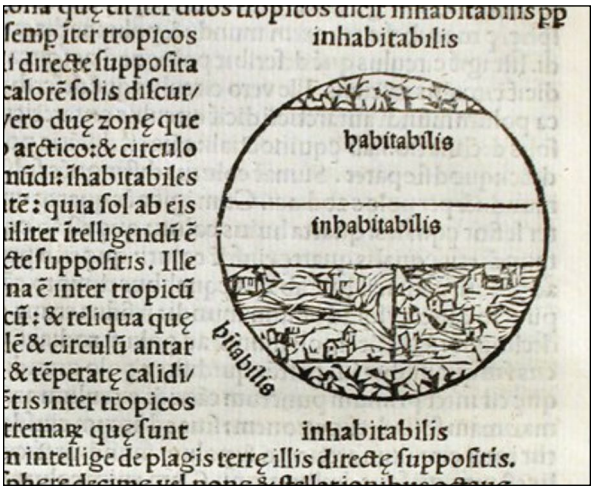


Figure 30: Uninhabitable zone. Sacrobosco (1519), 11v.[42]

Like contemporary geographers, Augustine divided the Earth into habitable regions separated by an uninhabitable zone at the equator that was too hot to travel across (Figure 30). Therefore, if people do live in the antipodes, or southern hemisphere, then they're not part of the history recorded in the Bible. And in his book *The City of God*, that history and the unity of the human race were what mattered to him. Augustine didn't say that the Antipodes don't exist; rather, he just conceded that there's no way for descendants of Adam to get there from here.[43]

41. Augustine, *The Literal Meaning of Genesis*, trans. John Hammond Taylor (New York: Newman Press, 1982), 2 vols. The quotation is from vol. 1, pp. 30-31, from Book 1, Chapter 10, entitled "How can we explain the light and darkness mentioned in v. 4?" Cf. Chapter 12 of Book 1 (pp. 32-34), entitled "Difficulties connected with the succession of day and night and the gathering of the waters."

42. Sacrobosco, *Sphaera mundi* (Venice, 1519). Hereafter "Sacrobosco (1519)."

43. Augustine, *City of God*, Book 16, Chapter 9.

So it was with well-known writers from Cicero in the first century BCE, to Pliny (1st century CE), Augustine (fl. 400 CE), Macrobius (fl. 400 CE), Martianus Capella (fl. 410 CE), and Bede (fl. 700 CE). These are not obscure authors like Lactantius or Cosmas, and they all assumed the sphericity of the Earth.

Don't you find it odd, then, when medievals are said to have believed in a flat Earth?

13. THOMAS AQUINAS: THE EARTH IS ROUND

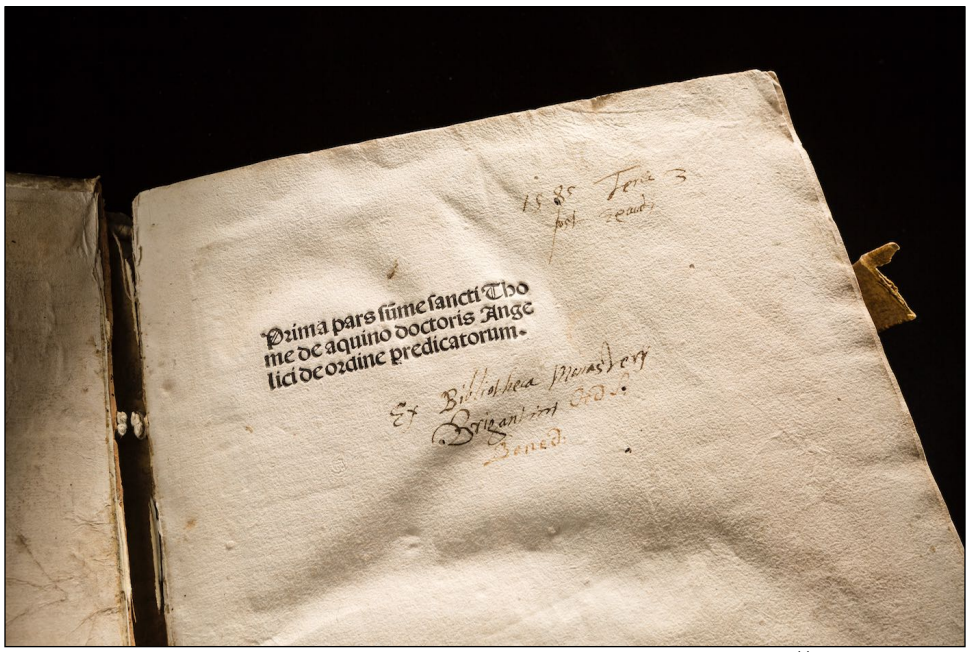


Figure 31: Thomas Aquinas, Summa theologiae (1496).[44]

If we look to the later Middle Ages, there is unanimity on the Earth as a globe. When Aquinas wrote his *Summa*, the greatest theological work of the Middle Ages, at the very beginning he took for granted that readers knew the Earth is round. That's the example he used when he wanted to show that fields of science are distinguished by their methods rather than their subject matter:

> "Sciences are distinguished by the different methods they use. For the astronomer and the physicist both may prove the same conclusion – that the Earth, for instance, is round. The astronomer proves it by means of mathematics, but the physicist proves it by the nature of matter."[45]

44. Thomas Aquinas, *Prima pars su[m]ma sancti Thome de aquino doctoris angelici de ordine predicatorum* (Nuremberg, 1496).

45. Thomas Aquinas, *Summa theologica*, Book I, chapter 1, article 1. Cf. Peter Kreeft, *A Summa of the Summa: The Essential Philosophical Passages of St. Thomas Aquinas' Summa Theologica, edited and explained for Beginners* (San Francisco: Ignatius Press, 1990), p. 37.

Aquinas meant that astronomy can prove the Earth is round from astronomical evidence like lunar eclipses or changing circumpolar stars. On the other hand, physics can prove the Earth is round from its own kind of evidence, the principle of gravity. Sciences are therefore distinguished not by their conclusions, which may coincide, but by the methods they use to reach those conclusions.

14. DANTE: THE EARTH IS ROUND

Nor was knowledge of the Earth as a globe confined to scholars in universities. A round Earth was assumed in popular literature and by major authors like Geoffrey Chaucer (14th century) and Dante Alighieri (early 14th century). The Penguin edition of Dante's *Divine Comedy*, translated by Dorothy L. Sayers in three volumes (*Hell*, *Purgatory*, and *Paradise*), includes a calculator for telling time by the stars from anywhere on the Earth.[46]

In one memorable scene of *Inferno*, when Dante describes his travels down through the very center of the Earth, he passed the center of gravity (at Satan's belly-button!) and began climbing upward to reach the other side.

Figure 32: Satan at the center of the Earth[47]

> "Kindly explain; what's happened to the ice?
> What's turned him upside down? or in an hour
> Thus whirled the Sun from dusk to dawning skies?
> Thou thinkest, he said, thou standest as before
> Yon side the centre, where I grasped the hair
> Of the ill Worm that pierces the world's core.
> So long as I descended, thou wast there;

46. Dante, *Hell*, trans. Dorothy L. Sayers (London, Penguin, 1949), vol. 1 of 3. Sayers introduces Canto XXXIV: "After passing over the region of Judecca, where the Traitors to their Lords are wholly immersed in the ice, the Poets see Dis (Satan) devouring the shades of Judas, Brutus, and Cassius. They clamber along his body until, passing through the centre of the Earth, they emerge into a rocky cavern. From here they follow the stream of Lethe upwards until it brings them out on the island of Mount Purgatory in the Antipodes" (p. 285). Sayers' translation maintains the rhyming pattern of the original Italian. Her copious annotations include many helpful astronomical notes, including "Dante's Universe," pp. 292-295. Dante was proficient in astronomy; Chaucer even more so. Chaucer wrote an important manual for using the astrolabe; see John D. North, *Chaucer's Universe* (Oxford: Clarendon Press, 1988).

47. Dante Alighieri, *La Divina Commedia* (Venice, 1757), vol. 1, p. 55. This is the first printed edition of Dante's complete works.

But when I turned, then was the point passed by
Toward which all weight bears down from everywhere.
The other hemisphere doth o'er thee lie –
Antipodal to that which land roofs in,..."[48]

Even non-university people who read Dante knew the Earth is a globe.

15. Middle Ages: The Earth is Round

Knowledge of the sphericity of the Earth in the Middle Ages reached beyond the educated elite to the emerging mercantile class, and it permeated aspects of popular culture such as almanacs, feudal ceremonies, sermon illustrations, and cathedral iconography.[49]

Figure 33: Regal orb. Prague Castle.

For example, a globe with a cross on top symbolized the divine right of kings to rule Christendom. The cross stands for the authority of the king and the globe stands for the realms given kings to rule. Whether in cathedral sculpture, paintings, tapestries, scepters, or other feudal depictions, this symbol of Christendom proclaimed the sphericity of the Earth for all to see, even illiterate peasants.

Knowledge of the shape of the Earth was widespread in the middle ages.

16. Nicole Oresme: Paradoxically, the Earth is Round

People took the spherical shape of the Earth for granted, but Nicole Oresme delighted in proposing paradoxes that would test whether they had really thought through the consequences of a spherical Earth. By all accounts one of the greatest scientists of the 14th century, Oresme is most often remembered for his development of a graphical representation of the Mean Speed Theorem, an antecedent of Galileo's law of free fall. Oresme contributed to many other areas of inquiry as well.[50]

The Book of the Heavens and the Earth, a comprehensive overview of physics and cosmology written for Charles V, King of France, was written in medieval French rather than Latin. It

48. Dante, ***Inferno***, canto 34; trans. Sayers, p. 288.

49. Cf. Lewis, *Discarded Image*, pp. ??***

50. Oresme probably obtained his bachelor of liberal arts at the University of Paris in the 1340's under the equally-renowned Jean Buridan. By 1348 Oresme was studying theology at the University of Paris in the College of Navarre, where he received a masters in theology in 1355. In 1356 he became master of the College. Oresme died in 1382. On Oresme and the Mean Speed Theorem, see below...***

captures something of the whimsical love of paradoxes that is characteristic of Oresme.[51] Nor was Oresme oppressed because of his scientific theories; he wrote openly in the vernacular to reach a broader readership. To show his appreciation, Charles V made him Bishop of Lisieux in 1377.

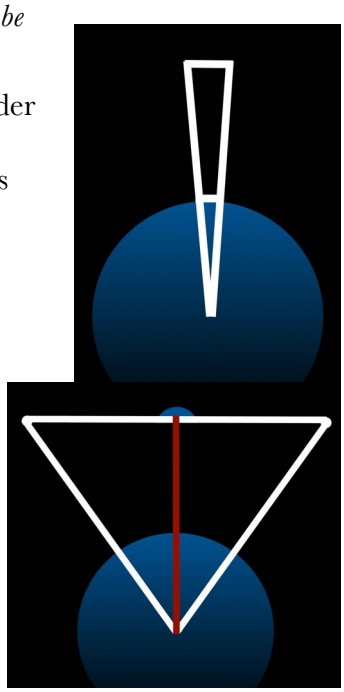
Paradox #1: Remember how Dante placed Satan at the center of the Earth? Was he standing right side up or upside down?

Oresme answered "both," because he would be weightless, in zero gravity:

> "Assuming that the Earth were perforated or pierced... and that a man were at the center standing straight with his head in one direction from the center and his feet on the other, I say that such a man would have his head and also his feet on top or upwards, and he would be no more in a lying than in a standing position, nor facing downward more than upward..."[52]

Paradox #2: If you build a tall tower so that each side goes straight up, will it be the same width at the top as at the base?

Oresme answered, if each side goes straight up, the top must be wider than the base. Each side makes a line that, if extended, would run through the center of the Earth. Therefore the lines must diverge as they go away from the center.



Paradox #3: Why does a little water spilled on a table not run off the side?

We would say hydrogen bonding, at least if we've studied chemistry, but Oresme thought it was because the Earth is round.

The legs of the table are like the sides of the tower; they must diverge as they rise higher above the Earth. Therefore the table top is wider than the base, and the middle of the table is closer than the edges to the center of the Earth. The water won't spread out to the edges, because to do so it would have to flow uphill. That's why a drop of water seems to pool in the middle.

Even though we know it's wrong, that's still pretty clever, isn't it?

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51. Nicole Oresme, *Le Livre du Ciel et du Monde,* trans. and ed. Albert D. Menut and Alexander J. Denomy (Madison: University of Wisconsin Press, 1968), Bk. II, ch. 31, pp. 573-581. This edition displays the text in medieval French and the English translation on facing pages.

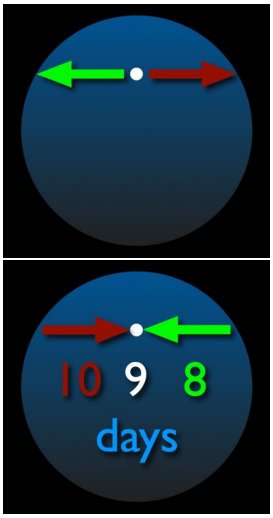
52. Oresme

Paradox #4: What's the best way to go from Rome to Paris? North over the Alps, or should one travel west around them?

Oresme answered that because the Earth is a sphere, the shortest line between two points on its surface is obviously a tunnel.

Paradox #5: The International Date Line

Oresme considered his favorite paradox so much fun that he cast it into Latin verse. To appreciate this, remember that Easter Sunday is the most important date in the church year, and Catholic churches should celebrate Easter according to a uniform calendar. Wouldn't it be awful if priests in two different cities celebrated Easter on different days?



Imagine three priests in the same city, say Paris, several days before Easter. One priest remains in the city; two depart on separate journeys. These two travel at the same speed on a road that encircles the Earth; one goes west and the other goes east, and at the end of their journeys, back in Paris, all three are reunited on the same day. The priest who travels west returns in 8 days and 8 nights. At the same rate of speed and in the same amount of time the priest who travels east returns, but he counts 10 days and 10 nights. And the priest who stayed home counts 9 days and 9 nights. Therefore, 8, 9 and 10 days are exactly identical!

There's more: The priest who traveled east celebrated Easter during the first part of his journey, but then the following day he arrived where people were still fasting in Lent, though they calculate the day of Easter in the same way. Therefore Easter and the day before Easter are the same day! In other words, Oresme foresaw the International Date Line. As he exclaimed, "Hallelujah! I tell you, this story contains nothing that is not pure and simple truth."[53]

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53. The paradoxes recounted above are taken from Oresme, 573-581. The quote is from p. 581. This "circumnavigator's paradox" was articulated before Oresme by several Islamic natural philosophers in Arabic texts; cf. Wikipedia, "Abulfeda," en.wikipedia.org/wiki/Abulfeda; and R. H. van Gent, "A History of the International Date Line" (2017), webspace.science.uu.nl/~gent0113/idl/idl_main.htm. Younes Mahdavi has shown that after Oresme it continued to be a staple among Islamic writers, including the theologian, philosopher and mathematician Baha al-Din Muhammad ibn Husayn al-Amili (fl. 1600).

17. COLUMBUS: THE EARTH IS SMALL

Figure 34: Sacrobosco (1537), frontispiece detail.

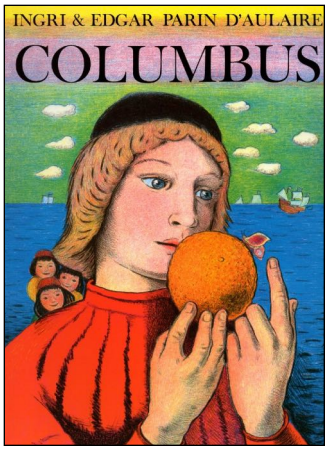
But what about Columbus? We're on the Santa Maria, heading west across the Atlantic. It's 1492. Didn't Columbus set out to prove the Earth is round? Didn't the churchmen in Spain argue that his ships would sail off the edge of the Earth?

Columbus and the myth of the flat Earth are deeply embedded in advertising, as in an ad for Windows Vista (2007) shown in Figure 35.

The Southern Baptists fell victim to the Columbus version of the flat Earth myth when they produced a brochure encouraging students to apply for world missions (Figure 35, right). The brochure says,

> "They all laughed at Columbus. He knew the world wasn't flat and set out to prove it. It took courage going beyond the horizon and into the unknown, but Columbus did it. He really changed the shape of the world."

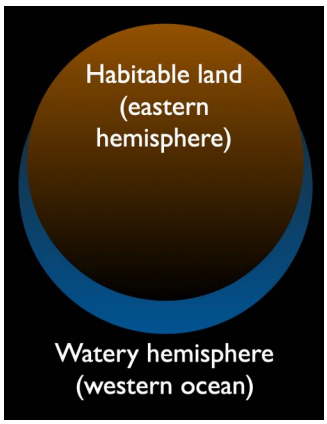
Figure 35: Columbus myth: Windows Vista (left); Southern Baptist missions pamphlet (right).



Consider Ingri and Edgar D'Aulaire, authors of best-selling children's books. Their *Columbus* suggests that the novel insight that the Earth is round was gained by contemplating an orange:

> "For in those days most people thought that if you sailed far enough out into the ocean you would come to the end of the world. They still thought that the world was as flat as a platter. They laughed at the learned men who said that the world was not small and flat but a huge ball that spun around in space."[54]

But think about it. There's something dreadfully wrong with what we were all taught about Columbus. Why would Columbus have to argue that the Earth is round at a time when people believed the physics of Aristotle and the astronomy of Ptolemy? When the works of theologians like Augustine and Aquinas, and of writers like Cicero and Dante, all assumed that the Earth is round? When even the iconography of cathedrals and feudal symbols taught the illiterate that the Earth was a globe? But we've been told about Columbus so often, that we tend to believe it no matter how little sense it makes.



We should learn to ask better questions. For example, we might ask: If everyone really knew the Earth is round, then why did Columbus have such a hard time getting support for his voyage?

Figure 36: The habitable and watery hemispheres (right).

Columbus had a new idea which led him to think he could sail around the world. Back then, it was thought that the far side of the Earth, where the Americas are located, was just a watery hemisphere without any dry land. The reasons are complicated, but the habitable land of the eastern hemisphere was regarded as a cork floating on the water.[55] Given this view, if there were just one wide ocean, then it would be too far and too dangerous to cross. The sailors would starve and after weeks on stormy seas the ships would fall apart for lack of repairs. That, not a flat Earth, was the error made by those who declined to support Columbus.

So if people at the time accepted this watery hemisphere idea, why was Columbus willing to risk the journey? Columbus believed the Earth is much, much smaller than it actually is. If the Earth were as small as he thought, then China would lie about where he found the New World. That's why Columbus thought he had landed in China, and why the New World is named after Amerigo Vespucci, a geographer who recognized that the New World is not China. Columbus was lucky to find land in the western hemisphere right when he needed it.

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54. cite

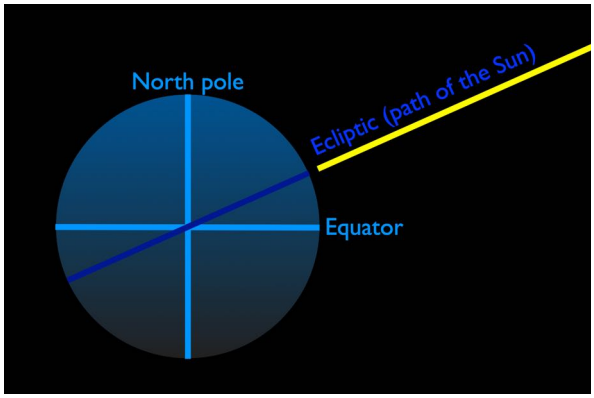
55. For an overview of medieval theories of the Earth, see my 12-minute video "14th-Century Science - 8.3 Theories of the Earth," at youTube or kerrymagruder.com/hsci/08-14thCentury/2-earth.html.

His skeptics were wrong about that. But they were right about the size of the Earth; it's not nearly as small as Columbus thought it was.[56]

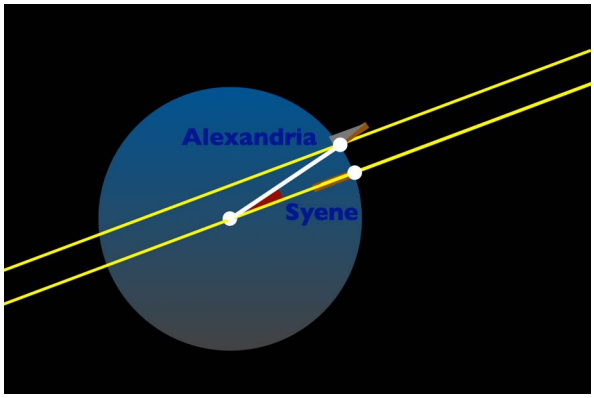
18. Eratosthenes (280 BCE): The Earth is Big

Eratosthenes, a Librarian in ancient Alexandria, figured out the size of the Earth before 200 BCE. He wasn't the first or the last, but his estimate was the best, and was never forgotten.

From Alexandria at the mouth of the Nile, Eratosthenes heard that farther south on the Nile, there was a town called Syene where one day each year the Sun would shine onto the bottom of a well. In Syene at noon on the day of summer solstice, when the Sun reached its highest point in the sky, it reflected on the bottom of the well. So at that moment in Syene the Sun was directly overhead.[57] But at the same moment, farther north in Alexandria, the Sun cast a small shadow. By measuring the shadow in Alexandria, Eratosthenes could figure out how much of the curve of the Earth separated Alexandria from Syene.



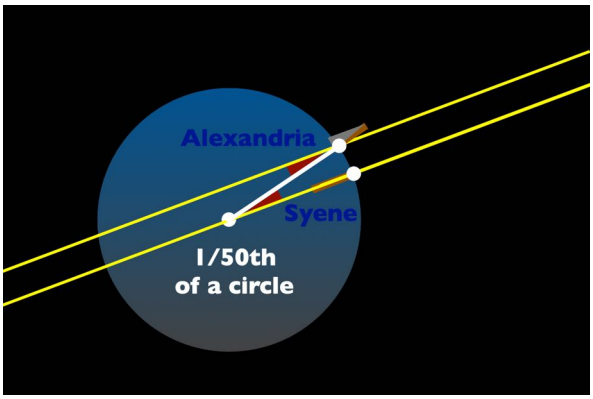
By simple geometry, you can prove that the angle of the shadow from the top of the stick to the ground in Alexandria is the same as the angle from the center of the Earth between Alexandria and Syene. The rays of light from the Sun are parallel, because the Sun is so far away. The line from the center of the Earth to Syene goes straight out to the Sun along one of the rays. But the line from the Earth's center to Alexandria intersects the sunlight at Alexandria. There, the sunlight casts the shadow of the stick. And the stick is on the line from Alexandria to the Earth's



56. Cite***

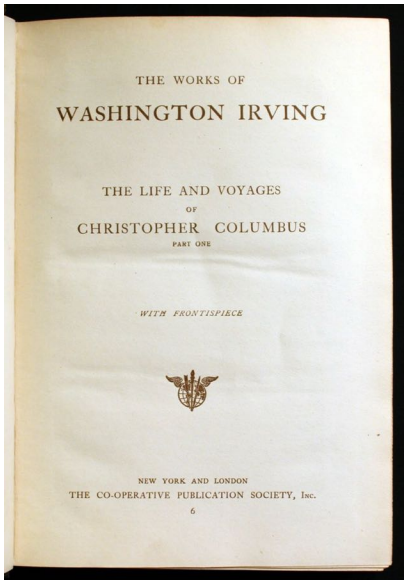
57. In other words, Syene (modern Aswan) lies on (or near) the Tropic of Cancer, a circle parallel to the equator at the latitude of the northern solstice, the northernmost latitude at which the Sun can reach a position directly overhead, on only a single day of the year (the June solstice). In actuality, Syene lies about 24° 5′ 23″ North, rather than exactly 23.5° N latitude.

center. So the angle from Syene to the Earth's center to Alexandria is an alternate interior angle to the angle of the stick's shadow. And alternate interior angles are equal.



Eratosthenes measured the angle of the stick's shadow to be about one 50th of a circle. Therefore the distance from Alexandria to Syene must be about one 50th of the distance around the Earth. Soldiers paced off that distance at 250,000 stades, or stadium lengths. Multiply 250,000 stadium lengths by 50 and you have the circumference of the Earth. Eratosthenes' figure turns out to be almost exactly right. Notice, this measurement of the size of the Earth does not *prove* the Earth is round. From the start, it *assumes* the sphericity of the Earth. The shape of the Earth wasn't controversial. Ever since Eratosthenes, people knew the Earth was not only round, but big.[58]

19. THE TRUE FLAT EARTH MYTH


THE WORKS OF

WASHINGTON IRVING

THE LIFE AND VOYAGES
OF
CHRISTOPHER COLUMBUS
PART ONE

WITH FRONTISPIECE

NEW YORK AND LONDON
THE CO-OPERATIVE PUBLICATION SOCIETY, Inc.
6

Why do so many people today think Columbus had to prove the Earth is round? This is the true "Flat Earth Myth." The Flat Earth Myth is not an alleged *medieval* belief in a flat Earth, but the mistaken *modern* belief that medieval people thought the Earth is flat, when it is so easy to show that they knew the Earth is round.

Historian Jeffrey Burton Russell has shown that the answer lies in part with one of America's earliest writers. Washington Irving fooled a lot of readers when he dramatized the flat Earth myth. We all enjoy Irving's far-fetched tales, but his *Life of Christopher Columbus* presented itself as biography, not fiction. Unfortunately, it was about as factual as the headless horsemen. Irving fabricated a tale of Columbus pleading his case before a council of Inquisitors at a convent in Salamanca, who assailed him with citations from the Bible and the teachings of the Church. Irving's account is nothing but misleading and mischievous nonsense. It should have been read only as a pleasant romance.[59]

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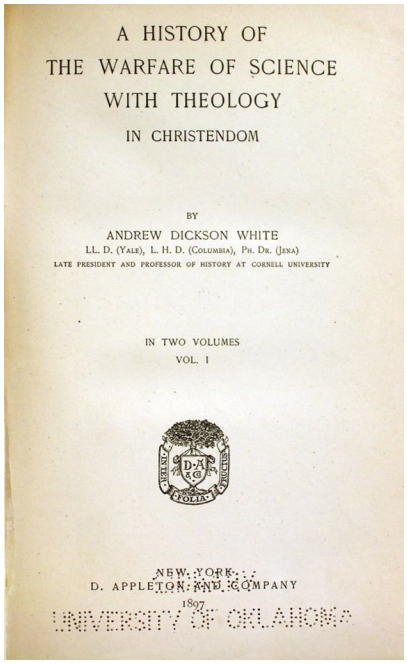
58. Descriptions of Eratosthenes' calculation, and how to replicate it, are readily available; one excellent popular presentation is found in the book (and in one episode of the companion six-part PBS video series) by noted physicist Philip Morrison, *The Ring of Truth* (Random House, 1987).

59. Russell, ch. 4.***

Other French and American writers endorsed the Flat Earth Myth, and by the end of the 19th century it was being taught in universities.

Andrew Dickson White, President of Cornell University, echoed Irving in his book, *A History of the Warfare of Science with Theology in Christendom*. White wrote:


A HISTORY OF
THE WARFARE OF SCIENCE
WITH THEOLOGY
IN CHRISTENDOM

BY
ANDREW DICKSON WHITE
LL. D. (YALE), L. H. D. (COLUMBIA), PH. DR. (JENA)
LATE PRESIDENT AND PROFESSOR OF HISTORY AT CORNELL UNIVERSITY

IN TWO VOLUMES
VOL. I

NEW YORK
D. APPLETON AND COMPANY
1897

> "The warfare of Columbus the world knows well: how the Bishop of Ceuta worsted him in Portugal; how sundry wise men of Spain confronted him with the usual quotations from the Psalms, from St. Paul, and from St. Augustine; how, even after he was triumphant, and after his voyage had greatly strengthened the theory of the Earth's sphericity, with which the theory of the antipodes was so closely connected, the Church by its highest authority solemnly stumbled and persisted in going astray."

White continued:

> "In 1519 science gains a crushing victory. Magellan makes his famous voyage.... Yet even this does not end the war. Many conscientious men oppose the doctrine for two hundred years longer."[60]

We owe to White many of our modern misconceptions of the Flat Earth Myth in particular, and the allegedly inevitable conflict between science and religion in general. For example, White propagated a mistranslation of Augustine to claim that Augustine affirmed a flat Earth. Actually, as we have seen, at most there were a dozen Flat Earth writers before modern times, and *none* of them were influential on this point. The Roman Catholic church, for instance, always taught the sphericity of the Earth. Yet White took exceptions like Lanctantius and Cosmas Indicopleustes as typical of the relationship between Christianity and science.

White went looking for something, then found only what he wanted to find. White did exactly what he accused the medievals of doing, believing in whatever he wanted without regard for the weight of the evidence.[61]

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60. Andrew Dickson White (1832-1918), *History of the Warfare of Science with Theology in Christendom*, 2 vols. Vol. 1, pp. 108-109.

61. Russell, p. 44: "The curious result is that White and his colleagues ended by doing what they accused the fathers of, namely, creating a body of false knowledge by consulting one another instead of the evidence."

20. How Could We Be So Wrong?

If we have believed in the Flat Earth Myth, then I wonder what else we believe about the past that's wrong? Maybe we don't know as much about the past as we think.

History is more often than not the story of the unexpected. Historical reconstruction results in a *drama*, rather than a predetermined, retrospective chronicle.

Historical reconstruction is based on actual evidence. Rational reconstruction fails to respect the contingent nature of history. Rational reconstruction leads to *precursor-itis*; a preoccupation with discoveries and opinions that seem to anticipate our own, taken out of context and severed from the perspective of the persons who made them. This occurs when we hear someone say something like "Columbus proved that the Earth was round," or "Stonehenge was the first astronomical observatory."

Herbert Butterfield's classic little book, *The Whig Interpretation of History* (1931), showed how historians in the 19th century wrote political history as if all past social orders had been groping along, trying but largely failing to achieve the Whig historians' own enlightened political views. If we substitute history of science for political history, the parallel is clear: Whig history of science portrays past cultures and thinkers as blindly groping along, trying but largely failing to arrive at our own enlightened views. This kind of history (e.g., "Aristotle's influence held back the progress of science for more than 1,500 years") is not only an obstacle to understanding, but it often becomes quite boring. If all that we can discover in others is that they were like or unlike ourselves, we close our minds off from a deeper understanding of the complexity of vanished worlds, and we miss the most important opportunities for interesting new discoveries.

Chronological snobbery, rational reconstruction, Whig history, precursor-itis, or simply, "presentism," all mean "writing history backwards." Any difference between these historical fallacies is mainly one of emphasis. All refer to evaluating the past, for the sake of praise or condemnation, in terms of present knowledge, seeing the past as so many steps on an inevitable progression toward us and our views.[62]

While there was no golden age, and it is important to critique the past, perils beset us when we do so hastily. Instead of grappling with historical complexity on the basis of actual evidence, we easily fall prey to rational reconstructions which project our *a priori* expectations onto the past. What biases do we hold that tempt us to adopt oversimplified schema that are a product of rational reconstruction more than of historical investigation?

What might we gain from studying history with the assumption that people in the past really were just as bright and inventive as we are? And that, albeit in different ways, we are just as flawed and susceptible to blind spots as they were? What if the dividing line between the wise and the foolish runs not between present and past, but right through each one of us? How

62. For an undergraduate lesson on rational reconstruction as a historical fallacy, also known as "The Whig Interpretation of History," using interpretations of Stonehenge as an example, see: kerrymagruder.com/hsci/01-Exploring/stonehenge/Stonehenge-4-rr.html. The Stonehenge lesson begins at kerrymagruder.com/hsci/01-Exploring/stonehenge/Stonehenge-Intro.html.

might we need to rethink our preconceptions of the relations between science and religion by studying the history of science?

Back in the Middle Ages, scholars like Oresme called themselves the *Via moderna*, the Modern Way, in contrast to those who came before. We do the same thing when we call their Via moderna the 'Dark Ages.'[63] I think we would do much better to regard medieval scientists like Oresme as living not in the "Dark Ages," but in the Age of Illumination.[64]

Figure 37: Pierre Crescenzi (1471), illuminated with gold leaf and adorning flourishes. The facing page is a Gregorian chant recycled to serve as the binding of the book.[65]

But myths, like misinformation, have a life of their own. Once the Flat Earth Myth made it into our textbooks, it became impervious to evidence or correction.[66] Although the original

63. Russell, p. 76: "The assumption of the superiority of our views to that of older cultures is the most stubborn remaining variety of ethnocentrism."

64. Next St. Patrick's Day, spend some time learning about the Book of Kells and other medieval illuminated manuscripts.

65. Pietro de' Crescenzi, *Ruralium commodorum* (Augsburg, 1471), "The Advantages of Country Living." Hereafter "Crescenzi (1471)."

66. Russell, p. 29: "The schoolbooks of the nineteenth century are inconsistent, but show an increasing tendency over the century to the Flat Error, a tendency that becomes especially pronounced from the 1870s onward .... Earlier in the century the dominant force behind the Error was middle-class Enlightenment anti-clericalism in Europe and 'Know-Nothing' anticatholicism in these United States. The

source is unknown to most of those who use our iconic woodcut, it was not a medieval woodcut at all, and was only created to spread the Flat Earth Myth. So pardon my asking, but who lives in a Dark Age now?

The Flammarion woodcut has proven an extremely durable piece of visual rhetoric. In the NASA publication, the theme of the image was transformed; its caption referred not to a flat Earth but to a common quest of discovery and exploration: as has been said, the challenge of "boldly going where no one has gone before."[67] This seems to be the rhetorically durable theme, the appeal of the woodcut which makes it so attractive to the those who have reprinted or adapted it so frequently. That was definitely what I had in mind when I created the logo for the OBU Planetarium in the 1990s while serving as Planetarium Director.

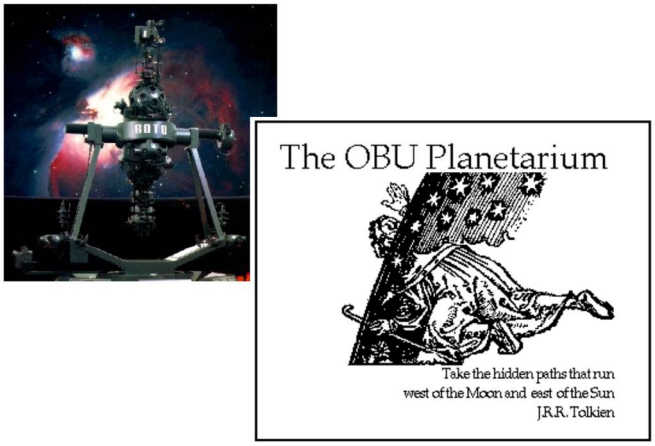

Figure 38: Logo for the Planetarium of Oklahoma Baptist University, early 1990's.

It was because of this quest theme, of breaking through the cosmic spheres to view the unknown beyond, that Robert J. Nemiroff, editor of NASA's Astronomy Picture of the Day (APOD) website, created a half-colorized version to mark January 1st, 2000, as the onset of the new millennium.[68]

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origin of the Error resides in these milieus."

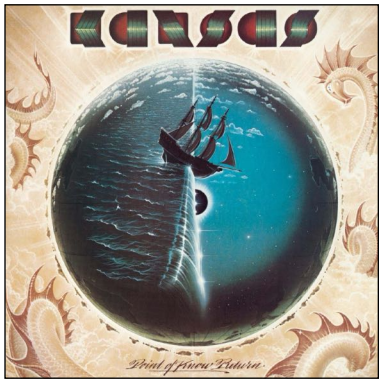
67. The motto of *Star Trek: Next Generation*.

68. Astronomy Picture of the Day, apod.nasa.gov/apod/ap000101.html.

Figure 39: APOD for January 1, 2000 (right); "Point of Know Return" album cover by Kansas (1977; below).

Although he intended to propagate the flat Earth myth, Flammarion has, ironically, bequeathed to us an icon of a cosmic quest, a search for truth. That figure is curious, determined to discover something new. He actually reminds me of Nicole Oresme. I hope Oresme would think he resembles you and me, too. If we could bring him back to life, here is what he might say to us about our culture's Flat Earth Myth, in the words of historian Jeffrey Burton Russell:

> "The search for truth is long and laborious and easily set aside. And since the present is transformed day by day, minute by minute, second by second, into the past, while the future is unknown and unknowable, we are left on the dark sea without stars, without compass or astrolabe, more unsure of our position and our goal than any of Columbus's sailors. The terror of meaninglessness, of falling off the edge of knowledge, is greater than the imagined fear of falling off the edge of the Earth. And so we prefer to believe a familiar error than to search, unceasingly, the darkness."[69]



To take up that quest for truth, let us set aside the Flat Earth Myth, no matter how disorienting or disconcerting we feel upon parting with such a familiar error. As we search for the truth about science and religion, and set aside our stereotypes about the alleged warfare of science and religion, we need not fear falling off the edge of the Earth.[70]

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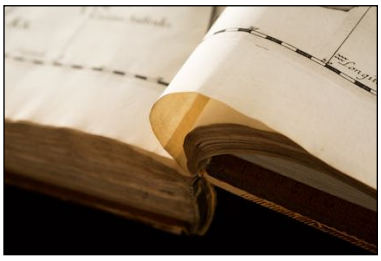
69. Jeffrey Burton Russell, *Inventing the Flat Earth: Columbus and Modern Historians* (Praeger Paperback, 1997).

70. Thus we can affirm the spirit if not the letter of Francis Schaeffer's exhortation: "The ancients were afraid that if they went to the end of the earth they would fall off and be consumed by dragons. But once we understand that Christianity is true to what is there, true to the ultimate environment – the infinite, personal God who is really there – then our minds are freed. We can pursue any question and can be sure that we will not fall off the end of the earth." Francis A. Schaeffer, *Art and the Bible* (Downers Grove,

21. After Words

— Classic Texts —



1. C. S. Lewis, "On the Reading of Old Books," in *God in the Dock: Essays on Theology and Ethics* (Grand Rapids, Michigan: William B. Eerdmans Publishing Company, 1970), pp. 200-207.
   "It is a good rule, after reading a new book, never to allow yourself another new one until you have read an old one in between…"
2. C. S. Lewis, "De descriptione temporum," in *Selected Literary Essays*, ed. Walter Hooper (Cambridge: Cambridge University Press, 1969), pp. 1-14.
   "It is not the remembered but the forgotten past that enslaves us... The unhistorical are usually, without knowing it, enslaved to a fairly recent past." (p. 12).
3. Ptolemy, *Almagest*, Preface and Book I. Found in Michael J. Crowe, *Theories of the World from Antiquity to the Copernican Revolution*, 2d ed. (Dover Press, 2001), pp. 50-65.

— Further Reading —

1. Jeffrey Burton Russell, *Inventing the Flat Earth: Columbus and Modern Historians* (Praeger, 1991)
2. Susanna Joy Magruder colorized the woodcut. You can download it and make a print, or put it on a coffee mug. (kerrysloft.com/history-of-science/boldly-explore-2/)

— Reflect and Discuss —

It's now time to put on our thinking caps and interpret the significance of what we've been exploring! If this chapter has been successful, then you are now doing some real thinking.

1. Are the wheels spinning? Did you discover anything new, surprising, or unexpected? What was most meaningful to you?
2. Have you traveled across the International Dateline? Which way, and what happened? Have you enjoyed other works of literature or movies in which the plot involves the dateline (e.g., Jules Verne, *Around the World in 80 Days*; Umberto Eco, *The Island of the Day Before*; etc.)?
3. Imagine if Nicole Oresme traveled to the present day, and in conversation with you he exclaimed: "The average student in medieval universities understood more about

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Illinois: InterVarsity Press, 1973), p. 9.

astronomy than university students do today." Although it sounds preposterous, why might he say such a thing?[71]

4. Why is the Flat Earth Myth so durable? What does the Flat Earth Myth suggest about our understanding of history?
5. Given the counsel of Lewis against chronological snobbery, how might the "Reading of Old Books" help us avoid the blind spots of our own age? That is, how can we use history to correct our own biases, while avoiding the use of history as a comfortable means of supporting them?
6. This chapter alludes to a number of similar historical fallacies, including chronological snobbery, rational reconstruction, the Whig Interpretation of history, precursor-itis, and presentism. Do you think the Flat Earth Myth has any connection with these historical fallacies?
7. Is there any connection between the Flat Earth Myth and the idea of an ongoing and inevitable conflict between science and religion?
8. Discuss the meaning of the concluding quotation from Jeffrey Burton Russell (p. 82).
9. Ideas lack power to change us until we relate them to our particular stories. Do you have any flat Earth stories, either that you have experienced yourself or heard about?
10. Imagine yourself in conversation with a friend who enjoys theology: How does this case study relate to Christian belief in the Trinity?
11. Imagine yourself in conversation with a friend who cares about science: How does this case study relate to natural science?
12. What are the implications of these things for "Love and the Cosmos"?

71. For an enactment of such a conversation, watch the "Shape of the Earth" video (note 1 on p. 43).

— Doxology —

"This is My Father's World," by Maltbie Davenport Babcock (1901)

Let's pray and sing in worship of Father, Son and Holy Spirit.

This is my Father's world,
And to my listening ears
All nature sings, and round me rings
The music of the spheres.

This is my Father's world:
I rest me in the thought
Of rocks and trees, of skies and seas;
His hand the wonders wrought.

This is my Father's world,
The birds their carols raise,
The morning light, the lily white,
Declare their maker's praise.

This is my Father's world,
He shines in all that's fair;
In the rustling grass I hear Him pass;
He speaks to me everywhere.

This is my Father's world.
O let me ne'er forget
That though the wrong seems oft so strong,
God is the ruler yet.

This is my Father's world:
why should my heart be sad?
The Lord is King; let the heavens ring!
God reigns; let the Earth be glad!

Amen.

✦ Part II ✦

Thinking Theologically

In Part II we develop the perspective of "Thinking Theologically," in order to develop a "Trinitarian theological instinct" (Chapter 3). We then apply that perspective to the relations between *science and religion*, and the relations of *science and scripture* (Chapter 4).

Think of Part I, "Beginnings," as the first week of class. Together with Part II, "Thinking Theologically," Parts I and II comprise an introduction to the book.

The first chapter of Part I, "Introduction," and the first chapter of Part II, Chapter 3, "Trinitarian Theological Instinct," introduce the book's overall approach and rationale. Read together, they form the essential prologue. If Chapter 1 is the orientation on the first day of class, then Chapter 3 picks up the main themes of the Introduction and fleshes them out a little more.

The case studies for Parts I and II offer, as initial reference points, concrete exemplars of the challenges of exploring science and *history*, science and *religion*, and science and *scripture*. Part I, Chapter 2, "The Flat Earth Myth," challenges us to rethink what we believe about science and *history*. Part II, Chapter 4, "Mathematical Astronomy in Ancient Mesopotamia," challenges our assumptions about science and *religion*; and a final long section of the same chapter on the magi and the Messiah's star sets the complexities of science and *scripture* before us.

Together, the four chapters of Parts I and II prepare us to travel on the road of "love and the cosmos." Later chapters refer back to the basic ideas and framework introduced here.

Part II ✦ Chapter 3

Perspective: Trinitarian Theological Instinct

Figure 40: "Winter Owl" by Michael Barfield

Have you ever seen an owl in the woods on a winter's day? That's an experience of nature to remember. What are your most memorable experiences of nature? Where were you? How old were you? Who was with you? Have you shared that experience with anyone recently?

— Scripture —

Colossians 1:15-20

"For in him *all things* were created:
things in heaven and on Earth,
visible and invisible,
whether thrones or powers or rulers or authorities;
all things have been created through him and for him.
He is before *all things*, and in him *all things* hold together.
And he is the head of the body, the church;
he is the beginning and the firstborn from among the dead,
so that in everything he might have the supremacy.
For God was pleased to have all his fullness dwell in him,
and through him to reconcile to himself *all things*, whether
things on Earth or things in heaven,
by making peace through his blood, shed on the cross."

— Prayer —

Dear Father, Son and Spirit,

Teach us today to see creation with the mind of Christ. Help us to develop a theological instinct to apprehend Christ as the reality sustaining the creation. Lead us to discern Christ, through the Spirit, as actively present in, and working behind, all things in heaven and Earth, toward the eventual full expression of your almighty love.

Give us the binoculars of Trinitarian perspectives to help us see further into the wonder of your creation, through Jesus Christ our Lord.

Amen.

1. Chapter Overview

In this chapter we explore background material for the entire book organized as follows: first, we explore what kind of book this is and is not. We raise the questions of what may be gained by studying the past, and of why so many case studies are taken from the history of science. We consider how the theme "Love and the Cosmos" applies to the entire book. We explore the ideas of "Doxological Science" and "Meta Levels." We take a closer look at reasons to focus on T. F. Torrance and C. S. Lewis and the benefits of taking them as partners in our journey. And, finally, we consider what we mean by a "Trinitarian theological instinct" for science.[1]

In later chapters, we will refer back to the fundamental concepts introduced here. So this chapter stands not only on its own, as a perspective chapter for its own sake, but as a foundation for the entire book. By learning to think theologically and developing a Christian theological instinct, we will stir ourselves to love and praise God in light of his creation with all our hearts and with all our minds.

2. What Kind of Book is This?

There are many books on science and religion. Why one more? What kind of book is this? What is its distinctive approach?

2.1. Doctrine of Creation

Is this a book exploring the biblical and theological doctrine of creation, and how that understanding developed through the ages, from ancient cultures to the present? There are wonderful introductory surveys of this sort, such as an excellent and readable overview by David Fergusson or a more detailed historical study by Colin Gunton.[2] The doctrine of creation merits a full treatment all by itself. While this book scratches the surface of a doctrine of creation, that is not primarily what this book is about. However, I do recommend that any reader put these two works on your reading list.

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1. The original version of this chapter was prepared for seminary students in a course offered through Grace Communion Seminary in Spring 2020. For a video presentation see kerrysloft.com/education/trinitarian-perspectives-on-faith-and-science/.

2. David Fergusson, *Creation*, Guides to Theology Series (Wm. B. Eerdmans, 2014); and Colin E. Gunton, *The Triune Creator: A Historical and Systematic Study*, Edinburgh Studies in Constructive Theology (Wm. B. Eerdmans, 1998).

2.2. Science from a Christian Perspective

Is this book an introduction to science from a Christian perspective, perhaps for non-science majors or designed to supplement science textbooks for a Christian school? There are great books for this purpose, such as a textbook by faculty at Wheaton College.[3] Topics considered in such books include subjects like cosmic origins; the geologic history of Earth; the origin of life on Earth; the origin of species and diversity of life; and human origins. These justify a full book all by itself, and I recommend the Wheaton textbook for your reading list. We will make a point of referring to it as appropriate. While this book overlaps with its topics, our approach is different.

2.3. Apologetics

Is this book an introduction to apologetics? For some, apologetics means using science to defend the Christian faith. This is very tricky to do, and might very well be contrary to the approach taken in this book. I believe we are mistaken if we think that arguments from science can establish or prove the Christian faith. We will refer to that kind of activity as foundationalist apologetics, or foundationalist natural theology. To the contrary, however, it is not wise to give the impression that faith rests upon the foundation of natural science rather than on the revelation of God in Jesus Christ, confirmed to us in the Spirit.

On the other hand, apologetics in a proper sense means answering challenges to Christian faith that arise from science, that are spoken into our culture by scientists – sometimes quite forcefully – or that seem to be posed by scientific discoveries. There are some great books in this line.[4] Learning to answer challenges to Christian faith that arise from science would justify a well-supplied bookshelf all by itself. While this book overlaps with apologetic concerns, it is organized with a different aim.

To summarize, readers in search of critiques of science or defenses of Christianity are advised to look elsewhere; this book assumes a posture of general affirmation for both and moves on from there.

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3. Robert C. Bishop, Larry L. Funck, Raymond J. Lewis, Stephen O. Moshier, and John H. Walton, *Understanding Scientific Theories of Origins: Cosmology, Geology, and Biology in Christian Perspective*, BioLogos Books on Science and Christianity (Downers Grove, Illinois: IVP Academic, 2018).

4. For example, David Wilkinson, *God, Time and Stephen Hawking: An Exploration into Origins* (Monarch, 2001); or Alister E. McGrath, *Dawkins' God: Genes, Memes, and the Meaning of Life* (Wiley-Blackwell, 2004).

2.4. Basic Issues in Science and Religion

Is this book a survey of "Basic Issues in Science and Religion?" There are great exemplars for this type of approach, such as *Science and Religion* by Alister McGrath or *Creation Care* by Douglas Moo and Jonathan Moo, and a classic by Ian Barbour.[5] Basic issues considered in these texts include, among others, topics such as faith and reason; natural theology; mind and body; creation care; science and the religions of the world, and many more. Basic issues would justify an entire series all by itself. While we will touch on them, that is not primarily what this book is about.

2.5. Basic Issues in Science and Ethics

Is this book an examination of "Basic Issues in Science and Ethics"? Whether with respect to technology; bioethics and medicine; ecological stewardship and sustainability; science and colonialism, race, or politics; or scientific research, administration, and public policy; issues of science and ethics continually press upon us and demand our attention. No field of science is exempt from ethical considerations. There are many helpful books for this purpose, enough to fill many bookcases, and many more still need to be written.[6] Again, while this book will touch upon science and ethics, particularly the ethical imperatives embedded within cognitive love, current issues in science and ethics are not its focus or chief aim per se.

2.6. History of Science and Religion

So, is this book a survey of the "History of Science and Religion?" There are great resources for that endeavor, too, such as Ronald Numbers' *Galileo Goes to Jail and other Myths about Science and Religion*; David Lindberg and Ronald Numbers' *God and Nature*, or John Hedley Brooke's *Science and Religion: Some Historical Perspectives*.[7] Historical case studies considered in texts like these include the episodes listed here, and many more.

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5. Alister E. McGrath, *Science & Religion: A New Introduction* (Wiley-Blackwell, 2020), 3rd ed.; Douglas J. Moo and Jonathan A. Moo, *Creation Care: A Biblical Theology of the Natural World*, Biblical Theology for Life (Zondervan Academic, 2018); and Ian G. Barbour, The Gifford Lectures, 1989-1991, published in two volumes as *Religion in an Age of Science* (Harper, 1990) and *Ethics in an Age of Technology* (Harper, 1993), with vol. 1 revised as *Religion and Science* (HarperOne, 1997).

6. Considering just Lewis, one might begin with *God in the Dock: Essays on Theology and Ethics*, *The Abolition of Man*, and the Ransom Trilogy. For Torrance, see works like *Test-Tube Babies: Morals, Science, and the* Law (Edinburgh: Scottish Academic Press, 1984) and the "Related Sources" listed on its bibliographic record at *tftorrance.org/1984-432*. A helpful introduction in a Torrancean/Lewisian vein is Paul Louis Metzger, *More Than Things: A Personalist Ethics for a Throwaway Culture* (Downers Grove, Illinois: IVP Academic, 2023).

7. Ronald L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (Harvard University Press, 2009); David C. Lindberg and Ronald L. Numbers, *God and Nature: Historical Essays on the Encounter between Christianity and Science* (Berkeley: University of California Press, 1986); John Hedley Brooke, *Science and Religion: Some Historical Perspectives* (Cambridge: Cambridge University Press, 1991).

- Christianity and the Scientific Revolution
- Galileo's Trial
- Astronomy and the Plurality of Worlds
- Geology and the Age of the Earth
- Charles Darwin and Evolution
- James Maxwell and Field Theory
- Albert Einstein and the Big Bang
- Computers and Artificial Intelligence

The History of Science and Religion would merit a series of books all by itself. While we will touch on these and other case studies, that is not primarily what this book is about.

2.7. Philosophy of Science

So, is this a book on the philosophy of science? For that important subject we might read Torrance himself, starting with *Theological Science*, or Travis Stevick, *Encountering Reality*, or *Contact with Reality* by Esther Meek, or *Where the Conflict Really Lies*, by Alvin Plantinga.[8] The philosophy of science from a Christian perspective would merit a full treatment all by itself. While we will introduce some of these issues, that is not primarily what this book is about, either.

2.8. What's Left?

So what's left? A single book can barely scratch the surface, so think of this book as an introduction to all of the other kinds of books just mentioned. This book will prepare you, and I hope motivate you, to perhaps start a community reading group, or a personal reading plan, with all the works just mentioned.

Yet this book has a specific, positive and constructive mission: it is chiefly about developing Trinitarian perspectives on science and religion that we might carry into each of those other topics and their discussions. We begin here with the Trinity not as a doctrine to which we give intellectual assent, but as the ground and grammar of all reality and all our thinking. Our purpose is to develop the practice of thinking theologically about science.

Think of all of the other concerns, such as basic issues like creation care, the argument from design, or the mind and body, as different cars moving along a metropolitan highway on one

8. Thomas F. Torrance, *Theological Science* (London: Oxford University Press, 1969); #1969-263; Travis M. Stevick, *Encountering Reality: TF Torrance on Truth and Human Understanding*, Emerging Scholars (Minneapolis, Minnesota: Fortress Press, 2016), #2016-TMS-1; Esther Lightcap Meek, *Contact with Reality: Michael Polanyi's Realism and Why It Matters* (Eugene, Oregon: Cascade Books, 2017); Alvin Plantinga, *Where the Conflict Really Lies: Science, Religion, and Naturalism* (Oxford: Oxford University Press, 2011).

level, along with historical episodes like Darwin and evolution, or Einstein and the Big Bang, along with science topics from a Christian perspective, apologetics and challenges to faith. We might think of such topics as cars occupying various lanes.

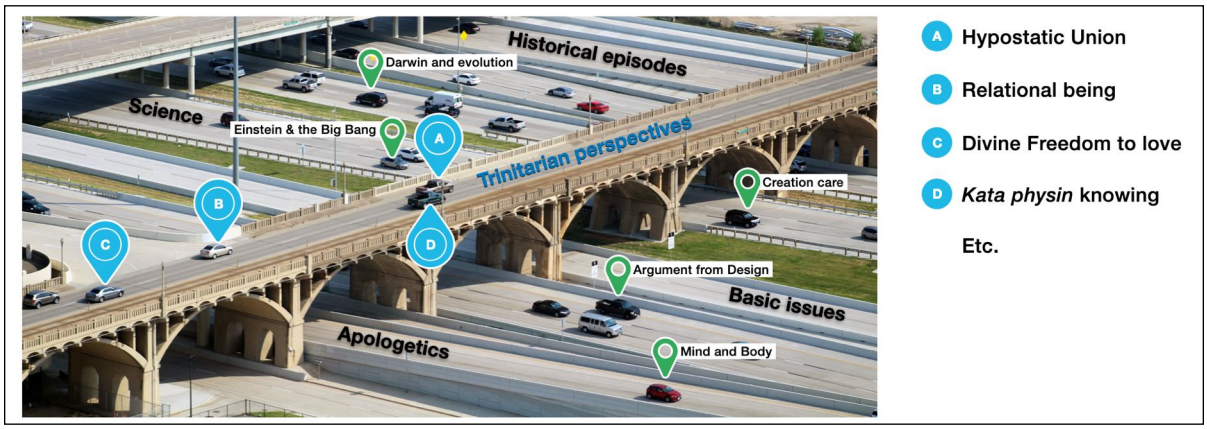

Figure 41: Trinitarian perspectives as a cross-cutting overpass. Historical episodes in science and religion and basic issues in science and faith, as well as related discussions in science and ethics or science and apologetics, comprise the ground-level lanes of traffic. The overpass represents Trinitarian perspectives on natural science such as the ones listed on the right. Photo credit: Texas Tribune.

But on a different level altogether, on a meta level as discussed in Chapter 1, Trinitarian perspectives cross above them like an overpass.[9] These perspectives have names like semantic reference (or language and reality), relational being (or onto-relations[10]), divine freedom to love (or contingent order), *kata-physin* knowing (or realist epistemology[11]), etc.

Theology and the natural sciences together may overcome epistemological and cosmological dualisms and repair cultural splits. Theology may reinforce scientific convictions on ultimate and penultimate beliefs, such as the amazing intelligibility of nature, for every day, every scientist assumes more than can be proved. Or the contingent freedom of nature, which constantly surprises us. And theology helps scientists preserve space for human significance, freedom and love on a personal level. Such ultimate and penultimate beliefs are required for the natural sciences, but may not be sustainable by the natural sciences alone. Some of the Trinitarian perspectives on science we encounter in this book, which Torrance and Lewis envisioned as part of a mutually beneficial dialogue between Christian theology and the natural sciences, are listed in Appendix D, "Perspectives."[12]

9. Cf. "… perspectives on science…" on pp. 16-22.

10. Onto-relations means that the relations of a thing are part of its nature and it cannot be known apart from those relations.

11. Personal knowledge is a realist epistemology in which knowing is an inherently personal and ethical act, requiring continual repentent re-thinking.

12. Scientism, broadly speaking, involves an illegitimate incursion or hegemony of one scientific

Our chief aim in this book is to explore what light might be thrown on science if we approach natural science with Trinitarian perspectives like these in mind. Don't worry if these terms are new to you now!

We will move back and forth between Trinitarian perspectives and carefully-selected issues or concrete historical episodes that show the perspectives in action. So our strategy, our distinctive emphasis in this book, is to constantly re-focus on the overpass, on the cross-cutting theological level, to develop a capacity for theological thinking, to learn how to exercise a Christian theological instinct – to cut across all the lanes by driving on the upper level.

3. Why Study the Past?

Next, let's address a question that no doubt has immediately occurred to you: Why are so many case studies selected from the history of science, rather than the present-day? I have claimed that this is not a course in the history of science, but the abundant use of history may surprise you. Let's consider eight advantages of selecting case studies and episodes from the past.

3.1. Focus on Perspectives

First and foremost, this book is designed to help us develop Trinitarian perspectives on science which you will be able to bring to bear upon any issue. The goal is not to adjudicate the hottest issue of the moment. We are focusing on fishing, not on the fish *per se*. There are plenty of fish in the supermarket. Give someone a fish and they eat for a day; teach them to fish and they eat for a lifetime. The fish are individual issues in science. Fishing is thinking with Trinitarian perspectives.

Current hot issues are superabundant; in-depth perspectives, however, are much more difficult to obtain. Thinking theologically is the key to the book: take time with each chapter patiently to learn how to fish, to think about science theologically. As you read, be intentional about not focusing on getting the right answers to issues in current science. This book is not written for that purpose.

To focus on thinking with theological perspectives requires extreme patience and discipline. Selecting case studies from the past may help us step back from current issues, in order to think more deeply about the theological perspectives you will eventually bring to bear on any issue in the future. Become more interested in your development of a Trinitarian theological instinct than which side you should take on any particular contemporary issue.

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discipline over another.

3.2. The Past is a Laboratory

Second, the history of science is a laboratory for the development and relations of the sciences in all kinds of interactions with all kinds of variables at play – in multiple changing disciplines, cultural settings, and perspectives. So becoming aware of a wide variety of episodes, and how they turned out, may offer us wisdom and clarity that would be difficult to obtain if our sample size of cultural settings were only n=1, limited to the present day.

Torrance explains:

> "The importance of… scientific questioning is very obvious when we study the history of science, which in all its great stages of advance has entailed radical revision of its premisses and methods. Advances can be made only through new ways of looking at things, through asking daring new questions, but new questions require corresponding changes in language and representation; they require changes in the framework of our concepts and in the logical structure of science itself. They may even call for a new meaning of the word 'understanding'. But all that is part of the pain and awe and excitement of radically new knowledge. The refusal to be bound by the rigid framework of our previous attainments, the capacity to wonder and be open for the radically new, the courage to adapt ourselves to the frighteningly novel, are all involved in the forward leap of scientific research, but in the heart of it lies the readiness to revise the canons of our inquiry, to renounce cherished ideas, to change our mind, to be wide open to question, to repent."[13]

This quotation could be framed and put on a wall next to a reading chair to remind us what this book is about. If we want a laboratory in which we can observe the production of radically new knowledge, case studies in the history of science will help us.

3.3. The Past is Drama

Third, rightly understood, the past is drama. Philip Roth writes:

> "… the unfolding of the unforeseen was everything. Turned wrong way round, the relentless unforeseen was what we schoolchildren studied as 'History,' harmless history, where everything unexpected in its own time is chronicled on the page as inevitable. The terror of the unforeseen is what the science of history hides…"[14]

What many see as definite outcomes, historical actors perceived as uncertain, and unpredictable. Outcomes were far from inevitable. History is contingent, in that it might have turned out otherwise. We must recover this sense of the past as drama.

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13. T. F. Torrance, *Theological Science*, 122.

14. Philip Roth, *The Plot Against America* (Houghton Mifflin, 2004), p. ?***. Cf. the historical fallacies noted in "How Could We Be So Wrong?" on pp. 79-82.

3.4. STORIES ARE CONCRETE, MEMORABLE, AND FORMATIVE

Fourth, historical case studies enable us to explore any theological perspective in terms of concrete examples rather than just abstract ideas. Stories can be memorable and powerfully formative. By the end of the book, you will be familiar with many stories that I hope will be meaningful to you as you develop your own internalized Trinitarian instinct for science.

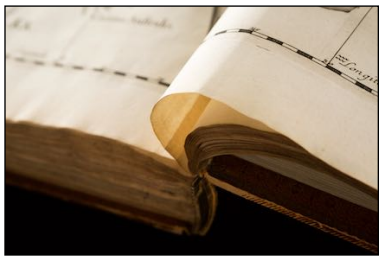
3.5. DETECT OUR CULTURE'S BLIND SPOTS

Fifth, the past helps us detect our own cultural blind spots. Historical episodes do not usually carry the same baggage and cultural filters as current issues, so we can exercise the muscles of our theological perspectives upon fresh historical episodes without as many extraneous cultural factors to disentangle, or to distract us. C. S. Lewis explains:

> "Most of all, perhaps, we need intimate knowledge of the past. Not that the past has any magic about it, but because we cannot study the future, and yet need something to set against the present, to remind us that the basic assumptions have been quite different in different periods and that much which seems certain to the uneducated is merely temporary fashion. A man who has lived in many places is not likely to be deceived by the local errors of his native village; the scholar has lived in many times and is therefore in some degree immune from the great cataract of nonsense that pours from the press and the microphone of his own age."[15]

Lewis said much the same thing in his introduction to a translation of Athanasius, reprinted in *God in the Dock*: "It is a good rule, after reading a new book, never to allow yourself another new one until you have read an old one in between…"[16]

Close Reading #1: C. S. Lewis, "On the Reading of Old Books."



Lewis continues:

> "Every age has its own outlook. It is specially good at seeing certain truths and specially liable to make certain mistakes. We all, therefore, need the books that will correct the characteristic mistakes of our own

15. C. S. Lewis, "Learning in War-Time" (1939), in *The Weight of Glory* (1949; New York: Macmillan, 1980), pp. #?***. Cf. the Lewis essays cited in the After Words for ch. 2, above, p. 83.

16. C. S. Lewis, "On the Reading of Old Books," in *God in the Dock: Essays on Theology and Ethics* (Grand Rapids, Michigan: William B. Eerdmans Publishing Company, 1970), pp. 201-202. You will be observing Lewis' "good rule" in this book, since it is also a guide to reading Lewis and Torrance, and both of them count as classic writers of old books.

> period… Nothing strikes me more when I read the controversies of past ages than the fact that both sides were usually assuming without question a good deal which we should now absolutely deny… The only palliative is to keep the clean sea breeze of the centuries blowing through our minds, and this can be done only by reading old books."[17]

A sense of history relativizes all eras, so that we do not mistake our own or any other as a Golden Age.

3.6. ADDRESS HISTORICAL CARICATURES AND MYTHS

Sixth, we need the past in order to address common historical caricatures and myths. Many people hold that there is an inevitable conflict between science and religion because they assume a number of mythical caricatures of the past. As William Faulkner said,

> "The past is never dead. It's not even past."[18]

In order to address alleged conflicts, it is essential to gain a deeper historical perspective. We have already explored one of the most pervasive caricatures rampant in our culture, the Flat Earth Myth. One of the lessons of that chapter is that a mature theological instinct needs to be informed by a knowledge of the past that goes beyond superficial retellings. Other historical myths we will address involve the trial of Galileo, the immensity of the universe, the plurality of worlds, the age of the Earth, Darwin and evolution, science and racism, and ecology and the Church. None of these could be adequately addressed without taking a long second look at what actually happened.

3.7. ENTER THE WORLDS OF C. S. LEWIS AND T. F. TORRANCE

Seventh, in this book we seek to enter the worlds of C. S. Lewis and T. F. Torrance, two of the most profound writers on science and religion in the last century. The chief objective of the book is to help you develop a Trinitarian theological instinct for science. But a secondary objective is to prepare you for lifelong reading of Torrance and Lewis, as noted above.[19] Think of the book as a seminar experience where you are guided in close-reading of select passages from their works, culminating in reflection questions that provide a structure for discussion of the passages quoted.

I suggest that right now, before reading further, begin your life-long journey exploring these two authors with two additional resources that will orient you to the life and works of each. For Torrance, read or listen to a lecture by Thomas A. Noble entitled "T. F. Torrance on the

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17. Ibid.

18. William Faulkner, *Requiem for a Nun* (New York, Random House, 1951); quoted by Woody Allen in the 2011 film, *Midnight in Paris*.

19. This section picks up where "… with T. F. Torrance and C. S. Lewis" on pp. 23-24 left off, and anticipates later in this chapter the section "Why Focus on T. F. Torrance and C. S. Lewis?" on pp. 126-140.

Centenary of His Birth."[20] For Lewis, watch "The Most Reluctant Convert: The Untold Story of C. S. Lewis." This movie, released in 2021 as the first of a proposed trilogy on the life of Lewis, covers the period of his early atheism through his conversion to Christian faith.[21]

But we are not reading either Lewis or Torrance merely for their own sake. When we read Lewis and Torrance, we access entire worlds. As we enter the now long-ago 20th-century worlds of Torrance and Lewis, we interact not just with them as individual writers but in their manifold relationships in their own communities. We will see Lewis in relationship with friends like Dorothy L. Sayers and J. R. R. Tolkien, and with contemporaries he interacted with in the Oxford Socratic Club and elsewhere. We will see Torrance in relationship with his brothers James (J. B.) and David (D. W.), and with contemporaries like Karl Barth, Michael Polanyi, Lesslie Newbigin, and many more. We approach Lewis and Torrance as ones who were then already partners in conversation with their friends and peers, not as Great Men from a Golden Age whose timeless words are authoritative simply because they said them.

The "clean sea breeze of the centuries"[22] is an open invitation for constructive criticism on all counts, only one that is, in charity and wisdom, at least as self-aware of our own communities as it is critical of other communities in other cultural worlds. For instance, we will not find it necessary to precisely emulate Lewis' early attitudes toward gender roles,[23] nor Torrance's

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20. An audio recording of the keynote presentation from the Thomas F. Torrance Theological Fellowship annual meeting in 2013 is available at #2013-TAN-2. It was later published as Thomas A. Noble, "T. F. Torrance on the Centenary of his Birth: A Biographical and Theological Synopsis with Personal Reminiscences," *Participatio* 4 (2013): 8-29, #2013-TAN-3.

21. Directed by Norman Stone, starring Max McLean and Nicholas Ralph, it is available on DVD and streaming on demand; for information see cslewismovie.com.

22. See the block quotation from C. S. Lewis, "On the Reading of Old Books," on p. 98.

23. Lewis' hierarchical views of gender roles, particularly in the Ransom Trilogy, have led some to describe him as a misogynist. This is simplistic, and a careful critique is needed, as we will see in Chapter 18, "Case Study: Reading Out of the Silent Planet / The Ransom Trilogy." By entering the world of Lewis' actual friendships, we will not be confined to males-only gatherings at Oxford. We will pay particular attention to Dorothy L. Sayers due to her sustained attention to the Trinity. MOVE TO CH 18: See Mary Stewart Van Leeuwen, *A Sword Between the Sexes? C. S. Lewis and the Gender Debates* (Grand Rapids, Michigan: Brazos Press, 2010); Monika Hilder, several works including *The Gender Dance: Ironic Subversion in C. S. Lewis's Cosmic Trilogy* (Peter Lang, 2013), and Monika Hilder, "As 'Wise as Women Are'? Gender, Science, and Religious Faith in George MacDonald's *Thomas Wingfold, Curate*, and C. S. Lewis' *Out of the Silent Planet* and *That Hideous Strength*," in Michael Partridge and Kirstin Jeffrey Johnson, eds., *Informing the Inklings: George MacDonald and the Victorian Roots of Modern Fantasy* (Hamden, Connecticut: Winged Lion Press, 2018), pp. 181-198; and the various essays in Carolyn Curtis and Mary Pomeroy Key, eds., *Women and C. S. Lewis* (Oxford: Lion Books, 2015). For example, see Crystal Downing, "The Divine Comedy of C. S. Lewis and Dorothy L. Sayers," in Curtis and Key, pp. 71-76. Gina Dalfonzo reports that Sayers' interactions with Lewis helped him to significantly modify his early views; see Dalfonzo, *Dorothy and Jack: The Transforming Friendship of Dorothy L. Sayers and C.S. Lewis* (Baker Books, 2020), ch. 4, "A Complete Blank: Of Men, Women, and Williams," and Catherine Kenney, "Sayers on Women: An Inquiry into the Fatal Subject," Part II of *The Remarkable Case of Dorothy L. Sayers* (Kent, Ohio: Kent State University Press, 1990). Of the 21 friendships profiled

occasional views about politics, economics, or the cold war.[24] Entering their historical 20th-century worlds helps us to avoid romanticizing them and to see them not as isolated authors speaking from on high, but as persons with their own stories, in transformative and dynamic relationships reflecting various communities and formative friendships.

Moreover, these two dinosaurs[25] will lead us deeper still into the past. Reading Lewis and Torrance is less intimidating when we see them in conversation with the historical figures they loved. Both Torrance and Lewis were extraordinarily familiar with writers from antiquity on up through their contemporary times. Each read regularly in both Greek and Latin as well as other modern languages. They lived in a lively mystical and intellectual communion with the saints stretching down through history. I will say more in a later chapter about my own brief encounter with Torrance during which, before responding to a question I posed, he seemed to enter into another world, communing with unseen witnesses as, with eyes closed, he recited a paragraph in Latin as if Duns Scotus were actually present with us, mildly scolding me. With a phenomenal memory, Lewis also could recite literary texts at will. To enter their worlds is not a matter of learned pedantry, to memorize the sheer number of historical figures they mention. Rather, they write with the wisdom of the ages in dialogue with a living past. Their writings cannot be read well or adequately interpreted apart from this dialogue. Indeed, this is one of our reasons for choosing them. By reading Torrance and Lewis we will better acquaint ourselves with the historical figures from whom they themselves drew inspiration.

3.8. Make Science Human and Personal

And finally, exploring the natural sciences through the light of their history can help to make them more human and personal. Instead of regarding science as a mechanical process that churns out inevitable outcomes, like packaged goods emerging from an automated assembly line, we will engage the history of science in a personal way, partaking in conversations with past figures in which we respect them as persons, appreciate their creativity and resourcefulness, and discern the highly personal character of scientific endeavor.

By the end of the book, I hope you will come to appreciate each of these benefits for yourself. Nevertheless, by no means are all the case studies taken from the past. Some episodes are relatively current, although cutting-edge case studies are generally avoided as, in contrast to a

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by Joel D. Heck in *No Ordinary People* (Hamden, Connecticut: Winged Lion Press, 2021), seven are women.

24. Torrance's sympathies with more conservative politics and capitalist economic policies are easily overstated. Assessment should be tempered by Roger J. Newell, "T. F. Torrance's Conversation with the Social Sciences and Political Theologies of his Era," *Participatio* 12: "Papers from the Pandemic" (2024): #-#; #2024-RJN-1. In addition, if TF leaned right, his brother JB leaned left. TF himself, and especially JB, were involved in reconciliation efforts in South Africa and Northern Ireland. By entering TF's world, whether in Scotland or in a global context, we will not encounter a politically homogenous or partisan culture.

25. See note 2 on page 43.

science course, it is too soon to assess hot button issues with sufficient scientific certainty, cultural depth, and theological perspective.

4. Love and the Cosmos

The central theme of this book is the question of "Love and the Cosmos."[26] It is based on the good news of Jesus Christ, the *evangelium* or *eucatastrophe* described in Chapter 1. What exactly is that good news? If we were to sketch the gospel on a napkin, it might look something like Figure 42.

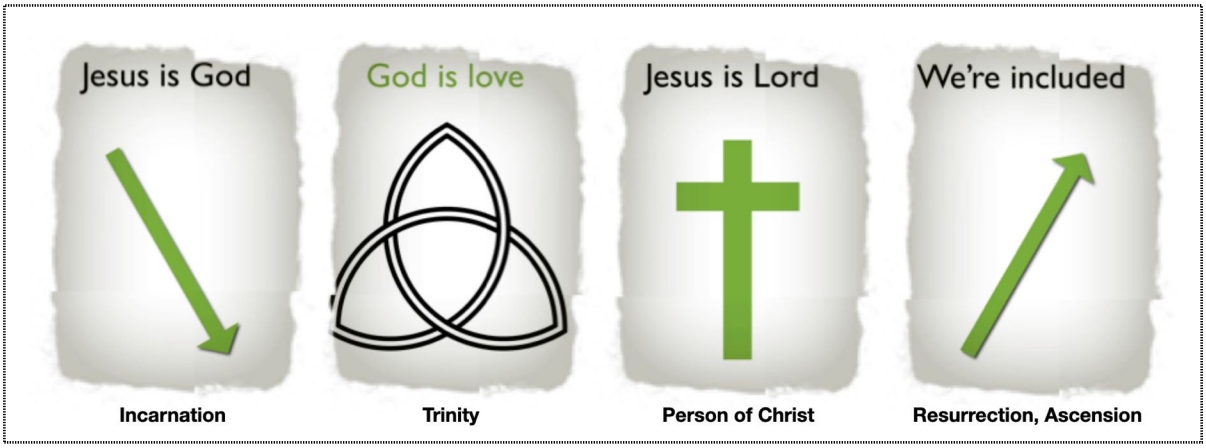

Figure 42: The Gospel on a Napkin

First, the gospel is the Incarnation. As we celebrate throughout the Advent and Christmas seasons, Jesus is Immanuel, God with us, not a God who is remote from us.[27]

Second, the gospel means God is love. Through Christ we discover that God is Triune, a communion of three Persons. What the doctrine of the Trinity means is that God is love.

Third, the gospel means that Jesus is Lord. He is the Victor; he has triumphed over every power in heaven and Earth. In the person of Christ, all things in heaven and Earth are redeemed, reconciled, re-made in a new creation, re-created from the inside out. He is the Victor over all of our sin, death, guilt, brokenness and alienation. Our brokenness did not hinder him. Death could not hold him. Through the whole course of his life, from conception to Ascension, including in the triumph of his death and Resurrection, Jesus Christ healed our wounded nature, and maintained a union of humanity with God, that is, a union of his human and divine natures in unbroken communion and love with the Father.

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26. This section picks up where "Love and the Cosmos…" on p. 10 left off.

27. Remember the music from King's College Chapel described in the "Parable" on pp. 9-10.

And fourth, the gospel means that we are included in Christ. By grace we participate by the Spirit in union with Christ. Because Christ has joined with us in our humanity, becoming one with human flesh, therefore, through the Spirit, in Christ, we are personally invited into the life of God, to participate in his life, to be recreated in his Resurrection and Ascension. Christians are those who are awakened to the present reality of Christ, and who, in the Spirit, repent and turn from our alienation to embrace in obedience the love and reconciliation he has accomplished for us. We embrace a reality which is both "already" and "not yet." We are already in Christ, but we do not yet see fully who we are in Christ. The New Creation is already on its way, manifest in the Ascended humanity of Christ and the ongoing action of the Holy Spirit.

These are four spiritual realities we proclaim in the gospel.[28] But how does this gospel apply to the cosmos?

According to New Testament writers, Christ's reconciliation and redemption do map to the cosmos, as we read earlier in the passage from Colossians. In the words of the Christmas carol, we sing that the joy of redemption reaches "far as the curse is found," and even farther.[29]

Torrance emphasized that the early church came to formulate the doctrines of both the Trinity and the Creation in light of the Incarnation. The Incarnation comes first. It demonstrates God's love for us, that God is with us in our alienation and darkness as Immanuel.[30] The doctrine of the Trinity, at bottom, is an affirmation that love is the ultimate reality and the fountain of being and order.

But can the same be said of the creation – that the doctrine of creation affirms that the cosmos was established as an act of love? What has Christ to do with the cosmos?

When we look at the cross; when we look at the cosmos, we see violence and suffering. The cosmos, this physical universe in which we live, together with atoms, photons, rocks, plants, animals, planets, neutrons, galactic clusters, billions of people, and all the cosmos contains, is as much a part of creation as we ourselves. Was the cosmos created with redemption in mind? Was it created with the Incarnation and Ascension in mind? Did the Incarnation, Resurrection and Ascension affect the cosmos?

For most modern people, the words "love" and "cosmos" do not seem to go together. Modern people are more likely to feel "lost in the cosmos" than "love in the cosmos."[31] Is there room in the cosmos for love? Despite its violence and suffering, is the cosmos a school for love?

This is a mystery, similar to the question is the cross a sign of love? Is the cosmos a place where we can learn what love is, and how to love? Is the cosmos a place where love eventually

28. These "four spiritual realities" are intended as a Trinitarian alternative to "The Four Spiritual Laws," a tract developed by Bill Bright, of Campus Crusade for Christ, often used by evangelicals for evangelism in the 20th century.

29. Isaac Watts, "Joy to the World," (1719); hymnary.org/text/joy_to_the_world_the_lord_is_come.

30. Cf. Thomas F. Torrance, *When Christ Comes and Comes Again*, pp. 20, 40, 41; available at kerrysloft.com/theology/christmas-reflections-immanuel-god-with-us/.

31. Walker Percy, *Lost in the Cosmos* (Farrar Straus & Giroux, 1983).

will come to its full expression? Is that what is meant by New Creation? Is the New Creation inaugurated by Christ both already real and not yet fully revealed? What does Trinitarian faith have to do with "love and the cosmos?"

I encourage you while reading every chapter in this book to reflect on connections between Trinitarian faith and the mystery of love and the cosmos. Chapter 1 introduced four dimensions of our response to God's love for the cosmos: *doxological* love, *cognitive* love, *ethical* love, and *eschatological* love.[32] "Love and the Cosmos" is the hidden thread running throughout this entire work, the musical soundtrack that will break through if we listen attentively enough to hear it.

5. Doxological Love[33]

The icon of the winter owl for this chapter symbolizes doxological love (Figure 40 on p. 89). In the Introduction, we took note of "Doxological Love" as the daily experience of the reality of every creature and every aspect of the natural order, when received with wonder, humility, awe, and gratitude (p. 10). We illustrated doxological praise of the Creator with a photograph of the stars from one of the best dark sky locations in the United States (Figure 4 on p. 16).

In the most general sense, by doxological love we refer to the *daily experience* of nature, whether prior to theoretical study or, for scientists and creation workers, the *regular practices* of natural science and of any activity or occupation involving day-to-day contact with nature.

In my own experience in the natural sciences, I recall activities as varied as preparing for and cleaning up after chemistry labs; monitoring remote cameras in order to record wolf behaviors; dissecting a human cadaver; conducting daily rounds in a medical clinic; examining rock outcrops on geological field trips; leading students on zoo tours and pointing out, for example, the remarkable coal-black foot-pads of the polar bear; staying up through the night hours to observe a meteor shower or holding a telescopic skywatch after a planetarium show; etc. Apart from activities in the sciences themselves, I recall daily experience of nature as varied as suddenly coming upon a natural wonder – a canyon or mountain range – after a long day of approach; a day's ride on a horse trail; bottle-feeding a calf; rising in the wee hours of the morning to go watch bald eagles at sunrise on a lake a few hours from home; picking strawberries and harvesting apples; fishing in our pond; washing a baby; organizing a rock collection; exploring an unimproved cave; raising puppies; listening to cows munching ground-corn; chopping wood in the wintertime; admiring wildlife art with an artist friend, and so on. These are some of the experiences of wonder, humility, awe, and gratitude for nature that are meaningful to me. Comparing our lists would be a great way to start a conversation together.

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32. See ""Love and the Cosmos…"" on p. 10.

33. Revise this section with illustrations from other figures in, e.g., ornithology, paleontology, astronomy, meteorology, zoology, health care, and chemistry.***

When I think of doxological knowing, I often recall the poem of Walt Whitman, "There was a Child Went Forth." As a former secondary science educator, I found this poem inspirational for my efforts to incorporate experiences of nature into the curriculum, and I know I was not alone in my admiration for it. Here are some relevant lines:

> "There was a child went forth every day,
>
> And the first object he looked upon and received with wonder or pity or love or dread, that object he became,
>
> And that object became part of him for the day or a certain part of the day.... or for many years or stretching cycles of years.
>
> The early lilacs became part of this child,
>
> And grass, and white and red morning glories, and white and red clover, and the song of the phœbe-bird,
>
> And the March-born lambs, and the sow's pink-faint litter, and the mare's foal, and the cow's calf, and the noisy brood of the barn-yard or by the mire of the pond-side...
>
> and the fish suspending themselves so curiously below there... and the beautiful curious liquid... and the water-plants with their graceful flat heads... all became part of him.
>
> And the field-sprouts of April and May became part of him.... wintergrain sprouts, and those of the light-yellow corn, and of the esculent roots of the garden,
>
> And the appletrees covered with blossoms, and the fruit afterward.... and woodberries.... and the commonest weeds by the road; ...
>
> And all the changes of city and country wherever he went....
>
> The hurrying tumbling waves and quickbroken crests and slapping;
>
> The strata of colored clouds.... the long bar of maroontint away solitary by itself.... the spread of purity it lies motionless in,
>
> The horizon's edge, the flying seacrow, the fragrance of saltmarsh and shoremud;
>
> These became part of that child who went forth every day, and who now goes and will always go forth every day,
>
> And these become of him or her that peruses them now."

Whitman's poem represents, for me, how daily encounter with nature profoundly shapes us in our deep heart's core.[34]

34. "Deep heart's core" is an intentional allusion to "The Lake Isle of Innisfree" by William Butler Yeats,

A culture's conceptions of nature and of the nature of science on this daily, experiential level are often revealed most clearly in its approach to science education. Consider Anna Botsford Comstock, a slightly later contemporary of Whitman. Comstock played a prominent role in the "nature study" movement to reform American science education in the early 20th century, particularly through her book, *Handbook of Nature Study*. Continuous in some ways with the long-standing field of science known as natural history, nature study rejected an approach to biology that was then characterized by a preoccupation with taxonomy and systematic classification – and a concomitant dry style and recitation-oriented pedagogy. In contrast, nature study emphasized a holistic and environmental approach that strove to understand each animal and plant, not merely as a specimen in and of itself, but in the context of its habitat. Nature study rejected an artificial, systematic sequence of instruction that would start with the most simple organisms, considered in abstraction, and then advance toward the more complex. Rather, nature study favored beginning with familiar living things in the student's locality, within the reach of direct, immediate experience. Children were encouraged to carefully observe and interact personally with nature on a regular basis under the motto "study nature, not books." In nature study, pupils could engage the world around them in a manner that was filled with meaning, consistent with the imagination and the fine arts, not to mention agriculture, rather than simply in terms of a standardized, place-less, text-centered approach to biology. Field trips and the preparation of collections by students who acquired their own specimens, cultivation of school gardens, visits to zoos, public lectures, illustrated nature books, field guides, public museums, and university extension programs at land grant universities all helped to spread the ideals of nature study. Nature study was congenial with rural and agricultural settings, and encouraged efforts to conserve wilderness, natural areas and public parks. The influence of the nature study movement is evident today in extracurricular programs such as scouts, kindergarten "show and tell" times, and various conservation and environmental organizations.[35]

We can regard these approaches and practices as illustrative of knowing nature from the standpoint of doxological love, an affirming openness to receive the reality of creation with wonder and gratitude day-to-day. To the Christian, the day-to-day experience of creation is a spiritual vocation whether the child going forth or the scientist in her study recognizes it as such or not. For, with conscious awareness or not, we experience nature not as a brute fact, not just as a mere given, but as a daily mercy created by the free grace and wisdom and love of God. When anyone, not just a Christian believer, receives an experience of the reality or beauty of any creature or any aspect of the natural order with wonder, humility, awe, and gratitude, we are adapting our souls to external reality and thereby praising the Creator through the practice of doxological love.

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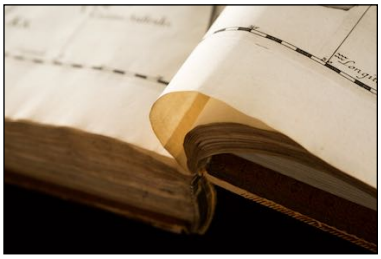
another poem which represents doxological love for me.

35. Anna Botsford Comstock, *Handbook of Nature Study* (Ithaca, New York, 1911, revised 1939). See Sally Gregory Kohlstedt, *Teaching Children Science*. Another example of educators seeking to place an emphasis on the daily reality of science is Richard Louv, *Last Child in the Woods: Saving Our Children from Nature Deficit Disorder* (Algonquin Books, 2008).

Close Reading #2: Doxological love: Job 38-41; Psalms 8, 19, 33, 96-98, 104, 147, 148; Proverbs 8:22-36; Isaiah 11:6-9, 65:17-25; Deuteronomy 29:22-28; Hosea 2:20-23, 4:1-6; 1 Corinthians 8:6; Colossians 1:15-20; Hebrews 1:1-4; Revelation 1:17, 21:5-6.



From the Hebrew scriptures of Job and the Psalms to the New Testament depiction of the New Creation, the Bible encourages us to attend to and take delight in the world God has made. Even the eternal, transcendent God himself, incarnate as Jesus of Nazareth, working as a carpenter, became intimately familiar with the ways of wood and stone. It would be good to meditate upon a short list of such passages, to read them all in succession on a single occasion. Here let's pause to consider but one example.

— Scripture —

> "Praise the Lord! How good it is to sing praises to our God, how pleasant and fitting to praise him! He determines the number of the stars and calls them each by name. Great is our Lord and mighty in power; his understanding has no limit. He covers the sky with clouds; he supplies the Earth with rain and makes grass grow on the hills. He provides food for the cattle and for the young ravens when they call." (Psalm 147:1, 4-5, 8-9)

How many sciences touch upon the observations recorded in these verses from Psalm 147? There's astronomy ("number of the stars"), and meteorology ("covers the sky with clouds"), and agriculture ("supplies the earth with rain"). The chapter icon (p. 89) depicts an owl rather than "young ravens when they call," but it's in the same spirit as the Psalm. In Psalms like this one, and numerous other passages which contemplate nature, God's redemption of his people is seamlessly set within the story of his covenant with creation. The Bible cries out, as the old hymn proclaimed, "This is my Father's world." He cares for it, "providing food for the cattle," and he redeems it as well.

Pascal wrote that "absolute novelty belongs to God alone."[36] The joy we experience as we encounter nature or discover something new comes from God, whether we realize it or not. Proverbs 25:2 asserts:

> "It is the glory of God to conceal a matter; but the glory of kings is to search things out."

When scientists discover hidden order in the universe, they are thinking God's thoughts after him, searching out hidden things as the glory of kings. This opportunity for discovery, combined with an ability to use one's discoveries in service of love toward others, makes science exciting.

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36. Pascal***

Scientists fulfill a deep human calling to act as priests and kings in the creation. Johann Kepler often described science as thinking God's thoughts after him. The scientist is a "priest of nature," interpreting the "book of nature."[37] Nature is mute, at least in the mode of human speech, so the understanding of the scientist gives nature its voice.[38] The scientist makes nature known, seen, and understood.

By doxological love, then, we first of all mean not science that is explicitly applied to praise of God, apologetics, or evangelism, but the everyday experience and excitement of science, of thinking God's thoughts after him, of searching out the intelligible order he has built into the creation, whether the scientist attributes it to God or not.

In doxological astronomy, we affirm the desire of Ptolemy, the great astronomer of antiquity, who sought to shape his soul through contact with the natural order of the motions of the stars and planets:

> "With regard to virtuous conduct in practical actions and character, this science [of astronomy], above all things, could make humans see clearly; from the constancy, order, symmetry and calm which are associated with the divine, it makes its followers lovers of this divine beauty, accustoming them and reforming their natures, as it were, to a similar spiritual state."[39]

No less than a monk tilling the ground for a monastic garden, we regard Ptolemy's astronomical activity as a spiritual vocation in the garden of the cosmos, centered upon the mundane tedium of calculating planetary motions and the day-to-day challenges of crafting ever-more faithful geometrical models. An anonymous epitaph attributed to Ptolemy reads:

> "I know that I am mortal and living but a day.
> Yet when I search for the numerous turning spirals of the stars,
> I no longer have my feet on the Earth,
> But am beside Zeus himself,
> filling myself with divine nurturing ambrosia."[40]

We join the Psalmist in praise, affirming:

> "He determines the number of the stars and calls them each by name" (Psalm 147:4).

In *Harmony of the Universe* (1619), one of the most innovative works in the entire history of astronomy, Johann Kepler exulted:

> "Great is our Lord and great His virtue and of His wisdom there is no

37. Kepler...

38. See the discussion of the "two books" in "… perspectives on science…"" beginning on p. 16.

39. G. J. Toomer, ed. and trans., *Ptolemy's Almagest* (Berlin: Springer-Verlag, 1984), Book I, chapter 1, p. 36-37.

40. Anonymous epitaph attributed to Ptolemy...***

number: praise Him, ye heavens, praise Him, ye Sun, Moon, and planets, use every sense for perceiving, every tongue for declaring your Creator. Praise Him, ye celestial harmonies, …: and thou my soul, praise the Lord thy Creator, as long as I shall be: for out of Him and through Him and in Him are all things; for both those whereof we are utterly ignorant and those which we know are the least part of them; because there is still more beyond. To Him be praise, honour, and glory, world without end. Amen."[41]

Figure 43: Herschel concert poster, New Rooms, Bath. On display at the Herschel Museum, Bath; on loan from the Holburne Museum.

Night after night, William and Caroline Herschel observed the skies from their home in Bath, England, searching for double-stars and comets with the superbly-crafted telescopes they made themselves. In the process they cataloged thousands of nebula, or cloudy patches, not to be mistaken for comets. A century later, these nebula were revealed to be clouds of interstellar gas or even galaxies beyond our own Milky Way.[42] Figure 43 shows a concert poster advertising a benefit concert organized by the Herschels, a performance of music from Handel's *Messiah* featuring solos by William and Caroline and others.

Jennifer J. Wiseman studies "star-forming regions in our galaxy using a variety of tools, including radio, optical and infrared telescopes. She has a particular interest in dense interstellar gas cloud cores, embedded protostars, and their related outflows as active ingredients of cosmic nurseries where stars and their planetary systems are born." Her scientific work represents this daily experience of doxological love for the creation in her effort to achieve fidelity to the realities she explores. She is a Senior Project Scientist for the Hubble Space Telescope and previously directed the Laboratory for Exoplanets and Stellar Astrophysics.[43]

41. Johann Kepler, *Harmony of the Universe* (1619), ***

42. We discuss the story of these nebula below on p. 605.

43. "Jennifer J. Wiseman," NASA website, science.nasa.gov/people/dr-jennifer-j-wiseman. Wiseman serves as a Fellow of the American Scientific Affiliation and on the BioLogos Board of Directors.

C. S. Lewis owned and regularly used a backyard telescope. In his letters and correspondence, he frequently mentioned the seasonal appearance of constellations and the weekly configuration of planets.[44]

Figure 44: Doxological Astronomy: the Great Nebula in Orion. Photo credit: Greg Hill.

A modern doxological amateur astronomer is Greg Hill, worship pastor of a church in Norman, Oklahoma. On clear nights he captures photographs of galaxies and nebula from deep space, voicing Creation's praise (Figure 44). Through countless hours at the telescope and computer, Greg seeks to number the stars and call them each by name.

Astronomy is one of the natural sciences in which amateurs still make substantive contributions, working with and alongside professionals. Ornithology is another. With apps like Merlin and eBird from the Cornell Laboratory of Ornithology, the observations of birdwatchers around the world are providing scientists with a richness of data about bird migrations and populations that was undreamed of only a few years ago. Whether as individual birdwatchers or in school groups or birdwatching clubs, ordinary people from all walks of life are participating in public science activities involving birds and their habitats.[45]

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44. Lewis, telescope

45. Cornell Laboratory of Ornithology, www.birds.cornell.edu; Merlin, merlin.allaboutbirds.org; eBird, ebird.org/explore.

Another doxological creation worker is Mike Morrison, President of Grace Communion Seminary. He catches birds near his home in La Verne, California. He uses nets so that he can band them with unique numbers and study how they move from one place to another. He participates in the MAPS program (Monitoring Avian Productivity and Survivorship) coordinated by the Institute for Bird Populations. There are several hundred stations around the county that standardize their methodology so comparisons can be made year to year and place to place. You can see a list of what he has caught, with a few photos, at his bird-banding website. Mike comments,

> "I like to feel the heartbeat of a hummingbird, feel the spunk of an Oak Titmouse, feel the strength of a California Scrub-jay. I want to know how they move around in their environment, how long they live, how their family is doing."[46]

Figure 45: Doxological birding. Credit: Mike Morrison.

Many admirers of the great 20th-century evangelical John Stott might be unaware that he traveled the world in pursuit of his passion for birds. In 1999 he published a book, with an accompanying CD, in which he sought to heighten awareness of birds.[47] More recently, during the Covid 19 pandemic many people around the world discovered the benefits of paying attention to birds. Courtney Ellis describes birdwatching as her chief spiritual discipline, a form of contemplative prayer.[48]

46. Personal communication. Michael Morrison, sites.google.com/view/birdbanding/home.

47. John Stott, *The Birds Our Teachers: Essays in Orni-Theology* (Harold Shaw Publishers, 1999).

48. Courtney Ellis, *Looking Up: A Birder's Guide to Hope Through Grief* (InterVarsity Press, 2024). Cf. Margaret Renkl, *Late Migrations: A Natural History of Love and Loss* (Milkweed Editions, 2019); Margaret

As with astronomy and ornithology, so with other sciences. The daily effort to understand and articulate the order and beauty and reality of nature is a divine vocation.

Charles Darwin devoted eight years of his life to dissecting barnacles.[49] Darwin sought to number the barnacles and call them each by name. When Darwin's young son visited a friend and saw no evidence of dissections going on in the house, he asked, "Where does your Daddy do his barnacles?" 8 years!

What we as Christians call the doxological experience of science refers to the scientist's daily experience, understanding, and practices as a scientist. Again, it doesn't matter if the scientist is a believer or not, or if they are consciously thinking of their work as worship or not. As Christians, we affirm that Darwin's passion and interest in understanding these little critters was God-given, just as much as Kepler's desire to understand the motions of the heavens. The work of every scientist to understand the least part of nature is an act of glorifying God, whether they are able to recognize it as such or not. Darwin's science gave voice to the barnacles' praise.

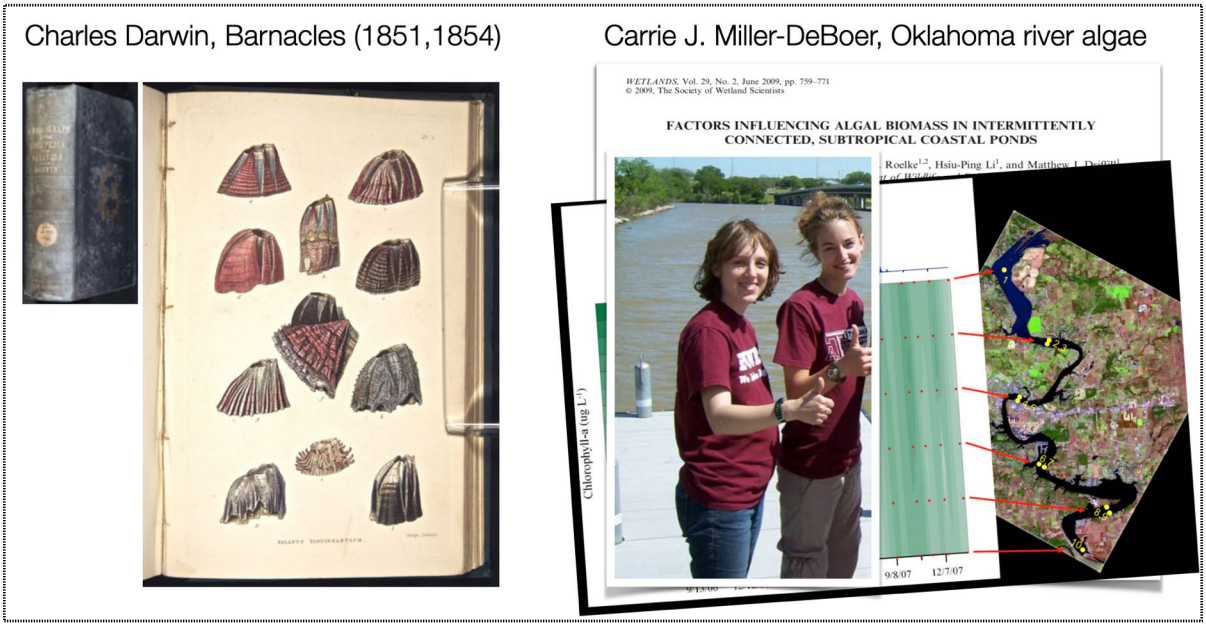

Figure 46: Doxological biology: Charles Darwin and Carrie Miller-DeBoer

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Renkl, *The Comfort of Crows: A Backyard Year* (Spiegel & Grau, 2023); and Joan E. Strassmann, *Slow Birding: The Art and Science of Enjoying the Birds in Your Own Backyard* (TarcherPerigee, 2022).

49. Charles Darwin, *Monograph on the Sub-Class Cirripedia: The Lepadidae; or, Pedunculated Cirripedes* (1851), F339.1; and Charles Darwin, *Monograph on the Sub-Class Cirripedia: The Balanidae (or Sessile Cirripedes); The Verrucidae, etc.* (1854), F339.2.

Carrie Miller-DeBoer has published several articles on algae in Oklahoma and Texas rivers. She is passionate about understanding these little algae and what they mean for the river systems they inhabit. Carrie sees her love of algae as an affirmation of the wonders of what God has made. Her science gives voice to the algae's praise.

Figure 47: Marvin Mann with Governor and visiting children. Willis Creek Ranch, Kirksville, Missouri.

In his *Church Dogmatics*, Karl Barth affirmed,

> "a really good horseman cannot possibly be an ungodly person."[50]

Some people would be startled to find this superlative assertion in the major work of the 20th century's most significant theologian, but not someone who has reflected on doxological love. George MacDonald, J. R. R. Tolkien, and T. F. Torrance also held a strong affection for and admiration of horses.[51] I regard anyone who works lovingly and wisely with horses, like my father and my brother-in-law Marvin Mann, as doxological creation workers giving voice to the horse's praise.

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50. Karl Barth, *Church Dogmatics* III.4, p. 352.

51. For MacDonald, see in particular *A Rough Shaking* (London: Blackie & Son, 1891). Rolland Hein's biography of MacDonald states that riding horses was MacDonald's favorite outdoor activity (p. 154). Robert Walker, a nephew of TFT, related to me that TFT also loved horses (personal communication).

Niels Steno, often recognized as a founder of geology, approached his investigations of gems, fossils, and strata as a way to acknowledge the power and wisdom and love of God. After completing his geological works, he became a bishop.

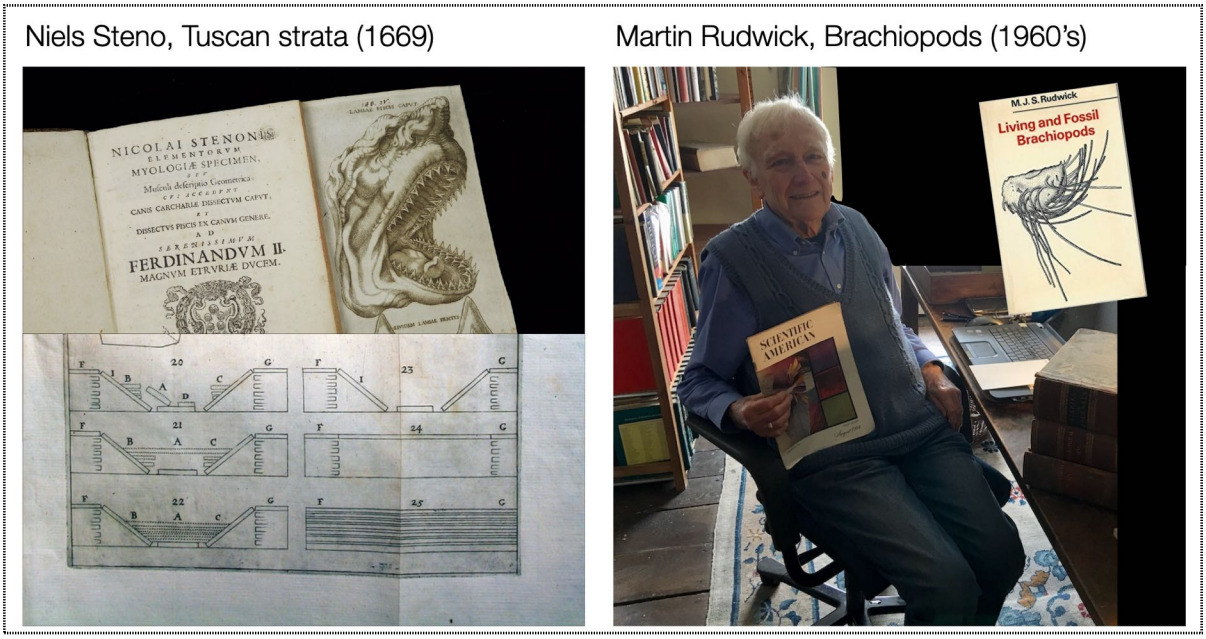

Figure 48: Doxological geology: Nicolaus Steno and Martin Rudwick

Martin J. S. Rudwick, the foremost historian of geology, started out as a paleontologist who, on the basis of his study of little brachiopods, published a book and several articles in the 1960's arguing for a Permian mass extinction and continental drift years before those ideas were accepted. Martin's science gave voice to the brachiopod's praise. Martin sees the entire history of geology as consistent with his Christian faith. In his mid-90's, as shown here in his study in 2019, Martin remains active in the Anglican tradition.

In the 1981 movie *Chariots of Fire*, the missionary-to-be Eric Liddell explains to his sister Jenny why he is delaying his trip to China in order to run in the Olympics:

> "God made me for a purpose... for China. But he also made me fast. And when I run, I feel his pleasure. To run is to honor him. Not to run would be to hold him in contempt."[52]

This is the doxological level of Creation in a nutshell. Just like Jenny, as Christians we are called to appreciate the everyday work of scientists in the same way. "When I photograph the stars," I feel his pleasure. When Darwin dissected barnacles for eight years, he felt the

52. Eric Liddell, as dramatized in the film *Chariots of Fire* (1981), directed by Hugh Hudson with screenplay by Colin Welland.

pleasure of God, whether he recognized it as such or not. Can we feel God's pleasure when someone understands the river algae? Let's put ourselves in the position of Jenny: Do we appreciate that to understand the river algae is to honor God? When I band a bird, I honor him. To chase the storm is to honor God, whether the meteorologist realizes it or not. When I comprehend the brachiopods, I feel his pleasure.[53]

We've just explored several examples of scientists and creation workers who in their day-to-day work engage their passion to understand nature. We who are Christians may appreciate the day-to-day practice of scientists as an indwelling of nature as "creation," which has its being and nature by the power and wisdom and love of God and is worthy of a lifetime of study and gratitude.

In the next section, we'll begin to look at how those who have experienced nature on this foundational level of doxological love may begin to share perspectives on a meta level with practitioners of other sciences.

6. META LEVELS

In the Introduction, we discussed horizontal relations between sciences mediated via perspectives that resonate on a meta level, above the foundational level of doxological love. Any perspective on a meta level shared in common between two sciences creates a space for constructive dialogue. We diagrammed it as shown in Figure 49 (which repeats Figure 7 on p. 20).[54]

B. Theological science	<– Perspectives –>	B. Natural science
A. God's Word (Bible)	<– Doxological Love –>	A. God's Works (Natural phenomena)

Figure 49: Perspectives mediate mutually beneficial dialogue between different domains on a meta level. Level A in green; Meta Level B in blue.

53. We have just mentioned Kepler, Darwin and Steno, each a major figure in the history of science. Don't worry when names are new to you. Appendix A has some timelines to help you get oriented. There is no need to already know about historical figures, nor to memorize them. In addition, Appendix B, "Conversations," suggests an activity that will offer you opportunities to explore what we are calling the doxological level of Creation through the eyes of contemporary scientists and other creation workers. They do not need to be Christian believers for you to understand their day-to-day experience and appreciate what they do, in your own doxological perspective. Perhaps in such conversations, by your appreciation of what they do, they may come a step closer toward comprehending that God takes pleasure in their work, and is honored by it. Scientists, believers or not, are carrying out the mission of God, interpreting the book of nature and thinking God's thoughts after him, as priests and kings of creation, voicing Creation's praise.

54. This section picks up the discussion where ""… perspectives on science…"" on pp. 16-22 left off.

6.1. Horizontal Relations

Let's take the blue rectangles in that diagram and represent them as three-dimensional boxes. With Figure 50 we can suppose that any two sciences or subject areas have begun to resonate with one another, creating a horizontal relation.

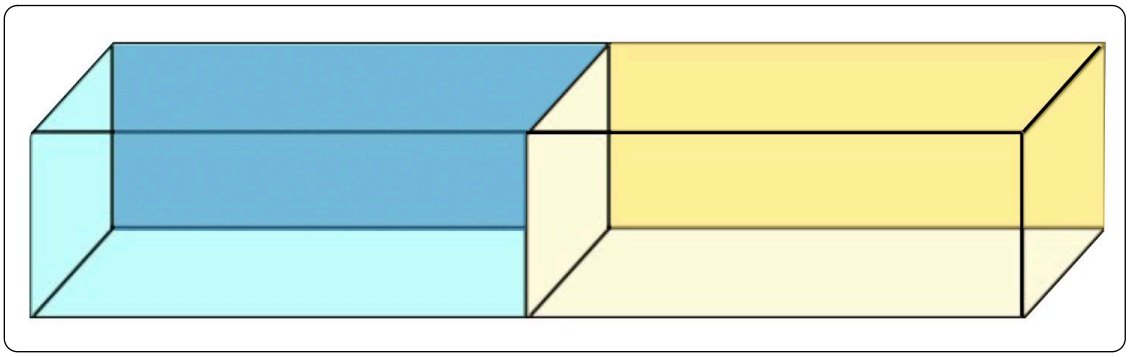

Figure 50: Sciences as boxes side by side

The left side of the yellow box is shared with the right side of the blue box. Instead of intersecting at a single point or line, there's a wider surface area connecting the two, representing a sustained mutual dialogue. While maintaining the integrity of each box, the larger surface of the side shared in common provides an opportunity for natural relations between them which may play out in a creative fashion.

The boxes may represent separate sciences or adjacent subject areas within a single science. Horizontal relations may occur at any scale, whether relating subject areas within a science, or as relating two entirely separate sciences. Indeed, over time, the former may develop into the latter.

In Chapter 12, "Case Studies: Interdisciplinary Relations," we will explore the horizontal resonances and beneficial interactions of astronomy, music, art, and theology in the world of Galileo.

6.2. Vertical Relations

In addition to horizontal relations, sciences and subject areas may also be related vertically. We will refer to vertical relations as *stratification*. As with horizontal relations, stratification occurs at many scales; e.g., between two or three different levels within a single science, or between two or three or more separate sciences.

An example of stratification between different levels within a single science is the vertical relation between the doxological level of daily experience and the meta level of a perspective, as described in the Introduction. On a larger scale, a similar dynamic of levels and meta-levels may characterize vertical relations between entirely separate sciences.

In Torrance's thinking, two paradigm examples of stratification represent each of these two scales: first, his discussion of three levels within the single science of theology for our knowledge of the Trinity (doxological, economic, and ontological)[55]; and second, stratification between the different sciences of physics, chemistry, biology, humanities, and theology.[56] As we shall see, C. S. Lewis discussed a hierarchy of different sciences as well. In Part X: "Multilevel Reality," we'll explore stratification more deeply, see how these varied scales complement one another, and have much more to say about levels and meta levels in the thinking of both Lewis and Torrance as well as others. The first chapter of that part will examine stratification involving no more than two levels, and the second chapter of that part will explore horizontal and vertical relations between multiple sciences.

But all that still lies ahead. Here, in the next two sections, we will introduce two varieties of vertical relations: *subordination* and *subalternation*. Then, to ground our thinking in a concrete example, we'll look at stratification in Torrance's discussion of the Trinity, and then apply that to the doctrine of creation.

6.3. STRATIFICATION: SUBORDINATION

Aristotle addressed relations between the sciences at length in the *Posterior Analytics*, which has prompted discussions of the unity and relations of the sciences ever since. Aristotle considered several different kinds of relations between the sciences, both horizontal and vertical. The core idea of vertical relations is the distinction between what Aristotle called knowledge of the "reasoned fact" (*quia*) and knowing the "reason why" (*propter quid*). The science on the higher level provides the "reason why" for what is known on the lower level as organized factual knowledge or day-to-day experience:

> "The *reason why* differs from the *fact*... when each is considered by means of a different science. And such are those which are related to each other in such a way that the *one science is under the other*, e.g., optics to geometry, and mechanics to solid geometry, and harmonics to arithmetic, and star-gazing to astronomy. Some of these sciences almost bear the same name – e.g., mathematical and nautical astronomy, and mathematical and acoustical harmonics. For here it is for the *empirical scientists* to know the fact and for the *mathematical scientists* to know the reason why; for the latter have demonstrations of the explanations, and often they do not know the fact, just as those who consider the universal often do not know some of the particulars through lack of observation."[57]

55. CDG, ...***

56. In *Space, Time, and Resurrection* (p. 188), Torrance explains: "the various sciences themselves, ranging from physics and chemistry to the humanities and theology can be regarded as constituting a hierarchical structure of levels of inquiry which are open upwards into wider and more comprehensive systems of knowledge but are not reducible downwards."

57. Aristotle, *Posterior Analytics*, Book I, ch. 13, 78b33-79a8. Translated by Jonathan Barnes. In *The Complete Works of Aristotle: The Revised Oxford Translation*, ed. Jonathan Barnes, Bollingen Series (Princeton: Princeton University Press), vol. 1, p. 128. Italics added, with slight modifications for clarity.

This passage is not entirely clear and was debated in the centuries that followed. Yet for our purposes at present, it is sufficient to note that the science on the lower level is more empirical and knows the organized "facts," while the science on the meta level is more theoretical and knows the "reason why," i.e., the "demonstrations of the explanations," but does not comprehend all of the particulars of the science on the lower level. It's also helpful to note from the start that the levels are not absolute, but relative to one another and relative to the specific questions being addressed.

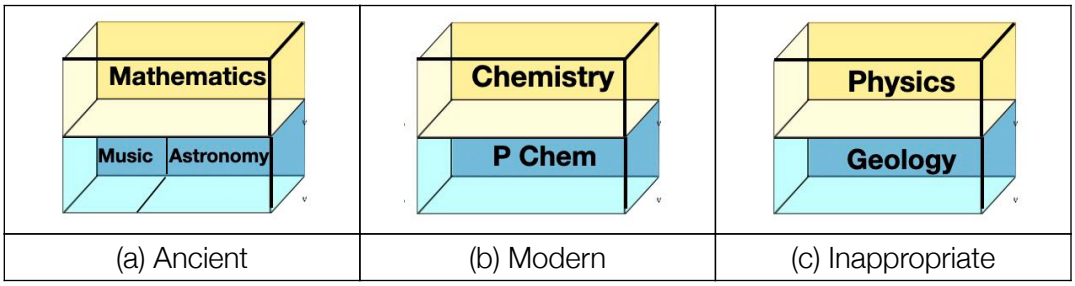

Figure 51: Subordination of sciences

We may characterize one form of vertical relation as *subordination* of one science or subject area to another, as when "one science is under the other." Figure 51 offers three examples. Astronomy and music, for example, were regarded as sub-fields of mathematics from antiquity up through the era of Copernicus, Kepler, and Galileo (Figure 51a). In this example, mathematics provided theoretical explanations or reasons why for the patterns of experience investigated in music and astronomy.

In a modern disciplinary configuration, a general science like chemistry provides the overall "reason why" for the narrower subject areas within it, such as physical chemistry or organic chemistry. Physical chemistry, organic chemistry, and the like investigate their own additional questions and super-added subject matter, but can legitimately and validly import at will all the principles already known to apply more generally in chemistry (Figure 51b).

In these two cases, we might find it more helpful to invert the diagrams and think of the field with superadded conditions (e.g., music, astronomy, physical chemistry) as lying above the other science (e.g., mathematics or general chemistry), resting on the other science's theoretical foundation as a basis for investigations in the superadded fields.

Finally, in Chapter 16, "Case Study: Geohistory," we will examine the famous controversy of Lord Kelvin and the age of the Earth to illustrate cases when subordination is imposed and suppresses the legitimate scope and methods of the subordinate science (Figure 51c). Perhaps the discipline of geology encompasses super-added considerations outside of physics, so that the theoretical perspectives of physics do not necessarily transfer directly into the theoretical

perspectives of geology? In such cases, horizontal rather than vertical relations might have been sought after instead.[58]

And what if, as Galileo and his contemporaries argued, music and astronomy also include non-mathematical considerations, rather than being entirely subordinated to mathematics? The total overlap of disciplines or subject areas envisioned in subordination raises many difficulties.

In general, to avoid inappropriate acts of subordination, perspectives from one discipline need first to be translated and developed into perspectives founded within the other discipline before they can be applied to the level of daily experience in the other discipline. Ordinarily, one applies a perspective from the meta level of Science #1 (Figure 52, upper left) to the daily experience level of Science #2 (lower right) indirectly, by first going through the Perspectives meta level of Science #2 (upper right). To go directly from "B. Science #1" to "A. Science #2" risks inappropriate subordination.

B. Science #1	<– Perspectives Meta Level –>	B. Science #2
A. Science #1	<– Daily (doxological) Level –>	A. Science #2

Figure 52: Perspectives mediate mutually beneficial dialogue on a meta level. Level A in green; Meta Level B in blue. The sciences-as-boxes metaphor works on the meta level (B, blue) where there is a resonance between the perspectives developed in two different sciences.

We might call the fallacy of inappropriate subordination the root error of "scientism." Even if correct, in a best-case scenario, the conclusions reached by cross-expertise violations yield accidental knowledge, rather than knowledge according to nature. Determining the conditions for when one science may be appropriately subordinate to another has been a matter of much debate ever since Aristotle raised these questions.[59]

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58. Joe D. Burchfield, *Lord Kelvin and the Age of the Earth* (Science History, 1975; reprinted with a new afterword, Chicago: University of Chicago Press, 1990).

59. In multiple chapters below, we will resume this discussion and explore these questions more deeply. [Note for later: James Weisheipl, "Classification of the Sciences in Medieval Thought," *** (Washington, D. C.: The Catholic University of America Press, 1985).]

6.4. STRATIFICATION: SUBALTERNATION

A second type of vertical relation is *subalternation*. In contrast to the subordination of one science as a whole to another, subalternation occurs when a science is only partially dependent upon the other. Figure 53a represents the "reason why" as "P." In these diagrams, "P" is a perspective imported from the science on the meta level in some area where the meta level science partially but not completely overlaps the science on the lower level.

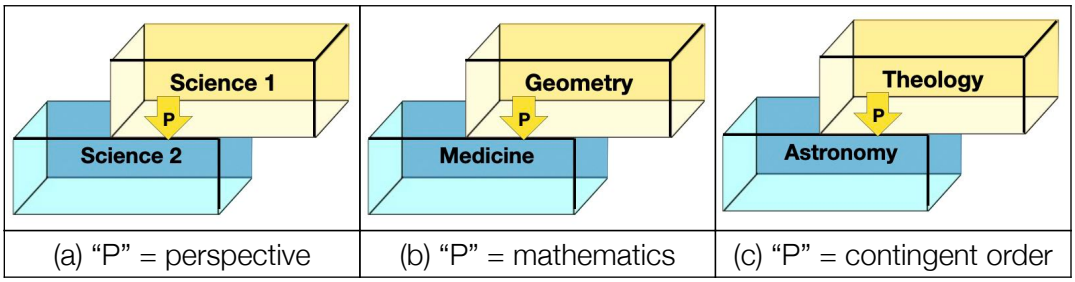

Figure 53: Subalternation of sciences

Aristotle offered the example of the subalternation of medicine to geometry (Figure 53b):

> "Many [sciences are] related like this – e.g., medicine to geometry, for it is for the doctor to *know the fact* that circular wounds heal more slowly, and for the geometer to *know the reason why*."[60]

Unlike music or astronomy, for Aristotle, medicine is not one of the mathematical sciences, so medicine is not subordinated to mathematics. Nevertheless, the physician may at times draw upon mathematical principles ("P" = geometry). The physician as a physician "knows the fact" that round wounds take longer to heal. To explain "the reason why," the physician can draw a principle from the mathematical science of geometry. It is the geometer as geometer who knows, from geometrical reasoning, that a circle will take longer to close off than a line the same length as the diameter. In this example, the science of medicine knows the fact (*quia*), while the science of geometry provides the "reason why" (*propter quid*).

This vertical relation of the science of medicine to the science of geometry is subalternation. Another example, which we shall explore in Chapter 18, "Interdisciplinary Relations," is theology and astronomy in the Galileo affair (Figure 53c). Pope Urban VIII urged Galileo to adopt a principle of contingent order, that God had a choice when he made the universe and might have constructed the natural order in a way that we do not necessarily expect. In this case "P" represents the perspective of contingent order in theological science.

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60. Aristotle, *Posterior Analytics*, Book I, ch. 13, 79a13-15. Translated by Jonathan Barnes. In *The Complete Works of Aristotle: The Revised Oxford Translation*, ed. Jonathan Barnes, Bollingen Series (Princeton: Princeton University Press), vol. 1, p. 129.

The relations between two disciplines are not defined as a timeless abstraction but depend crucially upon the precise circumstances at play in a given historical moment. For example, the principle of contingent order may provide a basis for either vertical or horizontal relations between theology and astronomy. In the Introduction, we placed the sciences side by side in a horizontal relationship of equality rather than subalternation. In horizontal relations, as in Figure 50, the common surface represents a resonance between the two disciplines. We used the idea of resonance rather than a direct disciplinary transfer from one science to another.

A similar example of resonance rather than subalternation in the science of astronomy is illustrated with Georges Lemaître, the priest who developed the Big Bang theory before Hubble. Lemaître cautioned Pope Pius XII against jumping to the conclusion that the principle of contingent history in theology is the only source for, or to be simply identified with, or provides the "reason why" for, the contingent history of the universe in the Big Bang theory. In other words, for Lemaître, the correlation of theological science and natural science mediated by the perspective of contingent order was one of horizontal resonance rather than one of direct transfer through subalternation.[61]

Like Lemaître, many cosmologists have achieved the discovery of contingent order or contingent history on the basis of their own disciplinary investigations without any direct transfer from the domain of theology. In this case, the arrow of influence might go from cosmology to theology horizontally, rather than vice versa. Such a cosmologist might theoretically prompt a theologian to re-examine the principle of contingency and recover it for theology. In this way, through interdisciplinary dialogue, the social co-efficient or social construction of knowledge plays an important role without undermining a realist understanding of both sciences involved.

In vertical relations, a higher level provides in some sense a "reason why" for a lower level. In many cases, the lower level may be more empirical, a realm of organized patterns of experience. The "reason why" may be more theoretical, explaining the underlying basis of those patterns. Or the "reason why" may be brought into horizontal resonance with the "reason why" of another discipline. Any two levels may relate together in different ways at different times, depending on the question being addressed. Precisely how and when different levels relate has been a topic of vigorous discussion ever since Aristotle.[62] We will come back to these questions and consider them more adequately in Part X: "Multilevel Reality."

For now, we have introduced models of horizontal and vertical relations between the sciences, the latter of which are stratified. Two varieties of stratification are subordination and subalternation. Both horizontal and vertical relations scale from subject areas within a science to disciplinary relations between multiple separate sciences. Next we'll look at how Torrance

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61. We will explore the story of Lemaître and Pius XII further in Chapter 14, "Case Studies: Relational Physics (and Genesis 1)," along with similar examples from geology in Part VIII, "Contingent Order and Contingent History."

62. Steven J. Livesey, "William of Ockham, the Subalternate Sciences, and Aristotle's Theory of Metabasis," *British Journal for the History of Science* 18 (1985): 129-145; Steven J Livesey, *Theology and Science in the Fourteenth Century: Three Questions on the Unity and Subalternation of the Sciences From John of Reading's Commentary on the Sentences* (Leiden: E. J. Brill, 1989).

used vertical stratification to understand our knowledge of the Trinity, and then apply that pattern to our knowledge of creation.

6.5. Stratification: Trinity

Level	Description	Trinity
Scientific	Knowing *kata physin* ("according to nature")	"Ontological Trinity" (eternally as 3 persons)
Theological	Organized knowledge	"Economic Trinity" (in saving relation with us)
Doxological	Experiential	Day-to-day worship

Table 13*: Stratification: The Trinity*

Within the single science of theology, Torrance argued, there is a stratification of three vertical levels in our knowledge of the Trinity: the doxological, the biblical, and the scientific.

- The doxological base level refers to the day-to-day experience of the reality of the Trinity through worship and prayer.
- Second, a biblical or "theological" level refers to *organized knowledge* based upon a more rigorous understanding – in this case, of revealed truth. This level is a meta level to the doxological level. For the Trinity, this level is represented by a biblical account of the three Persons of the Trinity *in their saving relations with us*. In a theology class, you would study this level as the "economic" Trinity.
- Third, there is a higher "scientific" level. This level is a meta level to the biblical or theological level. On the higher scientific level, we come to know not just that something is (the first, doxological, level), or how it appears to us (the second level), but how it is what it is because of its deeper nature. We come to know something scientifically when we apprehend it *kata-physin*, which means "according to its very nature," in light of its own inner relations and being. In a theology class, we would call this level the "ontological" Trinity, which refers to the eternal Triune character of God, his "being in communion" in himself eternally as three persons, even apart from his revelation in saving relationship to us.[63]

As Christians, we want to add the biblical and scientific levels of understanding to our doxological experience of reality, and then hold all three levels together in a mutually enriched experience of reality. The three levels are a stair-step of levels, with each step up to a meta level providing the "reason why" for the one before. The theological level is a meta level to the doxological, because the doctrine of the economic Trinity provides the "reason why" for our experiential knowledge of the Father, Son, and Holy Spirit in all the regular practices of prayer, liturgy, baptism, Bible reading, and worship. The third level is a meta level to the second, for the understanding of the ontological Trinity unveils a deeper "reason why" that makes more profound sense of what is known on the level of the "economic Trinity." Even at the two higher levels, the doxological level is never left behind. We keep all

63. T. F. Torrance, *Ground and Grammar of Theology*, pp. 155-164. Cf. CDG***

three levels together in interrelated cognitive and doxological love as we respond to the revelation of the love of the Triune God.

6.6. Stratification: Creation

Level	Description	Trinity
Scientific	Knowing *kata physin* ("according to nature")	In relationship to Christ ("Trinitarian")
Theological	Organized knowledge	In relationship to Creator ("Theist")
Doxological	Experiential	Nature as "creation"

Table 14*: Stratification: Creation*

After looking at the stratification of reality in relation to the doctrine of the Trinity, let's consider how the same three levels might apply to the doctrine of Creation.

- On the first level, the doxological experience of nature refers to the day-to-day practices of the scientist, creation worker, or lay experience of nature.[64] We explored several examples of scientists and creation workers who in their day-to-day work engage their passion to understand nature. We who are Christians can appreciate the day-to-day practice of scientists as an indwelling of nature as "creation," which has its being and nature by the power and wisdom and love of God and is worthy of a lifetime of study.
- On a second level, biblical and theological in character, we may organize scriptural teaching into a knowledge of creation that sees nature in relationship to God the Creator. Let's call this the development of "Theist" perspectives of creation. Theist perspectives on creation might be shared among participants of any of the Abrahamic religions, that is, Judaism, Islam and Christianity. Other perspectives might arise from non-theist religious traditions. We will explore Theist and non-theist religious perspectives in Chapter 5, "Perspective: Approaching Science and Religion."
- On a yet higher level, more theoretical and scientific in character, we reason on the basis of the ultimate nature of creation as revealed in relationship to Christ. In his Incarnation and

64. Depending on the sphere of daily experience for a particular person, we might envision even more levels and meta levels. We could start with lay experience of nature as the lowest level, such as listening to the songs of birds on a daily walk. Then the practices of a serious amateur bird-watcher (like Mike Morrison banding a bird) might be the next meta level, followed by yet another meta level for the ornithologist who interprets the research at a professional level. For present purposes, all of these levels of daily experience (which are specific to who we are), are collapsed into a single level relative to the theological understanding of creation (which we can share regardless of who we are on a doxological level).

Resurrection, Christ has reconciled all creation and set it on a new basis. Because the full understanding of the Incarnation is inseparable from the doctrine of the Trinity, let's call this the development of Trinitarian perspectives on creation.

Athanasius affirmed:

> "It is more worshipful and more accurate to call God Father than Creator."[65]

Following Athanasius, we affirm that knowing the creation only in relationship to its Creator is not the fullest understanding of its nature as implicated in the Incarnation, death, Resurrection, and Ascension of Christ. In the case of seeking to understand *human* nature, Karl Barth argued that we must begin not with anthropology but with the humanity of Christ.[66] In the same way, all of nature is most fully, truly, and accurately understood in relationship to the humanity of Christ. We will explore Trinitarian perspectives in more detail throughout this book.

In this book, we want to recognize and maintain all three levels, and hold them together. Torrance insists that the ground level, the doxological level, is the actual, concrete level that is not left behind, but remains the *sine qua non* of the higher levels developed in relationship with it.[67]

6.7. STRATIFICATION AS A TAPESTRY

Before we leave our introduction to stratified levels of reality, let's think of how we might picture the relation between any two levels as a tapestry. Imagine that a loom is set up vertically in a room, dividing the room into two spaces.[68] The weaver is in the process of creating a tapestry on the loom. From the space in front of the tapestry, we watch as a beautiful landscape is being created. Let any lower level be the front side of the tapestry, which is disclosed to us as we watch.

But our level is open to an additional level, which we begin to see if we go around to the back side of the tapestry. The back side suggests a hidden basis for the order on the front side. The additional level might seem like disorder to someone not familiar with it. But imagine that from the back side, we enter into conversation with the weaver as she works. She is herself intent upon both sides of the tapestry. From the back side, we hear about the weaver's intention with the tapestry, including the reasons why she chose the scene, the color palette, and the other artistic features of the tapestry. Through this conversation, on the back side, we eventually achieve a "dimension in depth" of understanding, knowing "propter quid" as Aristotle would say, although the front side remains the chief focus to which we always return.

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65. On this quotation from Athanasius, see Torrance, *The Trinitarian Faith* (#1988-489), pp. ***, and the discusison of it below, in Chapter 11, "Perspective: Knowing Kata-physin."

66. Barth***

67. Thomas F. Torrance, *The Christian Doctrine of God: One Being, Three Persons* (Edinburgh: T&T Clark, 1996); #1996-595, p. 90

68. Cf. "Weaving Tapestry: A Family Tradition," interview with photograph of Yadin Larochette, conducting a demonstration to accompany an exhibition at the Getty Museum; www.getty.edu/news/weaving-tapestry-a-family-tradition/.

This analogy is imperfect, but perhaps it might be of some help. We will come back later to consider stratified levels and the analogy with a tapestry more fully.

7. Why Focus on T. F. Torrance and C. S. Lewis?

In the introductory section "… with T. F. Torrance and C. S. Lewis" on pp. 23-24, and in "Enter the worlds of C. S. Lewis and T. F. Torrance" on pp. 99-101, we have already gotten to know a little about Torrance and Lewis. Now now we will take just a little more time to get to know them better, before we set out on the rest of our journey together.

7.1. Why Read Thomas F. Torrance?

Thomas Forsyth Torrance was born in Chengdu, China, in the province of Sichuan, in 1913, and died in Edinburgh in 2007. As the oldest son of the Reverand Thomas Torrance and Annie Torrance, who were missionaries in China, Tom grew up with a missionary vision. He was a teenager before he moved to Scotland for advanced schooling.

During World War 2, Torrance served in North Africa, the Middle East, and Italy, in a regimental pastoral role with the Church of Scotland's "Huts and Canteens" commission. Torrance occasionally undertook special missions and at times was a stretcher-bearer near the front lines. His war experiences profoundly influenced him.

After his initial degrees at the University of Edinburgh, Torrance studied under Karl Barth in Basel, Switzerland, from 1937 to 1938. Although his studies were interrupted by the war, he completed a thesis on *The Doctrine of Grace in the Church Fathers* in 1946.

In 1950, Torrance became a professor of Church History, and later of Christian Dogmatics, in New College, of the University of Edinburgh. He served as Moderator of the Church of Scotland, its highest honor, in 1976-1977. After receiving the 1978 Templeton Prize for Progress in Science and Religion, Torrance retired from New College in 1979 to pursue independent scholarship.

Universally regarded as one of the most important theologians of the 20th century, Torrance is best known for his work in three areas:

1. *Barth reception*: Torrance became the leading facilitator of Barth's reception in the English-speaking world by founding the *Scottish Journal of Theology*, and by serving as the general editor of the multi-volume English translation of Barth's *Church Dogmatics*. Torrance also wrote two highly regarded books of his own interpreting Barth's significance. Torrance was Barth's choice to succeed him in Basel, but Torrance declined, preferring to stay in Edinburgh.

2. *Science and Religion*: This area might seem odd, given a widespread impression that Barth was not interested in the sciences. But in addition to the prestigious Templeton Prize, already mentioned, Torrance was active in two relevant academic societies: the *Académe Internationale des Sciences Religeuses* from 1969, and the *Académe Internationale de Philosophie des Sciences*, from

1976. He served as president of the former from 1972-1981. Torrance was also a Fellow of the Royal Society of Edinburgh.

3. *The Trinity*: Torrance's primary area of theological focus was the doctrine of the Trinity. Torrance led ecumenical discussions on the Trinity between the World Reformed Alliance and representatives of the Orthodox Church which culminated in a landmark joint statement on the Trinity in 1991. For this effort, Torrance was awarded a Pectoral cross and made an honorary Proto-Presbyter in the Orthodox Church, a distinction that is unprecedented in Orthodox tradition.

Any list of Torrance's major books in theology would include:[69]

- *Space, Time and Resurrection* (#1976-331), published in 1976, is a classic work on the Incarnation, which also exemplifies Torrance's perspectives on the relations between theology and science.
- *The Trinitarian Faith* (#1988-489), published in 1989, is a magisterial account of the development of Nicene theology, and the nature of scientific knowing.
- *The Christian Doctrine of God* (#1996-595), published in 1996, is the culmination of Torrance's life-long work on the doctrine of the Trinity.
- *Incarnation* (#2008-TFT-1), and its sequel volume, *Atonement* (#2009-TFT-1), are comprised of Torrance's dogmatics lectures given at the University of Edinburgh. Reflecting that origin, these two volumes, edited by Robert T. Walker, are among the most readable of Torrance's works.

These books would be considered essential reading to understand Torrance's theology. Yet he published many additional books in theology, such as *The Mediation of Christ*; *The Doctrine of Grace in the Apostolic Fathers*; *Conflict and Agreement in the Church*; *Theology in Reconstruction*; *Theology in Reconciliation*; *The School of Faith*; and too many others to list here.

Beyond these, Torrance's books on theology and natural science include:

- *Space, Time and Incarnation* (#1969-262), examines the Incarnation's implications for space and time;
- *Divine Meaning: Studies in Patristic Hermeneutics* (#1995-588) goes deeper into some of the topics covered in *Space, Time and Incarnation*.
- *Divine and Contingent Order* (#1998-623) is Torrance's magisterial work on divine freedom and contingent order in nature.
- *Theological Science* (#1969-263) is a magisterial work in the philosophy of science and theology.
- *The Ground and Grammar of Theology* (#1980-369) originated as popular lectures, and so may be read as a relatively accessible general overview.

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69. For convenience, throughout the text, Torrance sources are cited as McGrath numbers. Use any McGrath number (e.g., #1976-331) to find the record for the first edition at tftorrance.org (e.g., tftorrance.org/1976-331). For quick access to detailed information about any title, see the chronological Book List at tftorrance.org/quickStart.

These five books are an excellent place to start for Torrance's perspectives on science and religion. In this study, in addition to these five books, we frequently refer to *Space, Time, and Resurrection* (#1976-331) and to *The Trinitarian Faith* (#1988-489), two of Torrance's major theological works which focus upon the doctrines of the Incarnation and Trinity respectively. These classic works are of enduring interest to Christian believers. We will use these exemplars of Nicene theology as a paradigm for science. In other words, we will ground our thinking about science, nature, and creation in the foundational theological perspectives of the Incarnation, Resurrection, and Trinity. These two works explore the heart of the Christian faith and will reward repeated reading and theological reflection over years to come. This book therefore will prepare you to read, mark, and inwardly digest these classics by means of close reading of selected excerpts from these two volumes.

Of course, we are just scratching the surface of what Torrance has to offer. Additional books by Torrance on natural science and theology include *Reality and Evangelical Theology: The Realism of Christian Revelation* (#1982-397); *Reality and Scientific Theology* (#1985-450); *God and Rationality* (#1971-290); *Transformation and Convergence in the Frame of Knowledge: Explorations in the Interrelations of Scientific and Theological Enterprise* (#1984-433); *Preaching Christ Today: The Gospel and Scientific Thinking* (#1994-571); *The Christian Frame of Mind: Reason, Order, and Openness in Theology and Natural Science* (#1989-505); *Theological and Natural Science* (#2002-TFT-3); *Christian Theology and Scientific Culture* (#1980-368); *Belief in Science and in Christian Life: The Relevance of Michael Polanyi's Thought for Christian Faith and Life* (#1980-370); and an edition of James Clerk Maxwell, *The Dynamical Theory of the Electromagnetic Field* (#1982-399), to which Torrance added a significant introduction. In addition, there are many more articles and essays published elsewhere.

To become more familiar with Torrance, begin with the lecture by Tom Noble, "T. F. Torrance on the Centenary of His Birth," as mentioned above. There is a lively academic society devoted to Torrance's theology, the Thomas F. Torrance Theological Fellowship, which is an auxiliary organization of the American Academy of Religion. A short biography of Torrance by Elmer Colyer is posted on the Fellowship website at tftorrance.org/bio. Tom Noble's address was a keynote presentation delivered at an annual meeting of this Fellowship.

When you're ready for more, Elmer Colyer's book, *How to Read T. F. Torrance* (#2001-EMC-1), is a survey of Torrance's thinking across the board. It is of indispensable value for serious study of Torrance. Alister McGrath's intellectual biography of Torrance is also of indispensable value (#1999-AEM-1). Part 1 of McGrath's study is a biographical narrative, which concludes in the Epilogue. Part 2 is organized topically, to explore select themes of Torrance's thought. *Theology in Transposition* (#2013-MH-1) is a shorter introduction to Torrance by Myk Habets. Paul Molnar and Myk Habets also edited a T&T Clark Handbook for Torrance (#2020-PDM-MH-1). Bruce Ritchie's memoir conveys the impressions of what it was like to study under Torrance at New College. All five of these books will help you understand Torrance and would be in any working library for Torrance study.[70]

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70. Elmer M. Colyer, *How to Read T.F. Torrance: Understanding his Trinitarian and Scientific Theology* (Downers Grove, Illinois: InterVarsity Press, 2001); Alister E. McGrath, *T. F. Torrance: An Intellectual*

7.2. Why Read C. S. Lewis?

Clive Staples Lewis, often known as Jack, was born in Belfast, Ireland, in 1898, and died in Oxford in 1963. Lewis suffered the death of his mother at a young age, and experienced emotional estrangement from his father who, coping with his own grief, sent Lewis and his brother away to an English boarding school.

At the time, Lewis wanted nothing more than to become an accomplished Irish poet. But Lewis, like Tolkien, experienced the devastation of World War I which marked so many other writers of that generation. Lewis was an atheist when he was wounded in the Great War in 1918.

Trained in philosophy and literature, in 1925 Lewis became a Fellow of Magdalen College, Oxford. In 1931, some time after a late-night conversation with J. R. R. Tolkien and Hugo Dyson, Lewis became a Christian.

From 1933-1949, Lewis gathered a group of friends and writers who called themselves the "Inklings" to meet regularly, often at "The Eagle and Child," a pub colloquially known as "The Bird and Baby." J. R. R. Tolkien, Owen Barfield, Lewis' brother Warnie, and others would take turns reading aloud various books they were each writing at the time. Lewis also worked with Stella Aldwinkle to host the Socratic Club, which met regularly at Oxford from 1942, interacting with believers and unbelievers alike.

During World War 2, Lewis was engaged to present radio broadcast talks on the BBC explaining Christianity to a public grappling with the sorrows, dangers, and uncertainties of war. These talks later became the book *Mere Christianity*.

In 1954, Lewis left Oxford and transferred to Magdalene College, Cambridge. In 1956, Lewis married the love of his life, Joy Davidman, herself an accomplished writer. Together they wrote *Till We Have Faces*, one of the most powerful of Lewis' novels.

In addition to the Inklings, Lewis also developed abiding relationships with other friends and regular correspondents, including Dorothy L. Sayers and his eventual wife Joy Davidman. Lewis himself, like Tolkien and Sayers, was deeply affected by the writings of George MacDonald in the late 19th century and of G. K. Chesterton in the early 20th century. We will encounter each of these writers as we enter into Lewis' world.

To become oriented to Lewis, I recommend (as suggested earlier), a movie dramatizing Lewis' early life, "The Most Reluctant Convert: The Untold Story of C. S. Lewis." I also recommend a podcast on Lewis and the Inklings by David and Crystal Downing, the curators of the Wade Center at Wheaton College. This podcast provides biographical background as well as introductions to authors of recent books and current scholarship on Lewis. The podcast archives are a rich treasure and well worth listening through.[71]

Biography (Edinburgh: T & T Clark, 1999); Myk Habets, *Theology in Transposition: A Constructive Appraisal of T. F. Torrance* (Minneapolis, Minnesota: Fortress Press, 2013); Paul D. Molnar and Myk Habets, eds., *T&T Clark Handbook of Thomas F. Torrance* (London, New York: T&T Clark, 2020); Bruce Ritchie, *T. F. Torrance in Recollection and Reappraisal* (Eugene, Oregon: Wipf and Stock, 2021); #2021-BR-1.

71. The Wade Center podcast, hosted by the Wade's co-directors Drs. David Downing and Crystal

As a professor of English literature, Lewis became known for lively and erudite works like the *Oxford History of English Literature in the Sixteenth Century*; *The Allegory of Love: A Study in Medieval Tradition*; *A Preface to Paradise Lost*, the great poem by John Milton; *An Experiment in Criticism*, a provocative guide on how to read a book; and *The Discarded Image: An Introduction to Medieval and Renaissance Literature*. This last book is one that played a significant role in my own decision to switch from science to pursue a graduate degree in the history of science. Then, after I came to the University of Oklahoma history of science program, in my first year of graduate study, imagine my delight to discover that *The Discarded Image* was being used as a survey textbook for a course on early modern science![72]

Non-academic books by Lewis include his Narnia stories, and several collections of essays such as *God in the Dock*; *Christian Reflections*; *The Weight of Glory*; and *Selected Literary Essays*, quoted earlier. We earlier mentioned *Mere Christianity*, an introduction to Christianity. Three works of adult Christian fiction or fantasy include *The Screwtape Letters*; *The Great Divorce*; and *Till We Have Faces*. There are many more worthy titles, such as *Letters to Malcolm Chiefly on Prayer*; *The Four Loves*; *Reflections on the Psalms*; *On Stories*; *The Pilgrim's Regress*; *Present Concerns*; *A Grief Observed* (which he wrote after the death of his wife Joy); a pamphlet on the King James Bible; an anthology of George MacDonald; and so on. If you haven't read them yet, exciting times lie ahead.

Lewis engaged Christianity and natural science in many of his books, including the Ransom Trilogy, which consists of *Out of the Silent Planet*; *Perelandra*; and *That Hideous Strength*. This book may serve as a way into the Ransom Trilogy, *The Abolition of Man*, *Miracles*, *The Problem of Pain*, *The Discarded Image*, *Mere Christianity*, *God in the Dock*, and *An Experiment in Criticism*.

Of the Ransom trilogy, the first volume illustrates some of the major themes of Lewis' extensive engagement with evolution, scientism, materialism, reductionism, ecology and conservation, and other issues of faith and science. The second volume will help us delve further into these as well as pantheist perspectives on science, the nature of evil, a vision of ecological harmony, and the hope of the New Creation. The third volume brings in medical ethics, technology and magic, and the music of the spheres, helping us to think in an interplanetary and cosmic context. In *The Abolition of Man*, Lewis set out what he believed to be the overall theme of the Ransom Trilogy. *Miracles* contains Lewis' critique of materialism and scientism, as well as a defense of miracles and an exploration of the nature of the Incarnation and New Creation. *The Problem of Pain* focuses not just on human pain, but on

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Downing, is a treasure trove of enthralling and insightful conversations about the seven authors the Wade Center collects: C. S. Lewis, J. R. R. Tolkien, Dorothy L. Sayers, Charles Williams, Owen Barfield, G. K. Chesterton, and George MacDonald. See the official websites for the Marion E. Wade Center (www.wheaton.edu/academics/academic-centers/wadecenter/) and the podcast (www.wheaton.edu/listen/wade-center-podcast/). I maintain an index of the podcast episodes devoted to primary sources: wadecenterpodcast.org.

72. Martin Rudwick told me a similar story about his switch from paleontology to the history of geology after hearing the lectures live at Cambridge which were posthoumously published as *The Discarded Image*.

animal pain and on the cosmos as a place of violence and suffering. These books are written in a compelling, easy to understand, almost conversational style, as only Lewis can do.

For relevance to the themes of this book, if you read only one Lewis biography, I recommend *The Narnian*, by Alan Jacobs, who explores the life-long development of Lewis' Christian imagination. David Downing's more in-depth study of Lewis' conversion also has much relevant material. I highly recommend all of Downing's many books on Lewis, as well as Gina Dalfonzo's study of the "transforming friendship of Dorothy L. Sayers and C. S. Lewis" (the subittle of *Dorothy and Jack*). An important topical study of Lewis is *Planet Narnia*, by Michael Ward, which explores the connections between Lewis' works (not just Narnia) and the cosmological perspectives of the medieval and Renaissance literature Lewis loved.[73]

7.3. SEMINAR FOR LIFE-LONG READING

Earlier we asked, "What kind of book is this?" One possible reply might have been: Is it an "Introduction to Torrance and Lewis?" The answer would be yes. This book is a seminar in how to read them with greater understanding. This is the reason for extensive allusions to Torrance and Lewis, oftentimes with almost line-by-line discussion. Keep the books at hand and don't skip over the recommended passages for close reading; they are an integral part of the argument and flow. Hopefully our discussion will help you ponder their core insights and arguments.

A goal of the book is to prepare you for life-long reading of both authors. One cannot hope to cover the insights of either Lewis or Torrance in a single volume.[74] Their works are so comprehensive and possess such depth that we simply cannot here touch upon every aspect, no matter how brief. The excerpts from both Torrance and Lewis that we do read together are not an all-you-can-eat buffet, but carefully chosen selections merely to whet your appetite for future reading. One of the finest meals I've ever enjoyed was at the Argyll Hotel on the island of Iona. This was definitely not a buffet! Just one plate: selectively planned, expertly prepared, carefully presented, immensely satisfying and sustaining. Just as a fine restaurant will serve up smaller portions than a buffet, you can read the suggested excerpts as the ingredients for your own culinary masterpiece, the first of many such over your lifetime. What matters is not *how much* you read, but *that* you read.

As we read we will remember, as noted earlier, that our aim is not to become little Lewisians, nor little Torranceans, more familiar with each of them than with the realities we wish to converse with them about. As Barth, who wished for no one to become a Barthian, wrote:

> "The angels laugh at old Karl. They laugh at him because he tries to grasp the truth about God in a book of *Dogmatics*. They laugh at the fact that

73. Alan Jacobs, *The Narnian: The Life and Imagination of C.S. Lewis* (San Francisco: Harper, 2005); David C. Downing, *The Most Reluctant Convert: C.S. Lewis's Journey to Faith* (Downers Grove, Illinois: InterVarsity Press, 2002); Gina Dalfonzo, *Dorothy and Jack: The Transforming Friendship of Dorothy L. Sayers and C.S. Lewis* (Baker Books, 2020); Michael Ward, *Planet Narnia: The Seven Heavens in the Imagination of C.S. Lewis* (Oxford: Oxford University Press, 2008).

74. Consider that the Torrance website has a Torrance bibliography which currently numbers more than 1500 items. Don't worry; you will not have to read them all to understand this book!

> volume follows volume and each is thicker than the previous one. As they laugh, they say to one another, "Look! Here he comes now with his little pushcart full of volumes of the *Dogmatics*! – and they laugh about the men who write so much about Karl Barth instead of writing about the things he is trying to write about. Truly, the angels laugh."[75]

So if our aim is not to write so much about Lewis and Torrance themselves, merely filling our little pushcarts with their volumes, why build this book around Torrance and Lewis? Several reasons may now be recalled, as presented in the Introduction:

- They were two of the most highly regarded 20th-century Christian writers.
- Each wrote in the Nicene theological tradition of Athanasius.
- Each also wrote prolifically on Christianity and science! As we have seen, each wrote more books relevant to this topic than we could easily read in a year.
- Each engaged in what Lewis called "rehabilitation," that is, a charitable reading and thoughtful recovery of overlooked historical writers.
- Each brings into our view an illuminating intellectual context – Lewis with Oxford and his friendships and correspondents, and Torrance with his Scottish and ecumenical traditions.
- Their books are not textbooks, but classics, for life-long learning.
- Many experience reading their books as intellectually exhilarating, and life-changing. I pray this might be the case for you.
- Each spoke as anchored in the Church, engaged beyond the Church, for the sake of the world.

With respect to the second point, we've already quoted from Lewis' introduction to a translation of Athanasius. In that same essay he commented that he regarded the *De Incarnatione* as a masterpiece from the time of his very first reading of it in the Greek text. He recommended it as an approach to miracles "badly needed today," and he commended Athanasius for standing firm on the "whole and undefiled" Trinitarian ground when "it looked as if all the civilized world was slipping back..." For Torrance's part, the three most significant theologians in the history of the church were Athanasius, Calvin, and Barth. Torrance cherished an icon of Athanasius, presented to him by a friend in 1963. He kept it on the wall of his study, and he used it as the frontispiece in the first edition of *The Trinitarian Faith*.

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75. Barth, quoted in George Casalis, *Portrait of Karl Barth* (New York, 1963), p. 3.

7.4. Contra mundum, pro mundum

The last point above recalls the saying about Athanasius, *contra mundum, pro mundum*: that he was "against the world, for the world" in the Trinitarian controversies of his day. In their writings and in their public lives, Lewis and Torrance each spoke as anchored in the Church, from the perspective of the Trinitarian faith, but not just speaking to the Church. Each engaged in conversations with the world, for the sake of the world, for the benefit of all.

Each regarded their task as one of cultural evangelism, a reconciliation of the mind. For Christianity is not a private faith, nor a personal ethic. It's not a tribal religion or even a planetary religion, but a way of living in the truth of the reality of God in Christ. This reality requires a reconstruction of the foundations of intellectual culture that will benefit every person and discipline and corner of society and culture.

But might someone object that, if we start out in our thinking as persons already committed to the Trinitarian faith, are we cutting ourselves off from the public square? Will we find ourselves talking only to our own tribe, as no one else will care to listen?

Consider the example of Lesslie Newbigin, the missionary to India who was a friend and colleague of T. F. Torrance and his brother J. B. Torrance. In works like *Trinitarian Doctrine for Today's Mission*, and *The Open Secret*, Newbigin argued that, rather than detracting from outward engagement, Trinitarian perspectives are foundational to the Church's outward, ecumenical mission. We openly declare the Trinitarian gospel – an "open secret" – in dialogue with a world that as yet does not recognize it or appreciate its meaning.[76]

Much has been written in recent decades about so-called "methodological naturalism." Less so about methodological deism, pantheism, atheism, or paganism, although I'm not sure why not.[77] For example, recall Fritjof Capra, a physicist, whose best-selling 1975 book, *The Tao of Physics*, advocated understanding modern physics through the lens of eastern mysticism and pantheism. Torrance corresponded with Capra, in fact, arguing that what Capra saw as advantageous for science in eastern thought was even more richly provided in Trinitarian theology.

Several notable writers have addressed what we might call methodological feminism and methodological Marxism, and so on. For example, feminists offer perspectives on the nature of science, against the world, for the world, to benefit the practice of science for all society and all scientists alike. I have personally benefited immensely from feminist perspectives on science. Feminist scholars have trained us to discern structures of scientific work that embed gender bias into the fabric of scientific practice. The privileging of male authority in 20th-century obstetrics and gynecology will suffice here as just one example to illustrate what is now known to be a disturbingly pervasive structural problem in modern science.[78] A greater

76. Lesslie Newbigin, *Trinitarian Doctrine for Today's Mission* (Edinburgh: Edinburgh House Press, 1963), and *The Open Secret* (SPCK/Eerdmans, 1978). Cf. Adam Dodds, *The Mission of the Triune God: Trinitarian Missiology in the Tradition of Lesslie Newbigin* (Pickwick Publications, 2017).

77. We will delve deeper into what is meant by Pagan, Deist, Pantheist and such terms in Chapter #, "?."

78. An exemplary study of this kind is Rima Apple, *Perfect Motherhood: Science and Childrearing in America* (Rutgers University Press, 2006).

level of participation of women in science is needed to begin to correct these biases. Path-breaking historians of women in science like Marilyn B. Ogilvie have trained generations of scholars to attend to the communities in which science takes place, where women were always present even when their names do not appear on the title pages of revered books.[79] Two examples among thousands are Elizabeth Hevelius, who completed and published the renowned Hevelius star atlas several years after her husband's death,[80] or Ada Lovelace's essay which contains what is now regarded as the earliest computer program but was actually published as an appendix to a man's essay on the work of another man.[81] Although, of course, many times the names of women do appear on title pages, and they were overlooked anyway; two examples among hundreds are Maria Cunitz, who drew attention to Kepler's work at a time when most astronomers (including Galileo) dismissed it[82]; or Émilie du Châtelet, who not only published works of her own but also translated Newton's *Principia* into French at a time when at most only a few dozen men on the continent could understand it.[83] Stories like these have only come to light because of the work of historians asking new questions in light of feminist perspectives.[84]

Or consider the approach taken in *The Dialectical Biologist*, by acclaimed biologists Richard Levins and Richard Lewontin. Levins and Lewontin start out in their thinking as already committed to Marxist dialectical materialism and seek to offer dialectical perspectives on biology that will aid and assist other biologists, even those who are not committed to Marxism. Their commitment to Marxism inspired them to develop scientific theories that avoided some of the mechanistic, reductionistic, and positivist aspects built-in to the mid-20th century methodologies in which they were trained:

> "Scientists, like other intellectuals, come to their work with a world view, a set of preconceptions that provides the framework for their analysis of the world. These preconceptions enter at both an explicit and an implicit level,

79. Among Ogilvie's many publications, see *The Biographical Dictionary of Women in Science,* ed. Marilyn B. Ogilvie and Joy Harvey (Routledge, 2000).

80. Johann Hevelius, *Firmamentum Sobiescianum sive Uranographia* (Gdansk, 1690), "The Firmament of King Sobiesci, or Map of the Heavens"; bound with Johann Hevelius, *Prodromus Astronomiae* (Gdansk, 1690), "Preliminary Discourse for Astronomy"; bound with Johann Hevelius, *Catalogus stellarum fixarum* (Gdansk, 1687), "Catalog of Fixed Stars." Only Johann's name appears on the title pages of these works, but I refer to each of them as published by "Elizabeth and Johann Hevelius."

81. Ada Lovelace, "Notes," pp. 691-731, to a "Sketch of the Analytical Engine Invented by Charles Babbage, by L. F. Menabrea," pp. 666-690, in *Scientific Memoirs* (London, 1843), vol. 3.

82. Maria Cunitz, *Urania propitia* (Oels, 1650).

83. Isaac Newton, *Principes Mathematiques de la Philosophie Naturelle*, par feue Madame la Marquise du Chastellet (Paris, 1759), 2 vols.

84. Science is similarly afflicted by other structural biases, including racism and colonialism. The pernicious role of methodological racism will be touched upon in Chapter 10, "Case Studies: Incurved Science." A greater level of participation in science by minorities, and by residents of former colonies, is needed for the sake of the integrity of science in a manner analogous to the issue of women in science.

> but even when invoked explicitly, unexamined and unexpressed assumptions underlie them... We too have our own intellectual preconceptions. If we differ from most scientists, it is in our deliberate attempt to make these preconceptions explicit where we can. The earlier chapters in this book were written largely from a Marxist perspective. They reflect the conflict between the materialist dialectics of our conscious commitment and the mechanistic, reductionist, and positivist ideology that dominated our academic education and that pervades our intellectual environment."[85]

In another book, Lewontin refuted the reductionism of geneticists like Richard Dawkins.[86]

Another well-known Harvard Marxist was Stephen Jay Gould, a paleontologist and popular writer, who published his magnum opus *The Structure of Evolutionary Theory* in 2002. In *Structure*, Gould writes:

> "I did not develop the theory of punctuated equilibrium as part of a sinister plot to foment world revolution… I did briefly discuss the congeniality of punctuational change and Marxist thought but only to illustrate that all science, as historians know so well and scientists hate to admit, is socially embedded. I couldn't very well charge that gradualists reflected the politics of their time and then claim that I had discovered unsullied truth…"[87]

We might generalize Gould's experience in these points:

- Extra-scientific beliefs and methodological commitments shape the development of scientific theories, but in profound and complex ways, not on a superficial level. Gould's underlying Marxist perspectives guided his own scientific investigations on some fundamental level embedded within science, not in order to co-opt science to serve political aims on a superficial surface level.
- Extra-scientific beliefs and methodological commitments do not operate prescriptively; there is not a one-to-one correspondence between perspectives and theory outcomes. Gould points out that the co-creator of punctuated equilibrium, Niles Eldredge, was not a Marxist, so the theory could hardly be associated with Marxism in a logically necessary manner.
- Scientific theories are co-developed by scientists with various extra-scientific beliefs and methodological commitments working together. Multiple investigators with various perspectives join together in shared, pluralistic scientific pursuits, as in the development of punctuated equilibrium. Gould was not advocating setting up a separate program of research that would be ideologically pure or confessional in a prescriptive sense.[88]

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85. Richard Levins and Richard Lewontin, *The Dialectical Biologist* (Cambridge, Massachusetts, Harvard University Press, 1985), p. 267.

86. Richard Lewontin, Steven Rose, Leon Kamin, *Not in Our Genes: Biology, Ideology, and Human Nature* (Pantheon, 1984).

87. Stephen Jay Gould, *The Structure of Evolutionary Theory* (Cambridge, Massachusetts: Belknap Press, Harvard University, 2002), p. 985.

88. Conversations among colleagues in scientific research teams might open up possibilities for discussion of various methodological commitments apart from the superficiality and polemics which at times characterize commentary offered in public media. Additionally, possibilities might arise for different

These characteristics are remarkably congruent with the perspectival approach described in the Introduction. Sadly, Levins, Lewontin and Gould sometimes opposed the participation in the sciences of those with non-materialist perspectives, an inconsistency which is perhaps made more intelligible given the vigorous religious polemics in the United States in opposition to evolution (and more recently to climate change and public health). Yet such exclusivity on their part (matching the equal and opposite exclusivity of the Young Earth Creationists) only exacerbates polarization between religious and non-religious communities in modern culture. A greater level of participation of various religious and non-religious traditions in science is needed to begin to correct these misunderstandings. In a social setting more amenable to pluralism, one might imagine Trinitarian and Marxist perspectives joining together in united opposition to reductionistic approaches to science.[89]

Therefore, with a redoubled commitment to pluralism and in a similar spirit to the attempts by Levins, Lewontin and Gould to explicitly consider possible beneficial relations between scientific work and extra-scientific beliefs and methodological commitments, this book is an experiment in "methodological Trinitarianism." What would our thinking about science look like if it were grounded in the Christian conviction of the reality of the Trinity?

A methodological Trinitarianism characterized the early church's attempt to think through the implications of the Incarnation for science and nature. This endeavor gave shape to the emerging doctrine of *creatio ex nihilo*, in which the singularity of the Incarnation validated a singularity at the beginning of all things, so that the cosmos became seen as possessing its own contingent history. This process turned ancient frames of thought upside down, requiring a radical transformation of intellectual thought.[90]

Torrance insisted that the achievement of Nicene faith required not only biblical study, but a comprehensive reconstruction of ancient frames of thought:

> "However, far from a radical Hellenisation having taken place something very different happened, for in making use of Greek thought-forms Christian theology radically transformed them in making them vehicles of fundamental doctrines and ideas quite alien to Hellenism."[91]

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methodological commitments to be comparatively assessed (although not falsifiably so) according to their fruitfulness in that common endeavor.

89. See, in addition to the section in the Introduction on perspectives, "Readership" on pp. 24-27.

90. Cite TFT***

91. T. F. Torrance, *The Trinitarian Faith*, p. 68. See also pp. 47-48: "When the Christian Church spread out from its centre in Judaea into the Mediterranean world its preaching and teaching of the Gospel came up against a radical dualism of body and mind that pervaded every aspect of Graeco-Roman civilisation, bifurcating human experience and affecting fundamental habits of mind in religion, philosophy and science alike. The Platonic separation (χωρισμός) between the sensible world (κόσμος αἰσθητός) and the intelligible world (κόσμος νοητός), hardened by Aristotle, governed the disjunction between action and reflection, event and idea, becoming and being, the material and the spiritual, the visible and the invisible, the temporal and the eternal, and was built by Ptolemy into a scientific cosmology that was

We face a similar task of reconstruction, of developing a methodological Trinitarianism, or a Christian theological instinct for science in our modern age. To begin, our preliminary assumptions are these:

- What if the Trinitarian faith of the Nicene tradition represents a paradigmatic achievement of theological science?
- What if T. F. Torrance and C. S. Lewis are reliable guides to that achievement?

Let's assume the answer to both of these questions is roughly yes. If so, we may then ask:

- *What light does the achievement of Nicene faith throw on the nature of science generally?*

Advocates of the various forms of perspectival thinking about the natural sciences, or methodological "-isms," challenge us to develop Trinitarian perspectives on science that will be of interest in the public square. Everyone speaks from a perspective of some sort; no one can claim neutrality. There is no objectivity in that sense. But we don't have to be tribal. In this book, we seek to clarify the perspectives of Trinitarian science in order to make a contribution to the public square, for the sake of the good of science and of the public understanding of science.[92]

We in turn would be wise to be attentive to what we can learn from other perspectives, including the major religions of the world and the various non-Theist models of reality (considered later), as well as the writers just mentioned. The critical test for us will be whether Trinitarian perspectives prove beneficial to scientists themselves, even for those who have no interest in becoming Trinitarian Christians, just as I have benefitted from *The Dialectical Marxist* and the theory of punctuated equilibrium but have no interest in becoming a Marxist. This may sound like a tall order, but like Lewis and Torrance, we seek to speak as among those anchored in the Trinitarian faith, as confessors of the Nicene Creed, but ready to engage in genuine conversations beyond the Church for the sake of the world.

One of the places where Lewis spoke about what a redeemed science might look like is *The Abolition of Man*:

> "I can go further… I even suggest that from Science herself the cure might come. I have described as a 'magician's bargain' that process whereby man surrenders object after object, and finally himself, to Nature in return for power… Is it, then, possible to imagine a new Natural Philosophy… The regenerate science which I have in mind would not do even to minerals and

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to dominate European thought for more than a millennium. The combined effect of this all-pervading dualism was to shut God out of the world of empirical actuality in space and time. When the Christian Gospel was proclaimed in that context, very quickly a sharp conflict emerged between Hellenistic and Hebraic patterns of thought, between a mythological way of thinking (μυθολογεῖν) from a centre in the human mind and a theological way of thinking (θεολογεῖν) from a centre in God. In particular, the biblical teaching about God's providential and saving activity in history, and the Christian message of incarnation and redemption in space and time, had to struggle with the underlying assumptions of a dualist outlook upon God and the world in order to be heard aright and take root."

92. Two discussions relevant to this point, already cited in the Introduction, are Nicholas Wolterstorff, *Religion in the University* (Yale University Press, 2019), and Miroslav Volf, *For the Life of the World: Theology That Makes a Difference* (Brazos Press, 2019).

vegetables what modern science threatens to do to man himself…"[93]

We will return below to Lewis' arguments in this extended passage.

Among the non-Christians whom Lewis engaged in his discussions of science were some of the leading figures of the time: J. B. S. Haldane, the great Cambridge biologist who advocated science as the basis for a Marxist vision of social progress. Lewis critiqued Haldane's views in the Ransom Trilogy, among other places. Olaf Stapledon was a popular British science fiction writer strongly influenced by Haldane's vision of scientific progress. Stapledon's *Last and First Men* (published in 1930) convinced Lewis that it was essential to counter the scientism so prevalent in the science fiction genre at that time, which led to Lewis engaging the popular imagination with the Ransom Trilogy. Arthur C. Clarke, one of the major science fiction writers of the 20th century, exchanged letters with Lewis for over 10 years in which they debated the issues, as they saw them, raised by scientific imperialism and space travel. C. E. M. Joad was a popular British philosopher. While Lewis was president of the Oxford Socratic Club, he engaged Joad in discussions, which Joad later credited with influencing his return to Christian faith. These are just four examples of Lewis speaking as anchored in the Church, engaged beyond the Church, for the sake of the world.[94]

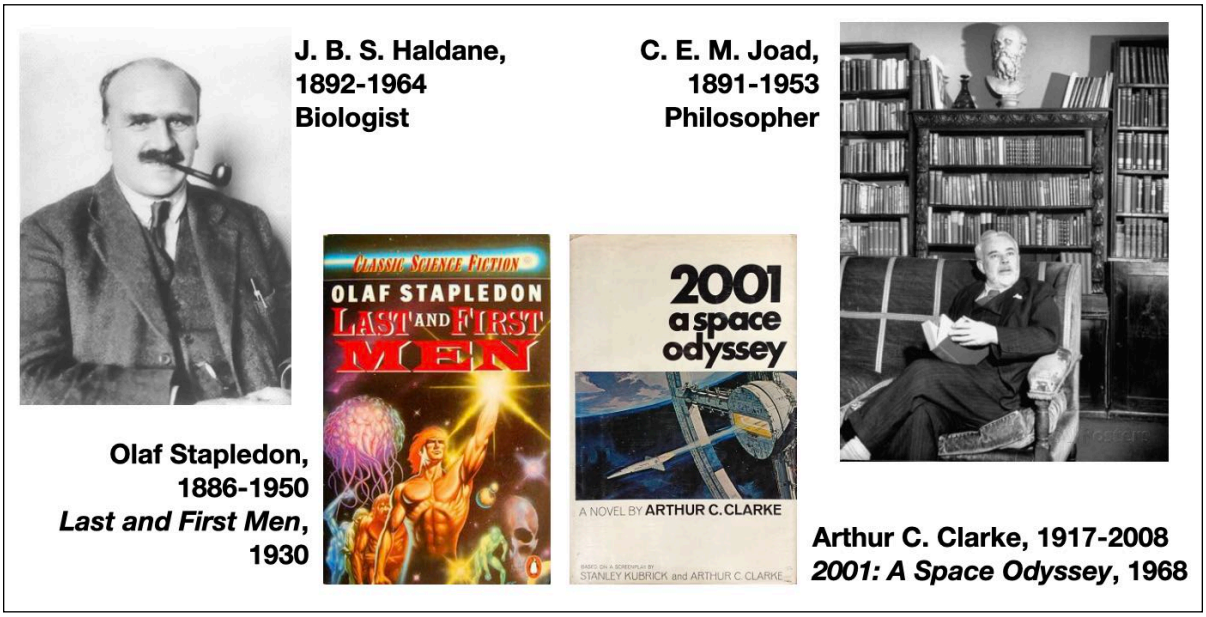

Figure 54: C. S. Lewis in dialogue

Turning to Torrance, in *Space, Time and Resurrection*, Torrance wrote:

93. C. S. Lewis, *The Abolition of Man*, ch. 6.

94. We will have more to say about each of these figures in the pages ahead.

> "It will be through dialogue at the deepest level between Christian theology and natural science, in which each remains faithful to the nature and character of its own field of inquiry, and in recognition that both operate within the same field-structures of space and time as the bearers of all rational order in the universe, that interpretation and intelligible appropriation of the message of the resurrection may take place."[95]

In the mode of Lewis and Torrance, a relational and Trinitarian natural theology does not mean disengagement from dialogue with the natural sciences, but rather offers a basis for a more profound dialogue than is possible otherwise.

Among the scientists Torrance engaged in dialogue were some of the leading figures of the time: Torrance and Michael Polanyi, the great mid-20th century philosopher of science, became personal friends after 1968 when Torrance was elected to membership in the International Academy of the Philosophy of Sciences (Académie Internationale de Philosophie des Sciences). A sign of their mutual friendship and trust is that Polanyi appointed Torrance as executor of his literary estate. John Wheeler, professor of theoretical physics at Princeton University, coined the terms black hole and wormhole. Torrance sought out Wheeler for conversation during his many trips to Princeton Theological Seminary.[96] Ilya Prigogine, winner of the Nobel Prize in Chemistry in 1977 for his work on the thermodynamics of open systems, was a founder of Chaos Theory. Torrance kept up with his work and was among the first to discuss its significance for science and religion. Sir Bernard Lovell was knighted in 1946 for building the Jodrell Bank Observatory in England, which at the time featured the largest radio telescope in the world. In 1969, TFT dedicated his book *Theological Science* to Lovell, crediting Lovell with stimulating him to think more deeply about scientific method.[97] These are just four of many examples of Torrance speaking as anchored in the Church, engaged beyond the Church, for the sake of the world.

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95. Torrance, *Space, Time and Resurrection*, p. 45.

96. I am still researching whether Wheeler and Torrance met in person.

97. "This volume is dedicated to Bernard Lovell, as he was then, who put to me the initial questions as to scientific method in theology which led me to examine more carefully the nature of the theology as a science, and to select this theme for the Hewett Lectures." Torrance, *Theological Science*, Preface, p. xviii. We will have more to say about each of these figures in the pages ahead.

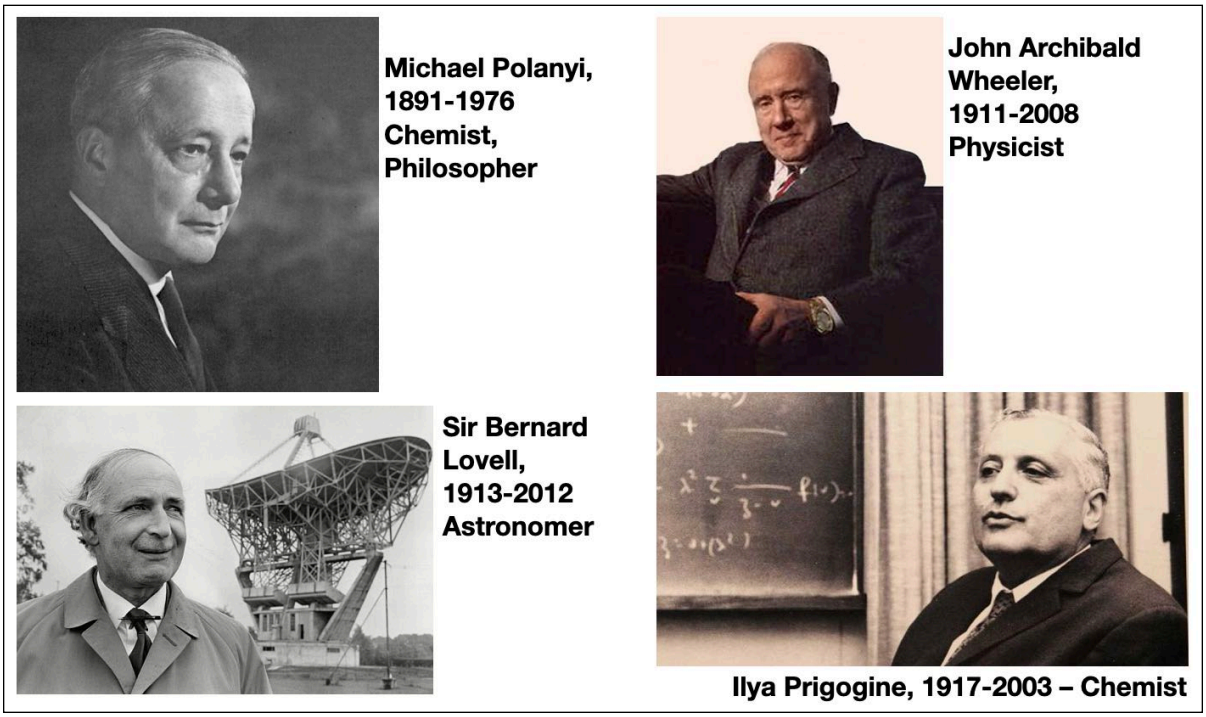


Figure 55: Torrance in dialogue

If churches, Christian colleges, and para-church institutions around the world can develop Trinitarian perspectives on faith and science, then in the Spirit we will witness to our culture, like Lewis and Tolkien, by speaking "against the world, for the world."[98]

All these considerations in combination are a short answer to the question "Why focus on T. F. Torrance and C. S. Lewis?"

8. What is a Trinitarian Theological Instinct?

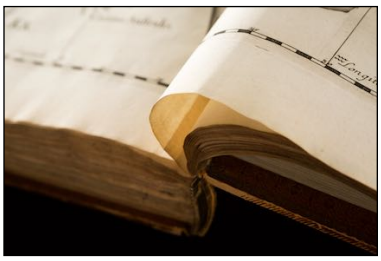
Now let's summarize what we've seen so far about developing a Trinitarian theological instinct. Albert Einstein spoke about the need to rigorously develop a scientific instinct that could discern, amidst all the noise and distractions, the essence of the reality being investigated.[99] Analogously, Torrance described a theological instinct as a reconciliation of the mind which involves clearing away the false assumptions, beliefs, preconceptions, and intellectual idols of our age in order to apprehend divine reality, and so to evangelize our own intellectual assumptions. We might summarize this, for the purpose of this book, as

98. George Marsden, *The Outrageous Idea of Christian Scholarship* (Oxford University Press, 1998).

99. Cite

developing Trinitarian perspectives on science and assimilating them into our habits of thought.

Close Reading #3: Thomas F. Torrance, "Theological Instinct," #2002-TFT-4



To evangelize our approach to science, exegesis is not enough; theological reflection, prayer, and dialogue are required. Torrance describes a need to learn to think from a "center in God" instead of from a "center in ourselves":

> "As Athanasius used to insist, we must learn to think strictly 'in accordance with the nature' (*kata physin*) of God the Father as he is made known to us through the Son and in the Holy Spirit, that is, in an essentially godly way (*eusebos*). To think like that from a centre in God himself, in accordancee with his essential nature revealed in the incarnate Son, is, he claimed, what *theologia* strictly is. If any one does not think that way, but thinks from a centre in oneself, governed by the devising of one's own reason, then one is bound to think of him in an unworthy or irreligious way (*asebos*) – which Athanasius designated *mythologia*. Either you think from out of a mind centred in God through union with the mind of the Lord Jesus, or you think from out of a mind centred in yourself, alienated from God and inwardly hostile to the truth incarnate in the Lord Jesus, that is finally governed by the unregenerate and unbaptised reason."[100]

Torrance concludes that thinking "from a center in God" will help us develop an instinct for seeing all of life according to the mind of Christ:

> "We have people who profess to believe in Christ as Lord and Saviour, but do we have a church that is so imbued with the mind of Christ that its members individually and as a community think *instinctively* in a Christian way?"[101]

Consider a parallel with the Bible's teaching on slavery. The seeds of the gospel eventually would lead to the elimination of slavery, as it called forth repentant rethinking in the evangelization of the culture, both in antiquity, in Britain in the 19th century, and as it still calls us to ongoing repentance and racial reconciliation in the United States in the 21st century.[102]

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100. Thomas F. Torrance, "The Reconciliation of Mind: A Theological Meditation upon the Teaching of St. Paul," in *Atonement: The Person and Work of Christ*, ed. Robert T. Walker (Milton Keynes: Paternoster; Downers Grove, Illinois: IVP Academic, 2009), pp. 445-446; #2009-TFT-1n. This short chapter covers similar ground as the more comprehensive audio recording, Thomas F. Torrance, "Theological Instinct" (Vancouver, BC, Canada: Regent College, 2002); #2002-TFT-4.

101. Ibid., p. 445.

102. Esau McCaulley, *Reading While Black: African American Biblical Interpretation as an Exercise in Hope* (Downer's Grove, Illinois: IVP Academic, 2020).

Yet apart from the gospel, the Bible itself was not enough. God did not give us in the Bible a direct command to abolish all forms of slavery. Proof-texting from the Bible was not sufficient to eliminate slavery – witness the United States before the Civil War. Mark Noll explains that the anti-slavery position in antebellum America

> "could not simply be read out of any one biblical text; it could not be lifted directly from the page. Rather, it needed patient reflection on the entirety of the Scriptures; it required expert knowledge of the historical circumstances of ancient Near Eastern and Roman slave systems as well as of the actually existing conditions in the slave states; and it demanded that sophisticated interpretative practice replace a commonsensically literal approach to the sacred text."[103]

Given that defenders of American slavery seemed to have the literal text of scripture on their side, Noll concludes:

> "The Book that made the nation was destroying the nation; the nation that had taken to the Book was rescued not by the Book but by force of arms."[104]

Slavery posed a theological crisis that was not resolved by appeals to the Bible. The Civil War exposed the public authority of the Bible as a false hope. The letter kills, but the Spirit gives life (2 Corinthians 3:6).

The dynamic of the antebellum debates over slavery is a revealing analogue to Christian engagement with various scientific questions. In late antiquity, the seeds of the gospel, assimilated into habits of thought, led to a profound evangelization of ancient intellectual culture. With a new theological instinct, Christians rejected deep-seated habits in the natural sciences of thinking in terms of (1) container concepts of space and time, (2) chance vs. necessity, (3) cyclical and fatalistic views of history, (4) dualism, and other perspectives that we will critique below. Similarly, in our own day, applying the Bible to current issues in science must take place not through proof-texting, or syllogistic argument, but through dialogue on a meta level which engages and reconciles the foundations of our modern scientific culture with the seeds of the gospel.

For example, some evangelicals today are suspicious of geology based on what they believe is a literal reading of Genesis 1. Yet biblical interpretation is a complex act in its own right.[105] A proof-texting approach, apart from deep theological reflection and dialogue, obscures the profound reasons why the discoveries of geology were theologically appealing to the evangelicals of the early 19th century, and in fact represented an outgrowth of centuries of reflection upon theologically-derived perspectives such as contingent order, as we shall see.

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103. Mark Noll, *The Civil War as a Theological Crisis* (Chapel Hill: University of North Carolina Press, 2006), p. 49.

104. Ibid., p. 8.

105. We will consider interpretations of Genesis 1 in Chapter 14, Section 5, "Genesis 1," on pp. 614-638, and the discovery of "geohistory" in Chapter 16, "Case Study: Geohistory."

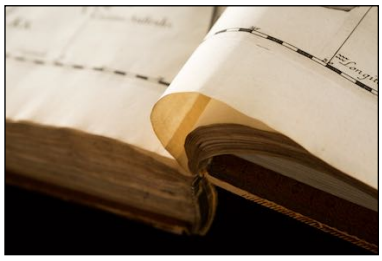
Exegesis is not enough; theological reflection and dialogue are required. When we come to know who God is – supremely and preeminently through the Incarnation and Trinity – we can expect our culture to be injected with new ways of thinking that will ultimately, as they work out over time, lead to massive changes in our thinking. This task is the reconciliation of the mind, the evangelization of culture, the development of a Trinitarian theological instinct for science, for the benefit of science and of the world.

As we develop our Trinitarian perspectives on creation and science, we will cease to approach any single issue on its own, *ad hoc*, but see how they relate to broader perspectives that cut across all the individual lanes. We will seek to identify the hidden assumptions that are Pagan, Atheist, Pantheist or Deist in character, rather than Theist or Trinitarian, and shift our thinking to bridge from their attractive qualities into the Theist and Trinitarian perspectives instead. We will work to hold together the doxological level with various meta level dimensions.

This is what it means to develop a Trinitarian theological instinct for science.

9. After Words

— Classic Texts —



> "It is a good rule, after reading a new book, never to allow yourself another new one until you have read an old one in between…"[106]

- Thomas F. Torrance, "Theological Instinct," 30-min audio recording (Vancouver, BC, Canada: Regent College, 2002); www.regentaudio.com/products/theological-instinct; #2002-TFT-4
- Thomas F. Torrance, "The Reconciliation of Mind: A Theological Meditation upon the Teaching of St. Paul," in *Atonement: The Person and Work of Christ*, ed. Robert T. Walker (Milton Keynes: Paternoster; Downers Grove, Illinois: IVP Academic, 2009), 437-447; #2009-TFT-1n.
- *Doxological love:* Job 38-41; Psalms 8, 19, 33, 96-98, 104, 147, 148; Proverbs 8:22-36; Isaiah 11:6-9, 65:17-25; Deuteronomy 29:22-28; Hosea 2:20-23, 4:1-6; 1 Corinthians 8:6; Colossians 1:15-20; Hebrews 1:1-4; Revelation 1:17, 21:5-6.
- *Doxological love:* To better appreciate the daily experience of what scientists do, read a biography of any scientist, immerse yourself in a classic of nature literature, or conduct an oral history interview of a scientist or creation worker you know (see Appendix B, "Conversations").

— Further Reading —

- Thomas A. Noble, "T. F. Torrance on the Centenary of his Birth: A Biographical and Theological Synopsis with Personal Reminiscences," *Participatio* 4 (2013): 8-29; #2013-TAN-3.
- Elmer M. Colyer, "Torrance's Life and Achievement," in *How to Read T. F. Torrance: Understanding his Trinitarian and Scientific Theology* (Downers Grove, Illinois: InterVarsity Press, 2001), 35-51; #2001-EMC-1a, online at tftorrance.org/bio.
- "The Most Reluctant Convert: The Untold Story of C. S. Lewis" (2021); directed by Norman Stone, written by Norman Stone and Max McLean; cslewismovie.com.

106. C. S. Lewis, "On the Reading of Old Books," in *God in the Dock: Essays on Theology and Ethics* (Grand Rapids, Michigan: William B. Eerdmans Publishing Company, 1970), pp. 201-202.

— Reflect and Discuss —

It's now time to put on our thinking caps and interpret the significance of what we've been exploring! If this chapter has been successful, then you are now doing some real thinking.

1. Are the wheels spinning? Did you discover anything new, surprising, or unexpected? What questions came to mind? What was most meaningful to you?
2. What prayer would you write to introduce this chapter?
3. What scripture passage would you select to introduce this chapter?
4. How do you interpret the painting of the Winter Owl by Michael Barfield in light of these things? Would you choose a different work of art to represent this chapter?
5. What are your most memorable experiences of nature? Were they "doxological" for you? How have those experiences shaped you?
6. After reading about all the kinds of books that this is not, do you think it might be worth your time to read it? If so, what do you hope to get out of it?
7. Are the "theological/Theist" and the "scientific/Trinitarian" meta levels at odds with the "doxological" level, or can the experience of reality across multiple levels be enriching, if they are held together?
8. What seems most interesting at this point to you about T. F. Torrance? About C. S. Lewis? What do you already know about them? What about them concerns you, or excites your interest?
9. Will Trinitarian perspectives and confession of the Nicene tradition cut us off from, or open up, conversation with the world? Can we truly be against the world, for the world? Anchored in the Church, for the benefit of all?
10. What is meant by a Christian theological instinct? Why is it needed? How is it acquired?
11. Ideas lack power to change us until we relate them to our particular stories. What stories would you tell to embody these ideas?
12. Imagine yourself in conversation with a friend who enjoys theology: How do the perspectives introduced in this chapter relate to Christian belief in the Trinity?
13. Imagine yourself in conversation with a friend who cares about science: How do the perspectives introduced in this chapter relate to natural science?
14. What are the implications of this chapter for "Love and the Cosmos"?

— Doxology —

Let's pray and sing in worship of Father, Son and Holy Spirit.

> The Song of Creation below is from the extra-canonical Song of the Three Young Men, verses 35-65, as included in the Book of Common Prayer and known by its first line as *Benedicite, omnia opera Domini*.[107]

Invocation

> Glorify the Lord, all you works of the Lord,
> praise him and highly exalt him for ever.
> In the firmament of his power, glorify the Lord,
> praise him and highly exalt him for ever.

I The Cosmic Order

> Glorify the Lord, you angels and all powers of the Lord,
> O heavens and all waters above the heavens.
> Sun and moon and stars of the sky, glorify the Lord,
> praise him and highly exalt him for ever.
>
> Glorify the Lord, every shower of rain and fall of dew,
> all winds and fire and heat.
> Winter and summer, glorify the Lord,
> praise him and highly exalt him for ever.
>
> Glorify the Lord, O chill and cold,
> drops of dew and flakes of snow.
> Frost and cold, ice and sleet, glorify the Lord,
> praise him and highly exalt him for ever.
>
> Glorify the Lord, O nights and days,
> O shining light and enfolding dark.
> Storm clouds and thunderbolts, glorify the Lord,
> praise him and highly exalt him for ever.

107. *The Book of Common Prayer and Administration of the Sacraments and Other Rites and Ceremonies of the Church: Together With the Psalter or Psalms of David According to the Use of the Episcopal* Church (New York: [Greenwich, Conn.]: Church Hymnal Corp.; Seabury Press, 1979). In worship, one or more of the three main sections are read, always beginning with the Invocation and concluding with the Doxology.

II The Earth and its Creatures

Let the earth glorify the Lord,
praise him and highly exalt him for ever.
Glorify the Lord, O mountains and hills,
and all that grows upon the earth,
praise him and highly exalt him for ever.

Glorify the Lord, O springs of water, seas, and streams,
O whales and all that move in the waters.
All birds of the air, glorify the Lord,
praise him and highly exalt him for ever.

Glorify the Lord, O beasts of the wild,
and all you flocks and herds.
O men and women everywhere, glorify the Lord,
praise him and highly exalt him for ever.

III The People of God

Let the people of God glorify the Lord,
praise him and highly exalt him for ever.
Glorify the Lord, O priests and servants of the Lord,
praise him and highly exalt him for ever.

Glorify the Lord, O spirits and souls of the righteous,
praise him and highly exalt him for ever.
You that are holy and humble of heart, glorify the Lord,
praise him and highly exalt him for ever.

Doxology

Let us glorify the Lord: Father, Son, and Holy Spirit;
praise him and highly exalt him for ever.
In the firmament of his power, glorify the Lord,
praise him and highly exalt him for ever.

Amen.

Part II ✦ Chapter 4

Case Study: Mathematical Astronomy in Ancient Mesopotamia

Figure 56: Ancient Babylon as seen approaching the city from a bridge over the Euphrates. The Euphrates River runs in the foreground, with the hanging gardens in the center of the view. The great ziggurat adorns the skyline to the left. The Temple of Esagila appears below the skyline just right of center. Drawing by Rachel Folmar.

When you think of ancient Babylon, what comes to your mind?

- The hanging gardens?
- The exile of the Hebrew people to Babylon in 586 BCE?
- The birth of quantitative, predictive, mathematical astronomy? If not the latter, why might it seem surprising given whatever else you have heard?

— Scripture —

"Then the king commanded his palace master Ashpenaz to bring some of the Israelites of the royal family and of the nobility, young men without physical defect and handsome, versed in every branch of wisdom, endowed with knowledge and insight, and competent to serve in the king's palace; they were to be taught the literature and language of the Chaldeans. The king assigned them a daily portion of the royal rations of food and wine. They were to be educated for three years, so that at the end of that time they could be stationed in the king's court. Among them were Daniel, Hananiah, Mishael, and Azariah, from the tribe of Judah. The palace master gave them other names: Daniel he called Belteshazzar, Hananiah he called Shadrach, Mishael he called Meshach, and Azariah he called Abednego.... To these four young men God gave knowledge and skill in every aspect of literature and wisdom; Daniel also had insight into all visions and dreams.... At the end of the time that the king had set for them to be brought in, the palace master brought them into the presence of Nebuchadnezzar, and the king spoke with them. And among them all, no one was found to compare with Daniel, Hananiah, Mishael, and Azariah; therefore they were stationed in the king's court. In every matter of wisdom and understanding concerning which the king inquired of them, he found them ten times better than all the magicians and enchanters in his whole kingdom." (Daniel 1:1-21)

— Prayer —

Dear Father, Son and Spirit,

We thank you for your faithful witness through all the ages of the world. As you did with Daniel, open our hearts and minds to discern your wisdom and to gain the understanding in every aspect of learning that comes from you.

Guide us by the compass of Trinitarian perspectives as we journey further into the wonder of your creation, through Jesus Christ our Lord.

Amen.

Chapter 2 emphasized the importance of reconsidering our assumptions about science and *history*. The first section of this chapter presents an introductory case study which may challenge our assumptions about science and *religion*, and the second section a related study which will place before us some considerations about science and *scripture*.

Section 1 of this chapter sets up the background for the birth of quantitative astronomy in ancient Babylon. Mathematical, predictive astronomy began not in ancient Greece, as part of an alleged "birth of reason," but in the thoroughly religious cultures of Mesopotamia. Might it be that modern attempts to claim that science began in ancient Greece were linked with the social construction of the idea that science and religion are locked in an inevitable conflict? As it turns out, that same filter, opposing religion and science, has obscured the nature of the presocratic natural philosophers who were often influenced by Mesopotamian neighbors and who are themselves sometimes best understood as engaged in religious reform rather than a rejection of religion altogether.[1]

Section 2 presents us with the enigma of Matthew's account of the magi and the Star of Bethlehem.[2] In this instructive case study we see that scripture itself cannot resolve the question of what phenomena the magi observed. Numerous theories, both scientific and otherwise, have been proposed. Their very multiplicity illustrates the uncertainty involved in reasoning from the language of scripture to a scientific theory. One question to ponder is why common accounts of Matthew's magi pay so little attention to Mesopotamian astronomy and, for that matter, to the book of Daniel.

The story of astronomy in ancient Mesopotamia provides a remarkable opportunity for us to re-examine our undersanding of science and religion and science and scripture.[3]

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1. The 600's BCE are now known as "the orientalizing period" because of numerous cultural interactions between Greece, Asia Minor, and the Near East. Presocratics as varied as Thales of Miletos (fl. 590 BCE) and Xenophanes of Kolophon (fl. 500 BCE) are best understood as proponents of monistic religious reform in a movement away from polytheism. See, for example, Walter Burkert, *Babylon, Memphis, Persepolis: Eastern Contexts of Greek Culture* (Cambridge, Harvard University Press, 2004); and Heinrich von Staden, "Affinities and Elisions, Helen and Hellenocentrism," *Isis* 83 (1992): 581-582. See also my discussion of "Contemporary social and religious cultural contexts" for the presocratics on my "The Presocratics: Introduction" web page, kerrymagruder.com/hsci/03-Egypt-Aegean/presocratics/01-intro.html. This page is part of a unit on the presocratics for my "History of Science to Newton" undergraduate course.

2. "Star" is capitalized for "Star of Bethlehem" in order to designate an unknown phenomenon which may or may not have been what we know of today as a "star."

3. A glossary of some terms frequently encountered in observational astronomy is provided for convenient reference at the end of the chapter (p. 210).

1. Stars Over Ancient Babylon

The text of Sections 1.1 through 1.8 consists verbatim of the script of "Stars over Ancient Babylon," a planetarium show I wrote and produced in 2005. I have used a rather poor-quality online video of that show in my history of science survey courses ever since.[4]

The show features two voices: the first narrates the main content, and the second claims to be Kidinnu, a Babylonian astronomer circa 300 BCE, who invites the viewer to dialogue with him. While Kidinnu was indeed a historical figure, one of the few ancient Babylonian astronomers known to modern scholars by name, in this script his comments are not quotations from cuneiform sources but paraphrases of my own representing what was known at the time.

When Kidinnu speaks, his words appear like this to set them off from the main narrator.

The video remains online and can be viewed alongside or instead of reading the first section. However, despite a superb soundtrack provided by Eric Barfield, its production value was relatively poor even by 2005 standards, so the video is not as enduring in value as the content it sought to convey. I hope presenting the script in print form here, just as it was written including the dialogue with Kidinnu, will stand on its own to more effectively continue to provide an engaging introduction to the origin of ancient mathematical astronomy.

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4. The first part of this chapter reproduces the script for my planetarium show, "Stars over Ancient Babylon," a 47-minute DVD which I wrote and produced for The OBU Planetarium as part of "The Cosmology and Cultures Project" of Oklahoma Baptist University, sponsored by the American Council of Learned Societies, and released in 2005 under a CC-by license; cf. my instruction manual at kerrymagruder.com/mov/Babylon.pdf. I've made the video available online at vimeo.com/28674346. I regularly assign it in my history of science undergraduate survey courses at the University of Oklahoma. Credits: Written & Produced by Kerry Magruder. Narrator: Candace Magruder. Original artwork by Rachel Magruder, including the Chapter icon, Figure 56, which depends on D. J. Wiseman, *Nebuchadrezzar and Babylon*, The Schweich Lectures (Oxford: Oxford University Press, for the British Academy, 1985). Throughout this chapter, I have depended upon the publications listed in "Further Reading" at the end, particularly Noel Swerdlow, *The Babylonian Theory of the Planets* (Princeton, 1998); Otto Neugebauer, *Astronomical Cuneiform Texts*, Sources in the History of Mathematics and Physical Sciences, no. 5 (New York: Springer-Verlag, 1983), vol. 1; and Mark Kidger, *The Star of Bethlehem: An Astronomer's View* (Princeton, New Jersey: Princeton University Press, 1999). Due to the interpenetration of sources drawn upon in the text, even on the scale of a single paragraph, it is not feasible to cite sources in a granular manner. For this reason, the "Further Reading" section is longer than usual.

God	Associated Planet
Marduk	Jupiter
Ishtar	Venus
Ninurta	Saturn
Nabu	Mercury
Nergal	Mars
Sin/Selardi	Moon
Shamash	Sun

Table 15*: Babylonian gods*

For reference, Table 15 lists the gods of the Babylonians associated with the planets, and Table 16 lists some of the Mesopotamian civilizations with their approximate dates.

Empire	Dates
Parthian	129 BCE - 224 CE
Seleukid (Hellenistic)	335-141 BCE
Medo-Persian	559-331 BCE
New Babylonian (Chaldean)	626-539 BCE
Assyrian	700-609 BCE
Intervening dynasties	1600-700 BCE
Old Babylonian	1700-1600 BCE
Ur	2100-2000 BCE
Akkadian	2350-2100 BCE
Sumerian	3000-2350 BCE

Table 16*: Revolution of empires.*

Section 1 describes Mesopotamian astronomical developments in the Sumerian through Seleukid periods. Section 2 discusses the Babylonian magi in the Parthian empire, contemporary with the Roman empire to the west.

1.1. PROLOGUE; "WELCOME TO BABYLON"

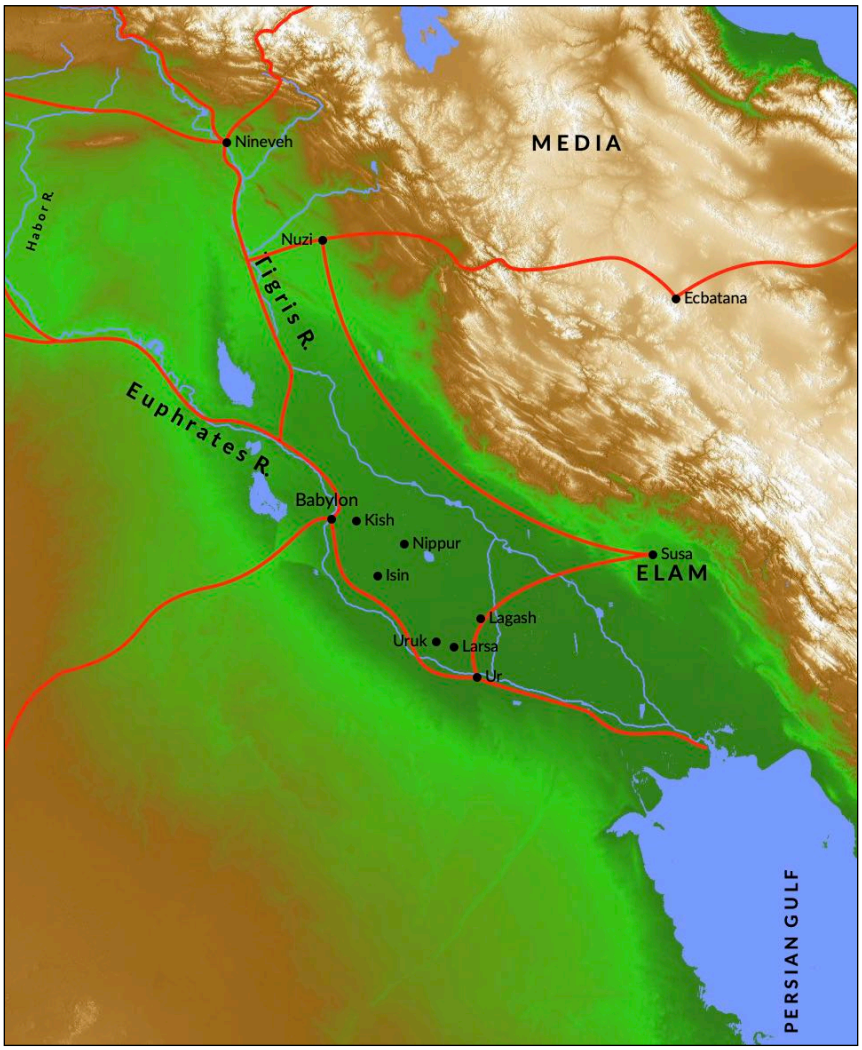


Figure 57: Ancient Mesopotamia of Babylon. Made with Accordance Bible Software.

The science of mathematical astronomy began four thousand years ago in ancient Mesopotamia, the land "between the rivers." The Tigris river winds southward from Ninevah, capital of the ancient Assyrian empire. To the south lie the lands of the ancient Sumerian, Akkadian, and Babylonian empires. The Euphrates River rolls past Babylon and onward to Ur. It joins with the Tigris river, then empties into the Persian Gulf. To the east lies the homeland of ancient Persia.

In these ancient civilizations, pursuing the practice of their priestly arts, the Scribes of Enuma Anu Enlil created mathematical astronomy. The Scribes of Enuma Anu Enlil were not merely astronomers and scholars; they offered counsel on affairs of state as powerful advisors to kings and emperors. Their specialty was divination, the art of interpreting omens, dreams, and the motions of the stars.

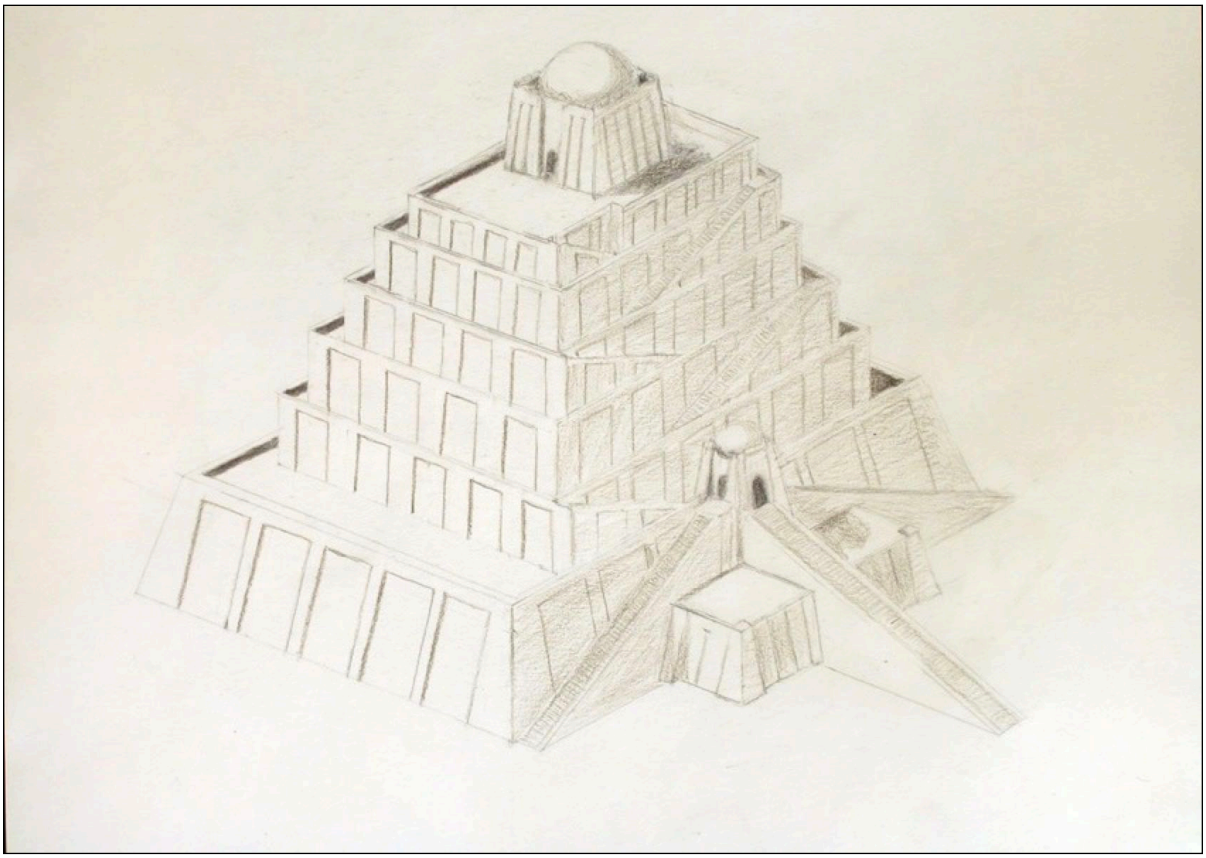


Figure 58: Ziggurat of Bablyon. Drawn by Rachel Folmar.

Seneca reported that Mesopotamian scribes visited Athens to offer sacrifices after Plato's death.[5] In the century of Plato, a millenium after the birth of Mesopotamian astronomy, the mathematical techniques of Mesopotamians were far more advanced than those of their Greek contemporaries. Without the Scribes of Mesopotamia, the works of Greek astronomers like Hipparchos and Ptolemy would have been inconceivable.

5. Seneca, Epistle 58.

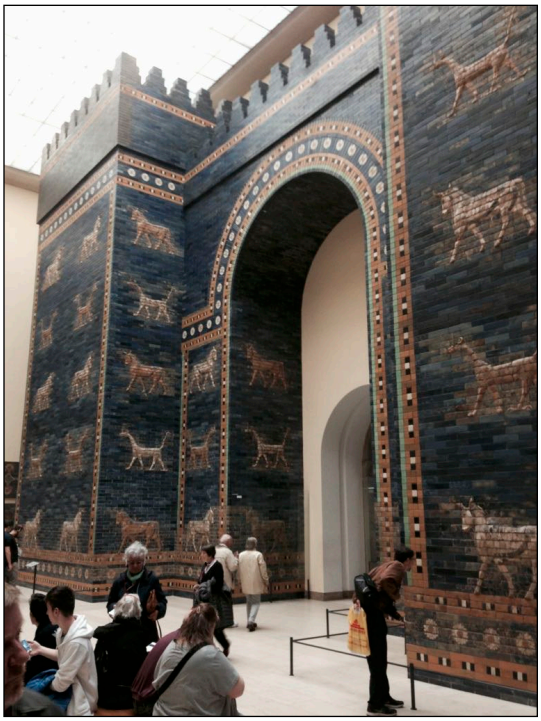


Figure 59: Ishtar Gates. Pergamum Museum, Berlin.

In the first century BCE, Strabo told of mathematical astronomers residing in Uruk, Ninevah, and Babylon. In Babylon, the Temple of Esagila, mentioned by Herodotos in the 5th century BCE, was still a center of astronomical practice in the 1st century CE. According to Strabo, Kidenas was the leader of astronomers in Babylon. Confirming this report, several astronomical tablets from Babylon bear the name Kidinnu.[6]

One can only wonder, how did the ancient Greeks hear of Mesopotamian astronomy? What might a Greek traveler have learned if he had talked with Kidinnu in ancient Babylon?

Welcome. I am Kidinnu, leader of the Scribes of Enuma Anu Enlil, watchers of the night. We are sworn to secrecy, and serve our king alone. Yet I have heard tales of you Greeks, and I would wish to hear more. Are you a musician or a soldier? Either way, I would have you send a message to your countrymen, but I much prefer music to swordplay. Music and astronomy share certain... harmonies. Come with me tonight: play your harp as the constellations rise, and I will show you some of the secrets of our arts. Listen carefully, remember what we do, and tell these things to your best astronomers. Perhaps someday one of them will return to Babylon to learn from us.

Look upon Babylon, our great city. I saw you cross the Euphrates on the stone bridge. From the northwest you beheld the terraced gardens built by Nebuchadnezzar, a former king, for his wife, to remind her of her Median homeland. You proceeded along the Procession way, a paved road lined with enamelled bricks showing lions, dragons and bulls. When you came before the majestic gates of Ishtar, you saw chariots pass abreast atop the double walls. When you entered the city you found your way to the Temple of Esagila, the center of Babylon, the center of the universe and the shrine of Marduk our god. Here we re-enact the creation at the birth of each new year. How, you ask, have we come to our knowledge of the stars? What is the story of our discoveries? Climb seven stories with me to the top of the ziggurat, this sacred mountain, our stairway to heaven. I will show you some of the ancient writings, and tell you stories of the night.

6. See the introductory chapters of Otto Neugebauer, *Astronomical Cuneiform Texts* (1983), vol. 1.

1.2. Sumerian period, 3200 - 2350 BCE

1.2(a). Culture and Cuneiform writing

Mesopotamian civilization is a long succession of the revolutions of empires, a story that begins with ancient Sumer, Akkad, and Ur. Charles Leonard Woolley excavated the royal tombs of Ur, which date to 2,600 BCE. They now reside in the British Musuem.

Figure 60: "Royal Standard of Ur." British Museum. Photo credit: Badger High School.[7]

Woolley called a mosaic of shell, lapus lazuli, and red sandstone the "Royal standard of Ur." One side shows a celebration of victory in warfare, a banquet served with the accompaniment of a singer and a harpist.

A "Ram in the Thicket," as Woolley called it, is made of gold foil and blue lapis lazuli. The harpist in the mosaic plays an instrument like one of four found in the largest royal tomb. Golden ear-rings complete a headdress adorned with ribbons and pendants of gold.

7. Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Standard_of_Ur_-_peace_side.jpg.

Ram in the Thicket[8]

Harp

Headress

Figure 61: Sumerian artifacts in the British Museum.

The archaeologist prizes one treasure above all others: inscriptions are far greater than jewels and gold. When Woolley proclaimed that "History begins in ancient Sumer," he announced the discovery of the oldest known written records.

From pre-history to the present day, people everywhere communicate with pictograms. A person who is illiterate can understand the meaning of a pictogram. Pictograms are signs, but are not phonetic; one cannot use pictograms for dictation, to write down whatever another person says. In contrast, written history began with the syllabary. More complex than an alphabet, a syllabary is a collection of about 300 symbols, where each symbol represents the sound of a particular syllable. The signs of a syllabary are phonetic, so that for the first time, when one person spoke, another could write it down.

Syllabaries emerged in Sumer in the 4th millenium BCE, and in Egypt not long afterward. Because a syllabary must represent several hundred sounds, it took time to learn. Reading and writing were secret arts, restricted to educated scribes.

Sumerian scribes wrote on small clay tablets, often about the size of one's hand. Their signs are "cuneiform," which is Latin for wedge-like. Scribes marked these signs by pressing (rather than scratching) with a reed. Signs may be vertical or horizontal. After filling up one side, the scribe would write on the back. Texts too long to fit on a single tablet were written on multiple tablets, numbered in sequence. Titles, prayers and colophons could be written on a tablet's sides.

Archaeologists have found many works of literature in ancient cuneiform tablets. There are epics, proverbs, parables, fables, love songs, essays, disputations, solemn hymns, prayers,

8. The "Ram in the Thicket" from Ur, photo by Jack1956, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=3584798. Unattributed photos (e.g., of the harp and headress, or Ishtar Gate) are by Kerry Magruder.

mythological poetry, handbooks of grammar, lists of signs, records of place-names, historical chronicles, letters, and laws.

Listen to Enuma Elish, our epic of creation. This tablet tells how Marduk brought order to chaos in the creation:
"WHEN on high the Heavens had not been named, Firm ground below had not been called by name, Nothing but 'Primordial Apsu' the Begetter, [Fresh Water]; and 'Mummu Tiamat', She Who Bore them All, [Salt Water]; --their waters commingling as a single body-- No reed hut had been matted, no marsh land had appeared, Uncalled by name, their destinies undetermined-- THEN it was that the Gods were formed within Them."[9]

Now hear the story of the hero Gilgamesh:
"I will proclaim to the world the deeds of Gilgamesh. This was the man to whom all things were known; this was the king who knew the countries of the world. He was wise, he saw mysteries and knew secret things, he brought us a tale of the days before the flood. He went on a long journey, was weary, worn-out with labor, returning he rested, he engraved on a stone the whole story."[10]

Enuma Elish. British Museum.[11]	Epic of Gilgamesh. British Museum.[12]

Figure 62: Sumerian tablets in the British Museum. Photo credits: British Museum.

9. For a translation of Enuma Elish, see Alexander Heidel, *The Babylonian Genesis*, 2d ed. (Chicago: University of Chicago Press, 1951). Quotation from Tablet 1, trans. ??***

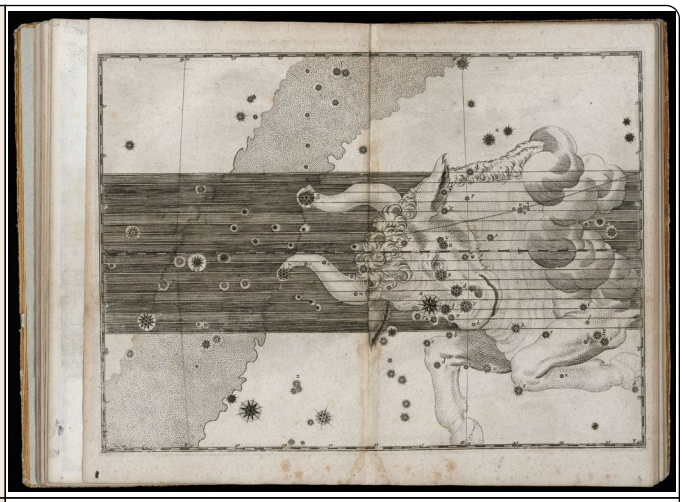
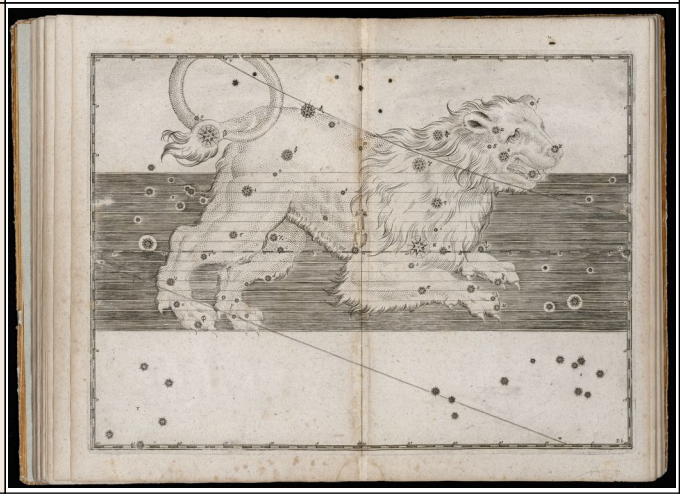
10. N. K. Sandars, trans., *The Epic of Gilgamesh* (Penguin Classics, 1972), p. 61.

11. Enuma Elish photo credit:

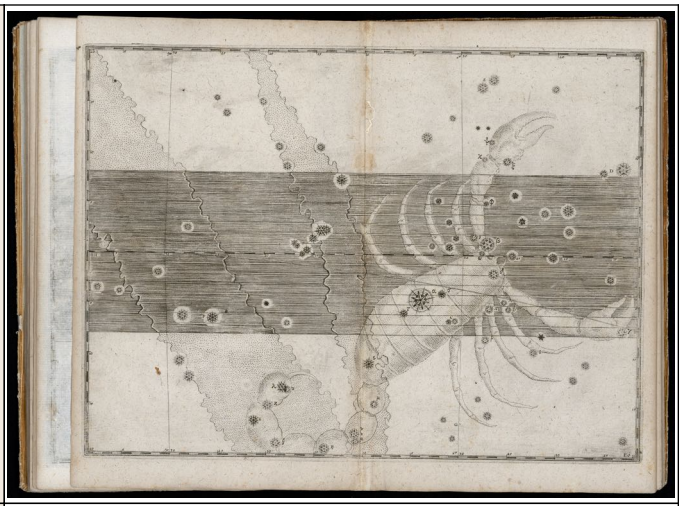
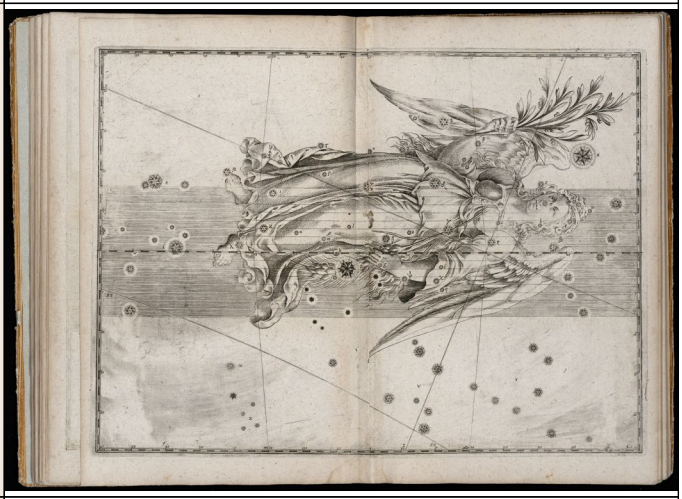
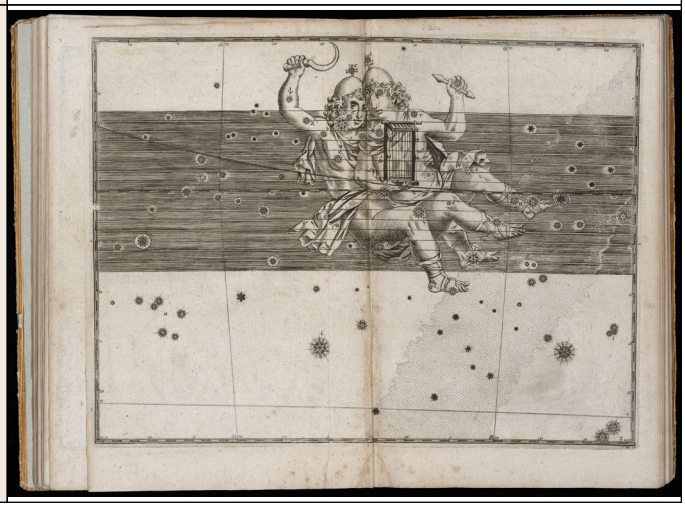
12. Gilgamesh photo credit: www.britishmuseum.org/blog/how-write-cuneiform. Iraq, 7th century BCE.

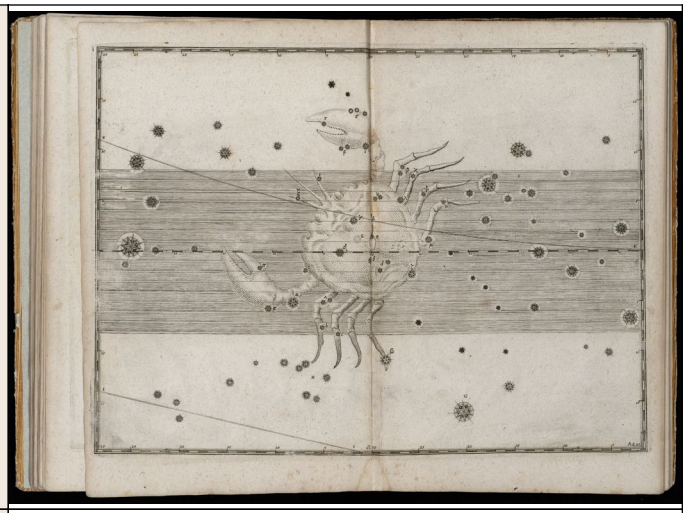
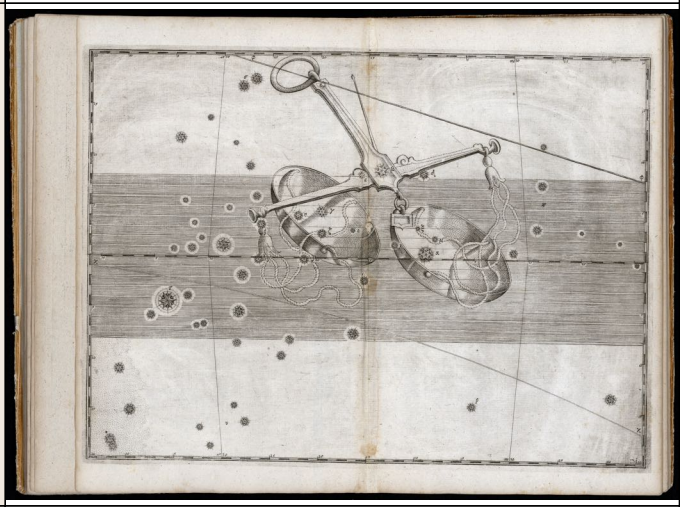
1.2(b). Ecliptic and Constellation names

Traditions of literature and astronomy were nearly as old to Kidinnu as Kidinnu is to us. From early Ur to later Babylon, ziggurats connected Earth and Sky. Through long nights at the tops of these towers the Scribes passed twenty centuries watching the skies.

Many constellations have Sumerian origins, particularly those with bright stars near the annual path of the Sun:[13] Taurus the bull of heaven, with bright star Aldebaran.	
Leo the lion, and bright star Regulus.	

13. These constellation images are all from Johann Bayer, *Uranometria* ("Measuring the Heavens"; Ulm, 1661; 1st ed. 1603), skytonight.org/Bayer-1661.

Antares, the red heart of Scorpius.	
Virgo with the barley stalk, and bright star Spica. These bright stars and ancient constellations mark the ecliptic, the annual path of the Sun around the sky.	
The planets follow near the ecliptic in a wider band, the zodiac. Additional zodiac constellations of early Babylonian origin include Gemini, the great twins...	

Cancer the crab...	
Libra the balance...	
and the goat-fish Capricorn.	

1.3. Old Babylonian period, 1800-1600 BCE

In the 18th century BCE, the Old Babylonian period, Hammurabi conquered the Fertile Crescent. From his capital in Babylon, Hammurabi ruled an empire stretching from the Mediterranean to the Persian Gulf. With a code of law inscribed on a black basalt pillar eight feet high, Hammurabi imposed order throughout the realm.

1.3(a). Planetary cycles: Venus tablet of Ammizaduqa

Scribes searching for the laws of the heavens discovered that Venus, the image of Ishtar, the queen of heaven, never moves far from the Sun. First Venus appears on one side of the Sun, and then on the other. When Venus appears east of the Sun, it is the evening star, setting in the west just after sunset. When Venus appears west of the Sun, it is the morning star, rising in the east before sunrise.

Figure 63: Ammizaduqa Venus tablet. British Museum.[14]

The Babylonians recognized that the evening star and the morning star are the same body. They knew that between its evening and morning appearances, Venus lies near the Sun, invisible in the daytime sky.

By the reign of Ammizaduqa, less than a century after Hammurabi, the scribes of Babylon knew that Venus repeats its motions against the background of fixed stars in an 8-year cycle. They recorded the motions of Venus for 21 years.

To the Babylonians, the motions of the planets were signs from the gods to be interpreted for the king.

"Venus disappears in the West. When Venus grows dim and disappears in Abu there will be slaughter in Elam. When Venus appears in Abu from the first to the thirtieth day, there will be rain, and the crops of the land will prosper...."

14. British Museum, CC BY-SA 3.0, via Wikimedia Commons.

1.3(B). BABYLONIAN MATHEMATICS: PLACE VALUE, SEXAGESSIMAL

1	𒁹	11	𒌋𒁹
2	𒁹𒁹	12	𒌋𒁹𒁹
3	𒁹𒁹𒁹	13	𒌋𒁹𒁹𒁹
4	𒁹𒁹𒁹𒁹	14	𒌋𒁹𒁹𒁹𒁹
5	𒁹𒁹𒁹𒁹𒁹	15	𒌋𒐗𒁹
6	𒐗	16	𒌋𒐗𒁹𒁹
7	𒐗𒁹	17	𒌋𒐗𒁹𒁹𒁹
8	𒐗𒁹𒁹	18	𒌋𒐗𒁹𒁹𒁹𒁹
9	𒐗𒁹𒁹𒁹	19	𒌋𒐗𒁹𒁹𒁹𒁹𒁹
10	𒌋	20	𒌋𒌋

Table 17*: Cuneiform numbers*

At least by the time of this Old Babylonian period, the Babylonians had developed a facility with mathematics sufficient for the advance of astronomy. Numbers from 1 to 9 were written with vertical marks. A horizontal mark represents 10. Numbers from 11 to 20 combined horizontal 10's and vertical 1's as needed. Therefore, 3 horizontal and 2 vertical marks (𒐕𒁹𒁹) equals 32. 3 horizontal and 8 vertical marks (𒐕𒐗𒁹𒁹) equals 38. Similarly, 5 horizontal and 9 vertical marks (𒌋𒌋𒐕𒐗𒁹𒁹) equals 59.

60's	1's	
	𒌋𒌋𒐕𒐗𒁹𒁹	59
𒁹		60
𒁹	𒁹	61

Table 18*: Cuneiform place value: Base 60*

But a remarkable thing happens when we write 60: instead of marking 6 horizontal signs for six tens, only a simple 1 sign is needed (𒁹). 61 is a 1 and a space, followed by another 1 (𒁹 𒁹). In other words, Babylonian mathematics employed a place value system, where the position of the sign in the number determines its value. A vertical mark can represent either 60 or 1, depending on where it is placed. Because of place-value, Babylonian numbers, quite unlike Roman numerals, are similar to our modern decimal system.

Decimal Place Value		
10's	1's	Tenths
6	3	5
60 + 3 + 0.5 = 63.5		

Sexagessimal Place Value		
60's	1's	1/60th's
𒐕	𒐗𒐗𒐗	𒌋𒌋𒌋
60	3	$^{30}/_{60}$
60 + 3 + 0.5 = 63.5		

Table 19*: Decimal and Sexagessimal place value: 63.5*

For us, the number 63.5 is represented by a 6 in the tens position, a 3 in the ones place, and a 5 in the tenths position. 60 plus 3 plus 5 tenths is 63.5. The Babylonian place value is a sexagessimal system, based not on 10 but on 60. 63.5 is represented by a 1 in the sixties position, a 3 in the ones place, and 30 in the sixtieths position (𒐕 𒐗𒐗𒐗 𒌋𒌋𒌋). 60 plus 3 plus 30 sixtieths equals 63.5.

A place value system enabled Babylonian astronomers to work easily with fractions, reciprocals, multiplication and division. Cuneiform tablets have been found with tables of squares, square roots, cubes and cubic roots.

Figure 64: Plimpton 322. Columbia University.[15]

One tablet known as Plimpton 322 dating to 1500 BCE contains Pythagorean triplets, or numbers which satisfy the relation we know as the Pythagorean theorem. If a right triangle has sides of 3 and 4 units in length, the hypoteneuse must be 5 units long. In general, the square of the hypoteneuse is equal to the sum of the squares of the sides. This tablet, known as Plimpton 322, contains many rows, where each row contains examples of Pythagorean triplets. Given the lengths of two sides of a right triangle, Babylonians could generate the length of the missing side.

15. Photo credit: Unknown.

Figure 65: YBC 7298 tablet (Yale University)[16]

Another tablet known as YBC 7298 tablet from the Old Babylonian period shows a value for the square root of 2. If two sides of a right triangle are each 1 unit in length, then the hypoteneuse must equal the square root of 2. This Yale University tablet shows a square with sides 30 units long. The length of the diagonal is recorded, and shows a value for the square root of 2. When translated to decimal notation, the Old Babylonian value is correct to 6 significant figures, with an error of only one in the seventh place.

Equipped with a sophisticated mathematics, Babylonians were prepared to develop an equally sophisticated quantitative astronomy.

1.4. Intervening dynasties, 1600-700 BCE

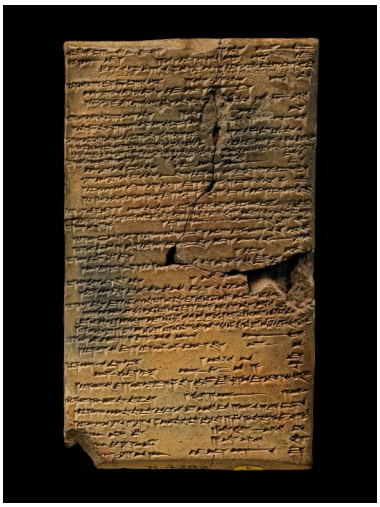
1.4(a). Tablets of Enuma Anu Enlil

For centuries after the Old Babylonian period, amid the tumult of revolutions of empires, through a variety of lesser known dynasties, the scribes sustained their careful inquiry into mathematics and astronomy. Because the scribes provided counsel for the king, their inquiry was of great importance to the empire. The scribes advised the king by divination, which is the art of interpreting omens such as dreams. The scribes also practiced divination by the stars, or astrology. To interpret the meaning of the stars, astrologers required a knowledge of astronomy as a mathematical science. Ancient astronomy and astrology were thoroughly mixed together.

Modern astronomy and astrology have no relation; there is no physical reason to expect the positions of the stars and planets to cause events on the Earth. Yet this modern separation between scientific astronomy and popular culture astrology does not mean that astronomy began only when astrology was set aside; rather, astrology remained the most important incentive for the development of mathematical astronomy up through early modern times. If we deny scientific status to Babylonian astronomy on the basis of its intermixing with astrology, then we will also rule out of court the astronomy of Copernicus, Kepler, and Galileo, for instance, each of whom cast horoscopes and worked as astrologers for their various patrons. The elimination of astrology from scientific astronomy has been a gradual and quite recent process of refinement, which is by no means yet accomplished in popular culture.

16. Urcia, A., Yale Peabody Museum of Natural History, http://peabody.yale.edu, hdl.handle.net/10079/8931zqj derivative work, user:Theodor Langhorne Franklin, CC0, via Wikimedia Commons; en.wikipedia.org/wiki/YBC_7289,

Figure 66: Enuma Anu Enlil (tablet 50), British Museum.[17]

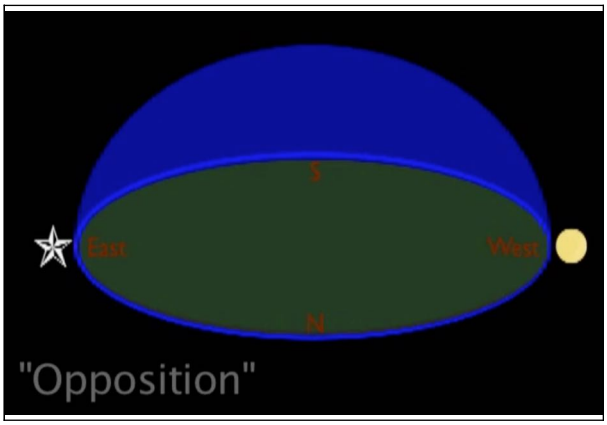


In the Kassite dynasty, from 1600 to 1200 BCE, the scribes of Enuma Anu Enlil compiled 70 tablets containing the interpretations of thousands of omens. These tablets were an experiment to collect observations of the Moon and planets, and then to see which, if any, of these various omens might correlate with economical prosperity, agricultural prices, civic health, and affairs of state, all of which were assiduously recorded.

1.4(b). Heliacal risings of bright stars

The tablets of Enuma Anu Enlil record observations of a wide variety of astronomical phenomena that the scribes believed might serve as possible omens. For example, the scribes observed the heliacal risings of bright stars such as Regulus, in Leo the Lion.

As the Sun moves around the sky once each year, it will sometimes be found on the opposite side of the sky from a star such as Regulus. When the Sun and Regulus are thus in "opposition," so that the angle between them is 180°, Regulus will rise when the Sun sets, and Regulus will be visible all night long.

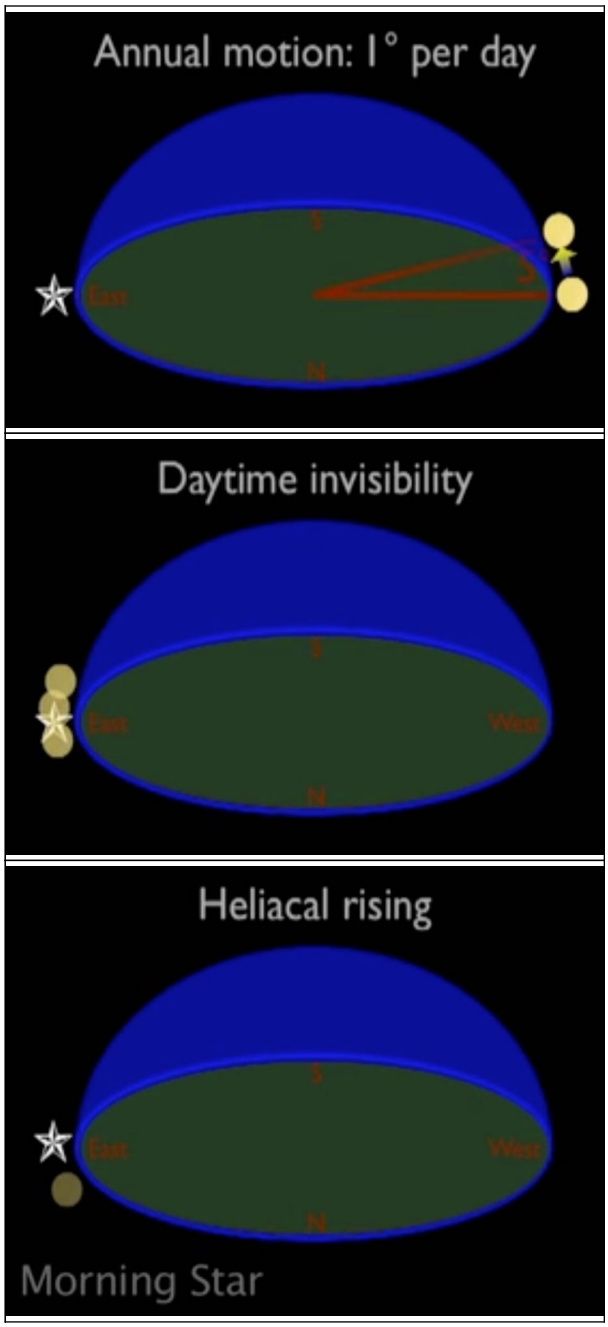


17. Photo credit: Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0).

Each night the Sun moves about one degree in a roughly eastward direction along its annual path known as the "ecliptic." In 10 days, the Sun will move about 10 degrees, roughly the width of one's fist held at arm's length.

Six months later, as the Sun approaches Regulus, Regulus and the other stars of Leo will disappear into the daytime sky.

Eventually, as the Sun continues to travel roughly eastward about a degree a day, the Sun will pass them by. A morning will come when Regulus rises on the eastern horizon, just before sunrise. This first appearance of Regulus after its period of invisibility in the daytime sky is called its "heliacal rising." After its heliacal rising, Regulus is a morning star, visible in the east just before sunrise.



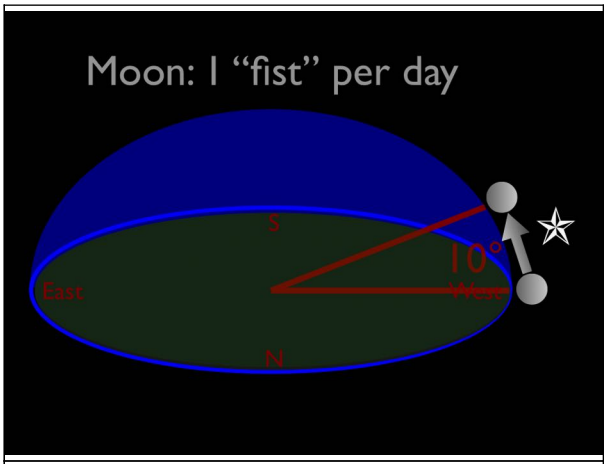
The Sun returns to the same place against the background of fixed stars each year, and the heliacal risings of important bright stars occur at certain fixed times of the year.

1.4(c). DIRECT MOTION OF PLANETS

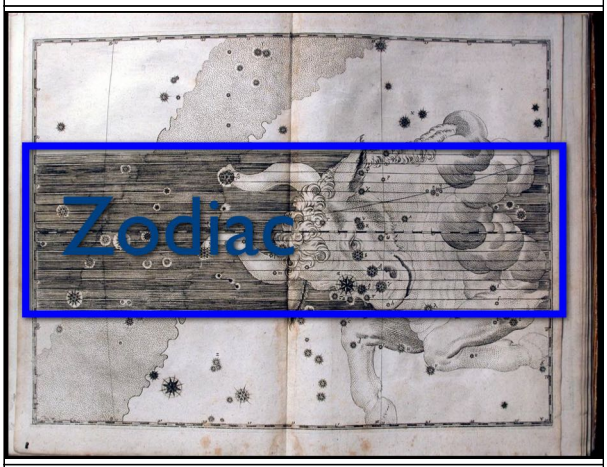
The scribes of Enuma Anu Enlil also watched the skies to observe the motions of the Moon and planets. We have seen that the Sun moves roughly eastward about a degree a day along the ecliptic, its annual path around the sky. Similarly, each planet and the Moon move roughly eastward, near the ecliptic, with what is called "direct" motion.

For example, on average the Moon moves about 10 degrees a day, roughly the width of one's fist held at arms length. If tonight the Moon is located a few degrees west of a star, then tomorrow night it will be a few degrees east of the same star.

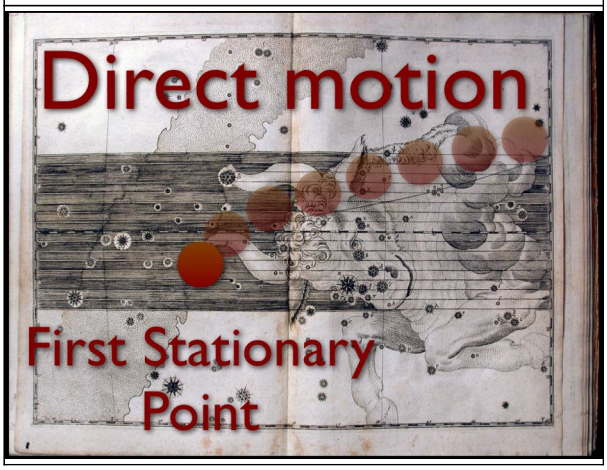
At this pace the Moon completes its journey around the sky in about a month.



Jupiter, Saturn, Mars and the other planets also complete journeys around the sky in this direct, roughly eastward motion. They never stray far from the ecliptic as they journey through the constellations of the zodiac.



Yet sometimes an outer planet like Mars will stop its direct motion, and rise several nights in a row near the same position against the background of fixed stars. This is its first stationary point.



On subsequent nights it moves backwards, reversing its path in the sky. This is retrograde motion. Coincidentally, retrograde motion only occurs when the planet is opposite the Sun, visible through the entire night. The planet appears much brighter during retrograde motion than at other times.

Eventually, the planet comes to another halt, which is the second stationary point. After rising a few nights near the same position in its second stationary point, it then resumes its ordinary direct motion.

1.4(D). LUNAR ECLIPSE RECORDS

Usually the Moon lies a little above or below the line between the Sun and the Earth, but occasionally it may happen to fall exactly on the line. If it does, then the Earth's shadow will move across the face of the Moon, eclipsing the Moon.[18]

In the late 8th century BCE, during the reign of Nabonassar, the scribes of Babylon initiated an effort to observe every lunar eclipse. Despite the tumults of later conquests and revolutions, the scribes maintained records of lunar eclipses in a continuous sequence down to the first century BCE.

18. Cf. Chapter 2, Section 9.2, "Lunar Eclipses prove the Earth is a Sphere" on pp. 63-64.

1.5. Assyrian period, 700-609 BCE

King	Century BCE
Ashurnasirpal II	9th
Shalmaneser III	9th
Tiglath-Pileser III	8th
Shalmaneser V	8th
Sargon II	8th
Esarhaddon	7th
Ashurbanipal	7th

Table 20*: Assyrian kings*

In the late 9th century BCE, Assyria ruled northern Mesopotamia from their capital city of Ninevah on the Tigris river. Tiglath Pileser the Third conquered the Babylon of Nabonassar. Eventually Assyrian forces extended their conquests as far as Palestine and Egypt.

Herodotos, a Greek historian of the Persian Wars in the 5th century BCE, knew nothing about earlier Mesopotamian civilizations, and Europeans in 1800 knew little more. Despite the magnitude of the Assyrian empire, it vanished without a trace until a French physician and diplomat named Paul-Émile Botta discovered the palace of Sargon II at Khorsabad, on the norhern outskirts of Ninevah, in 1843. Parts of Ninevah are still inhabited, yet finds at the mounds of Ninevah have cast much light on ancient Mesopotamian astronomy.

1.5(a). Library of Ashurbanipal

Issar-Sumueres, the chief scribe of Esarhaddon, advised the king to heed the omen of the retrograde motion of Mars:

> "If Mars, retrograding, enters Scorpius, do not neglect your guard; the king should not go outdoors on an evil day. This omen is not from the Series [of Enuma Anu Enlil]; it is from the oral tradition of the masters.... Wherever else it might retrograde, it may freely do so, there is not a word about it."

The 7th century ruler Ashurbanipal amassed a vast library of Sumerian, Babylonian and Assyrian literature. This library was discovered in 1853 by Austen Henry Layard. Finds included one thousand tablets of planetary omens sent to the Assyrian king from the scribes of Enuma Anu Enlil in Babylon. In appreciation, Ashurbanipal rebuilt their Temple of Esagila.

1.5(B). MUL APIN TABLETS

Figure 67: Mul Apin tablet. British Museum.

Mul Apin tablets were copies (of much older originals) made for the library of Ashurbanipal.[19] The Mul Apin series contains the names of stars and constellations, including the Bull, the Balance, the Lion, Scorpion, Twins, and a Sea-Goat.

In circular star charts, bright stars are listed in three regions (Ea, Anu or Enlil), according to where they rise on the horizon. The Mul Apin star calendar was far more complete and systematic than *Works and Days*, a comparable Greek calendar by Hesiod.

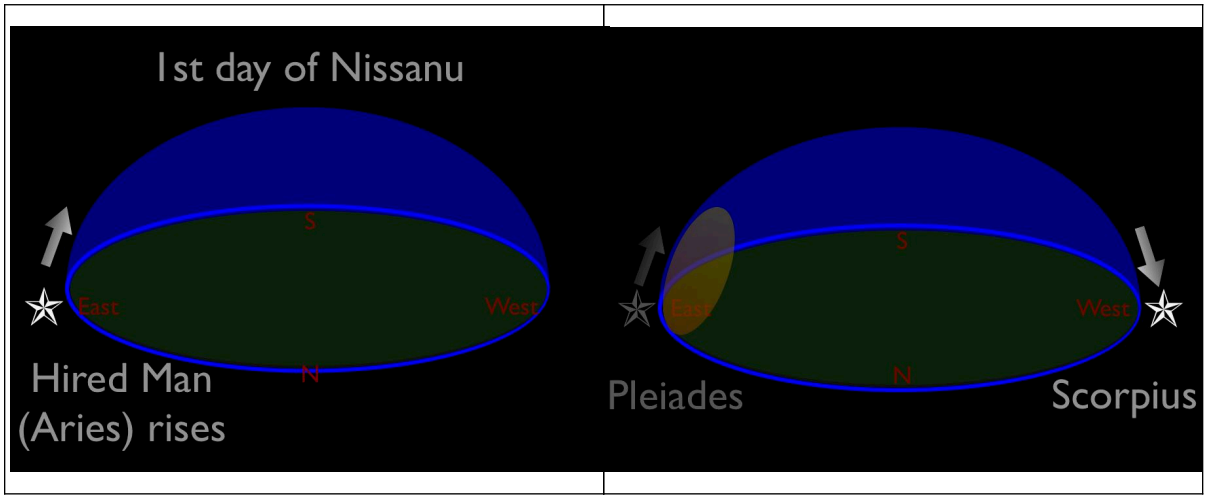
Mul Apin tablets include a star calendar based on the dates of the heliacal risings of bright stars:

"On the 1st of Nisannu the Hired Man is visible"

But what if there is bad weather? What if the eastern horizon is obscured by sandstorms or clouds? For this reason the Mul Apin astronomers included a list of simultaneous risings and settings.

"The Pleiades rise and the Scorpion sets"

If the eastern horizon is obscured, then just before sunrise one may look to the west. If Scorpius is setting, then the Pleiades must be rising.



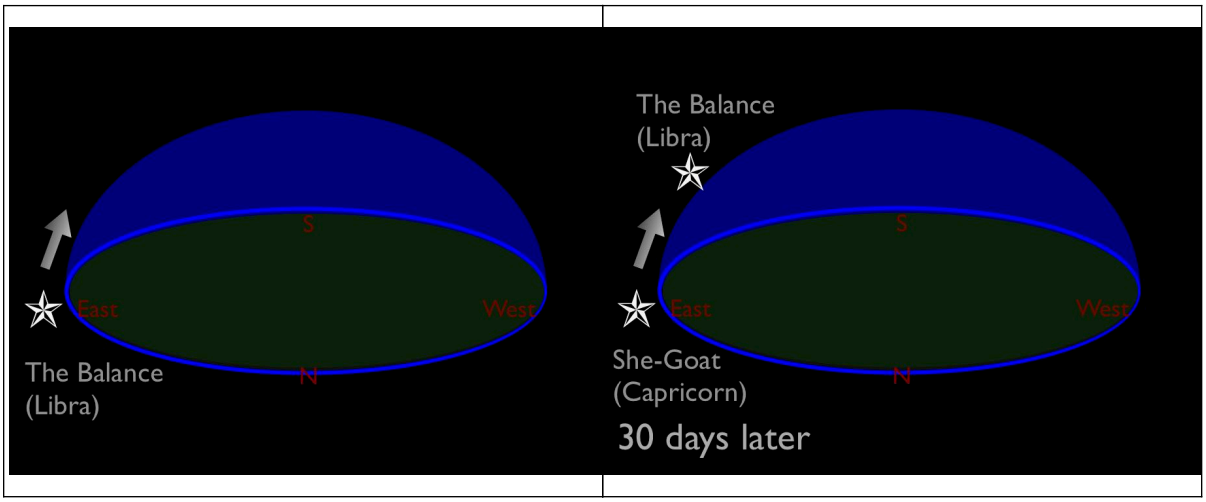
19. "Mul-Apin" is the first word of the tablet, "The Plow-star, Enlil, who goes at the front of the stars of Enlil."

In 250 BCE, Aratos of Soli would write a similar Greek work called the *Phenomena*.

Mul Apin scribes also tabulated the number of days between morning risings.

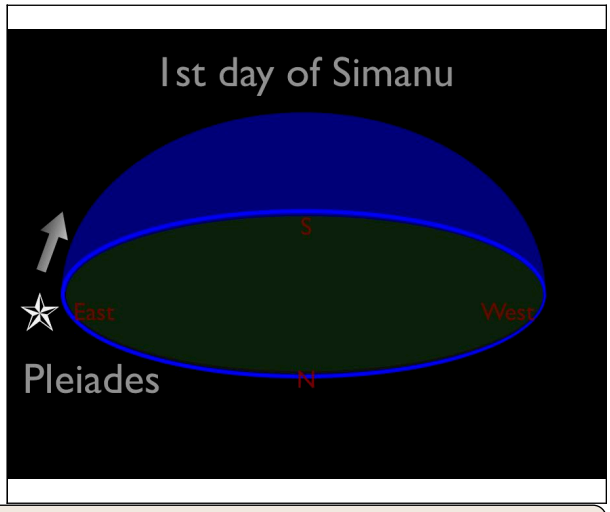
"30 days pass from the rising of the Balance to the rising of the She-Goat."

When bad weather prevailed and both horizons were obscured, the Scribes could still infer what bright star must be rising by counting the number of days since the previous month's rising.



The Babylonian calendar was a "Luni-solar" calendar, where each month began with the the first sighting of the Crescent Moon. First sightings of the Crescent Moon occur either 29 or 30 days apart. Therefore 12 lunar months require 354 days; while the Sun requires slightly more than 365 days to complete its annual cycle. This means that the lunar and solar calendars fall out of sync about 11 days each year.

The Mul Apin tablets offered rules for when to add a 13th month:



"If the Pleiades become visible on the 1st of Simanu, this year is a leap year."

Figure 68: Goal year tablet (British Museum)

The Mul Apin tablets are not the only astronomical writings discovered in ancient Assyria. "Goal Year" texts were records of the motions of planets in the past. The scribes could then match the current motions of any planet with the pattern it showed during a similar year in the past. For example, the goal year of Jupiter is 71; this means that to predict how Jupiter will move this year, one needs records of how it appeared 71 years ago. Similarly, the goal year of Venus is 8 years; this year, Venus will appear to move much as it did 8 years ago. The compilation of goal year texts enabled the scribes to predict the positions of each planet, not by calculation on the basis of theory, but simply by consulting past goal year records.[20]

The scribes discovered that lunar eclipses occur in patterns so that they could predict when an eclipse could be ruled out, when it might occur, and when it was sure to happen.[21]

1.6. NEW BABYLONIAN (CHALDEAN) PERIOD, 626-539 BCE

King	Century BCE
Nabopolassar	7th
Nebuchadnezzar	6th
Nabonidus	6th

Table 21*: New Babylonian kings*

The Babylonian ruler Nabopolassar defeated the Assyrian empire in 612 BCE, ushering in the New Babylonian period. The New Babylonian empire reached its zenith with Nebuchadnezzar's defeat of the Egyptians at Carchemish in 605 BCE. Returning home, Nebuchadnezzar took Hebrew captives with him to Babylon, as told in the Book of Daniel. In 587 BCE he returned to Palestine to crush Jerusalem, forcing the Jewish people into exile.[22]

20. The goal years for the planets are: Jupiter, 71 years; Saturn, 59 years; Mars, 79 and 47 years; Venus, 8 years; Mercury, 46 years; Moon, 18 years.

21. Lunar eclipses frequently occur 6, 12 or 18 months apart. The earliest documented successful lunar eclipse prediction was made in the 7th century BCE.

22. In 605, Daniel and his friends were taken captive to Babylon; the fall of Jerusalem, and exile of Judah to Babylon, occurred in 587 BCE.

1.6(a). Astronomical Diaries

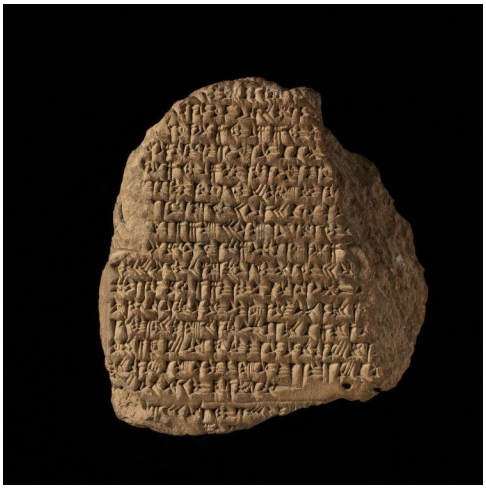


Figure 69: Astronomical diary tablet. British Museum. Photo credit: ADART 1.[23]

For 600 years, beginning in this era, the Scribes of Enuma Anu Enlil maintained a continuous series of Astronomical Diaries. In these diaries they recorded observations of the Moon, planets, heliacal risings of stars and other phenomena. A typical diary entry might take this form:

> "In year x of King y, month z, day n, Mars reached its first stationary point; it was in zodiacal sign z."

Other records explicitly correlated celestial events with meteorology, economics, politics and warfare, or other potential omens:

> "If you want to make a prediction of the market price of barley, notice the movement of the planets. If you observe the first visibilities, the last visibilities, the stationary points, the conjunctions, ... the faint and bright light of the planets and zodiacal signs and their positive or negative latitude... your prediction for the coming year will be correct."[24]

The scribes collected observations on a scale not seen again until the statistical and economic surveys of modern states in the 18th-19th centuries. As historian of astronomy Noel Swerdlow explains:

> "Their systematic observation and recording of phenomena ... has remained to this day the longest and most comprehensive program of astronomical observation ever carried out.... extending from the 8th or the 7th to the 1st century, ... the longest continuous scientific research of any kind in all of history, for modern science itself has existed for only half as long."[25]

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23. Photo on blog post about ADART 1: ancientworldonline.blogspot.com/2010/07/open-richly-annotated-cuneiform-corpus.html. The standard source is Abraham Sachs and Hermann Hunger, eds., *Astronomical Diaries and Related Texts from Babylonia* (Vienna: Austrian Academy of Sciences, 1988-2014), 7 vols. An online searchable edition is being prepared: e.g., ADART 1 contains a searchable edition of the texts published in vol. 1: "Diaries from 652 B.C. to 262 B.C."; oracc.museum.upenn.edu/adsd/adart1/, content released CC BY-SA 3.0.

24. 4th century BCE. Source?

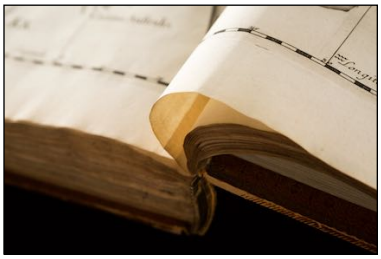
25. Here as elsewhere I rely upon Noel Swerdlow, *The Babylonian Theory of the Planets* (1998), p. #?

1.7. Persian empire, 559 - 331 BCE

King	Century BCE
Cyrus	6th
Darius	6h
Xerxes	5th
Artaxerxes	5th

Table 22*: Persian kings*

Close Reading #1: Dorothy L. Sayers, "A Vote of Thanks to Cyrus."[26]



From eastern Mesopotamia, the Persian king Cyrus the Great (d. 530 BCE) swept upon Babylon, conquering it in 539 BCE. Cyrus freed the Jews in exile there, who returned to Palestine.

Figure 70: Behistun inscription[27]

26. Dorothy L. Sayers, "A Vote of Thanks to Cyrus," in *The Whimsical Christian* (New York: Macmillan, 1978), pp. 53-59.

27. Photo by Hamidreza Sorouri, PersianDutchNetwork, CC BY-SA 4.0, commons.wikimedia.org/w/index.php?curid=50210803.

Darius the Great ruled the Persian empire from his palace in Persepolis until 486 BCE. Although his palace was later destroyed by Alexander the Great, inscriptions there led to the modern decipherment of cuneiform by Georg Friedrich Grotefend and Henry Rawlinson in 1837.[28] On the side of this 1,700 foot mountain near Behistun, dangling from ropes 300 feet above ground, Rawlinson transcribed inscriptions of Darius written in three parallel cunieform scripts: Old Persian, Elamite, and Babylonian.[29]

The ancient historian Herodotos recounted, in his book *The Persian Wars*, how the Greek city states united to turn back the Persians' attempt to conquer them under King Xerxes.

The Persian King Artaxerxes supported the efforts of the Jews under Esther, Ezra and Nehemiah to rebuild their Temple in Jerusalem.[30]

1.8. SELEUKID (GREEK) PERIOD, 335-141 BCE

Alexander the Great came like a bolt out of the west and conquered the Persian empire in 331, before dying in Babylon in 323 BCE. At his death, Alexander's four generals divided his conquests. Ptolemy controlled Egypt; and Mesopotamia was given to Seleukis. Through the revolutions of empires, under Persian and then Seleukid rule, the scribes of Enuma Anu Enlil continued their astronomical investigations.

In the late 19th century, scholars working in the British Museum discovered 300 tablets of Seleukid-era mathematical astronomy, apparently from two locations, Uruk and Babylon. These tablets represent the climax of Mesopotamian cuneiform astronomy, because in them the Scribes of Enuma Anu Enlil, including one named Kidinnu, discovered how to make accurate numerical predictions of complex planetary events.

The texts include *ephemerides*, which are calculated tables predicting the times and locations of planets during significant planetary events, and *procedure texts*, which explain the rules for calculating the ephemerides. In their planetary ephemerides, scribes accurately predicted the first and last visibility of planets, the first and second stationary points, and the duration of retrograde motion. With these texts Babylonian astronomy became fully mathematical, no longer dependent upon constant empirical input.[31]

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28. Georg Friedrich Grotefend, *Beiträge zur Erläuterung der persepolitanischen Keilschrift* (1837); "Contributions to a Commentary on Persepolitan Cuneiform Writing."

29. Henry Rawlinson, *Persian Cuneiform Inscriptions at Behistun* (1846).

30. Artaxerxes I, 464-423; Biblical events: Esther, Ezra, Nehemiah in Jerusalem.

31. Ephemerides were more like a computer program than a field notebook. Åboe asserts (p. 36), "The creation of mathematical astronomy is thus one of the last, as well as one of the finest, original efforts of Mesopotamian culture, an event without precedent anywhere, and with great consequences." Åboe distinguishes three levels of ancient astronomy, where in the Seleukid period the Babylonian scribes attained the third: 1. Naming and Recognition of celestial phenomena; 2. Recognition of various cyclic patterns or periodic rules for planetary motion; and 3. Numerical functions to predict observations with

Come my friend, let me show you the tablets for this month. Here you can see I have calculated that Mars will begin to retrograde tonight, Jupiter is in Taurus the Bull, and Regulus will rise in the east just before sunrise. The Moon is now moving much faster than usual along the zodiac; tonight it will appear in Gemini. These things will happen just as I have foretold, and we will interpret them for the king.

Figure 71: Zig-zag functions

To calculate planetary positions, Kidinnu and the other scribes used a technique of arithmetical progression known today as a zigzag function. This technique accounted for the non-uniform speeds of the Moon and planets, by altering the speed by a prescribed amount at regular intervals.

Given the accuracy of these arithmetical functions, the Scribes were not concerned with the geometry of rotating spheres, so central to the models of their Greek successors. Unlike the early Greek astronomers, whose models were strictly qualitative, the Babylonian scribes attempted and achieved the ideal of quantitative prediction.

Historians do not know how Greek astronomers learned Babylonian mathematical astronomy, but somehow they did. Greek musicians and mercenary soldiers occasionally visited Babylon during the New Babylonian and Persian empires, but after Alexander's conquest, east-west travel and intellectual exchange intensified.

A former head of our order foretold that your Alexander the Great would capture Babylon. Before he died, Alexander ordered the restoration of our Temple of Esagila. To repay this favor, I am willing to teach one of your Greek sages our astronomical arts. When you return to your city, tell them what you have seen and heard, and send them back to me.

1.9. SIGNIFICANCE OF BABYLONIAN MATHEMATICAL ASTRONOMY

At the beginning of the 19th century, the ancient Mesopotamian civilizations were little more than a myth, lost in the remote reaches of time. In the Athens of Aristotle, Mesopotamian civilization was already ancient. Today we know more about ancient Babylon than Aristotle did.

Much of that story is a dismal succession of destruction, revolution, and rebuilding. Considering the social disruptions of wars, invasions, and revolutions, the diversity of ruling dynasties, and even the variety of ethnicity, language, and capital cities, the remarkable fact is that for two millenia there were any continuities at all:

- There were continuities of language, including a persistance of Sumerian and Akkadian vocabulary.

minimal initial observational input. This latter achievement is the basis for Åboe's assessment of Babylonian astronomy.

- Works of literature and mythology were preserved, including the Epic of Gilgamesh. The Scribes continued to serve successive empires as a highly trained intellectual and religious elite.
- Mathematical techniques also persisted from Old Babylonian to the Seleukid period.
- The idea that heavenly events determine events on earth continued; astrology served as the crucial motivation for Babylonian astronomy.
- As with literature, art, and architecture, the Scribes maintained continuity despite the great political changes and the devastations of conquest.

In so doing, the Scribes of Enuma Anu Enlil created the tradition of mathematical astronomy. They designated the 12 signs of the Zodiac; perfected the luni-solar calendar; accurately determined planetary periods; predicted lunar and solar eclipses; and calculated important events in planetary cycles, including the first and second stationary points and the duration of retrograde motion.

"Wherever else we encounter scientific mathematical astronomy, we can detect... the influence of the Babylonian[s]."[32] In early Greek natural philosophy, there was nothing comparable to the Babylonian achievement in astronomy, until cultural interchange between Mesopotamia and Greece increased after Alexander the Great. Around 150 BCE, Hipparchos of Nicaea discovered the 26,000 year cycle of precession. This discovery was possible only because Hipparchos used Babylonian determinations of the length of the year.[33] Claudius Ptolemy wrote the greatest astronomical work of antiquity, the *Almagest*, in 150 CE. In the *Almagest*, Ptolemy relied upon the Babylonian calendar and other Babylonian observations, including lunar eclipses going back to 750 BCE.

When we tell time by minutes and hours, or measure angles in degrees, we are still today heirs of Babylonian sexagessimal mathematics.

Yet the most important legacy of Babylonian astronomy is the ideal of the exact quantitative prediction of natural phenomena. Historian Asger Åboe explains:

> "Babylonian mathematical astronomy was the origin of all subsequent serious endeavour in the exact sciences."[34]

Until recently, many historians dismissed the significance of Babylonian astronomy for the history of science because of its obvious astrological and religious character. Babylonian astronomers predicted the motions of the planets, but because of their religious beliefs they did not attempt to offer physical explanations of the causes of these motions. Yet

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32. "Wherever else we encounter scientific mathematical astronomy we can detect, directly or indirectly, the influence of the Babylonian forerunner." Åboe, 36.

33. G. J. Toomer argues that Hipparchos traveled to Babylon and learned cuneiform astronomy for himself. Cite***

34. Åboe, 40.

> "mathematical science in the service of the interpretation of omens is still mathematical science."[35]

The Scribes maintained an indifference to causes, but so did Isaac Newton in the 17th century. Newton set forth mathematical laws describing gravity without specifying the actual physical cause of gravity.

> "In science causes are ephemeral while mathematics endures."[36]

The economist and Newton scholar John Maynard Keynes explains:

> "Newton was not the first of the age of reason. He was the last of the magicians, the last of the Babylonians and Sumerians, the last great mind which looked out on the visible and intellectual world with the same eyes as those who began to build our intellectual inheritance rather less than 10,000 years ago."[37]

Today, whenever we use the sexagessimal system, observe the constellations of the Lion or the Bull, rely upon quantitative mathematical science, read our horoscopes, interpret the results of the latest poll, or try to predict the will of the gods, we are modern Babylonians.

Come join with me as a watcher of the night. As we look out from these heights over the splendor of the city, our vision rises to things beyond mortal human life. We fly to the stars, the home of the gods. With our secret mathematical arts, guided by the sacred writings of long ago Scribes, we interpret the signs of the heavens, for the good of the king and empire.[38]

35. Swerdlow, 182.

36. Swerdlow, 182.

37. Keynes, "Newton, the Man." Cite***

38. With this concluding comment by the fictional Kidinnu, the video "Stars over Ancient Babylon" ends; see note 4 on page 153.

2. Science and Scripture: The Magi and the Star

I have long been interested in questions about the Star of Bethlehem, as a lifelong amateur astronomer, a former planetarium director, and as a professional historian of science.[39] While Chapter 2 challenged our assumptions about science and *history*, and the first section of this chapter challenged our assumptions about science and *religion*, this section will stimulate our thinking about science and *scripture*.

2.1. Intro

With all the legends and lore that accompany our Christmas carols and celebrations, sometimes purely fanciful elements seem to rise to the fore, making it difficult to distinguish popular ideas from what might have actually happened. Who were the magi? Why did Matthew recount in the way he did the story of how they followed the Star? What does it all mean, anyway?

Assuming it would be simplistic and misconceived to try to prove scripture from science or to prove science from scripture, what exactly is the nature of their relationship? Is it ever possible to draw upon information from science in our attempts to understand the biblical text? How do we read the "Two Books"?[40]

There are at least four parts to our story: What does Matthew say? What was the Star? Who were the magi, really? How are our ideas shaped by legend and later lore? We'll be very selective in our discussion, for any one of these topics would garner sufficient material for a semester course in college.

What does Matthew say?

First is the text of Matthew. What did Matthew actually say about the Star? Sometimes our interpretations of scripture reflect our own preconceptions more than the text itself. For example, consider just the opening phrase, "During the time of King Herod, magi from the east came to Jerusalem..." (Matthew 2:1). Herod's death in 4 BCE is well attested due to a

39. Over the years I have frequently given public talks on the magi and Matthew's star at churches and various Christian gatherings, including during my tenure in the 1990's as director of the OBU Planetarium. Finally, in 2020, I created a 47-minute video of that talk entitled "The Magi, the Star, and the History of Science," available online at vimeo.com/477359942. This chapter is based upon the script for that video and and on my short entry on the Star for the *Zondervan Dictionary of Christianity and Science* (Grand Rapids, Michigan: Zondervan, 2017), pp. 644-646. See also my post about the magi on my personal blog: kerrysloft.com/family/christmas-reflections-magi/.

40. See the Introduction for a discussion of the "Two Books," beginning on p. 16. This is not an attempt to prove Matthew by an argument from science about the Star. The Star may indeed have been an angel and not a natural phenomenon at all. But if it was a natural phenomenon, then some light may be thrown on Matthew's account by coming to a better understanding of the astronomy of the Babylonian magi as presently understood through scholarship in the history of science.

lunar eclipse which occurred shortly beforehand, so most scholars think that Christ was born not in 1 CE but in 5 BCE. We do not know the season, month, or day.

According to Matthew 2:1, the magi came from east of Judea, not from the Roman empire. Matthew's magi were not like the magi spoken of elsewhere in the New Testament such as Simon Magus, described in Acts 8:9, who was from Samaria. Samaria is north of Jerusalem. Nor were Matthew's magi like the sorcerer Bar Jesus, spoken of in Acts 13:5, who was from Cyprus, which is to the west. The term magi had many meanings at this time, which can lead interpreters astray, but Matthew states that the magi who came to worship Jesus were from the east. Descriptions of magi located within the Roman empire do not apply to the magi in Matthew's account.

The magi's interpretation of the Star according to their own wisdom led them to Jerusalem; Herod then sent them to Bethlehem on the basis of Micah's prophecy (Micah 5:2). Matthew says nothing about the brightness of the Star. The nature of the Star was not the point he wanted to communicate. We may infer that the Star was not obvious enough to have been noticed in Jerusalem; people became agitated due to the appearance of the magi, not the Star.

According to Matthew, the magi were wise men; he does not call them kings. Matthew says there were three gifts; he does not say how many magi. For all we know, there may have been 60 or 70, with an armed military escort. Given the hospitality shown them by Herod, the magi were likely an imposing delegation on an intimidating visitation from the powerful Parthian kingdom.

Matthew does not specify any particular meaning of the gifts other than that they were royal tributes. The same gifts were offered to King Solomon by the Queen of Sheba (1 Kings 10:1-10). The story of the Queen of Sheba anticipates the visit of the magi who brought a similar royal tribute from afar, probably expecting to present it at Herod's palace.

From their conversation with Herod, we can surmise that the magi did not arrive in Bethlehem on the same night as the shepherds, but within two years of his birth. Matthew 2:11 states that "on coming to the house, they saw the child..." Rather than a new-born, they saw a παιδίον (*paidion*), a "child." And not in a cave or stable, but an οἰκίαν (*oikia*), or "house." Other phrases in Matthew's text also contain more than meets the eye, and we need to keep on our toes.[41]

Let's summarize some of the inferences we may draw from Matthew's text (Table 23, rows 1-6). These criteria must be satisfied in any proposed explanation of the Star.

41. For a closer reading of Matthew's text, see my blog post, "Christmas reflections – magi," kerrysloft.com/family/christmas-reflections-magi/, and click the link for an exegetical sermon.

1	Magi from east of Judea	Matthew
2	Magi saw Star in the east < 2 yrs	
3	Star did not lead to Bethlehem	
4	Star not obvious in Jerusalem	
5	Star went before them	
6	Star stood over the place	
7	Star confirmed at the right time	Star
8	Star implied birth of king in Judea	Magi
9	Star intelligible to the magi	

Table 23*: Star Checklist.*

What was the Star?

Second, what have astronomers said about the Star? What interesting celestial events occurred around the time of the birth of Christ that might be a candidate for the Star of Bethlehem? It turns out that astronomers have proposed far more plausible candidates for the Star of Bethlehem than we have time to inventory. If one enjoys astronomy, studying candidates for the Star is an engaging prospect, for at one time or another practically every interesting astronomical phenomenon has been proposed. The multitude of theories fall into two general groups: first, theories that regard the Star as an unexpected source of bright light such as a nova, supernova, or comet; or second, as a familiar planet moving into a significant configuration during the course of its planetary cycle. We will say more about these theories below. While we cannot expect to settle the question on the basis of astronomical evidence, nevertheless, astronomers can confirm for us whether any proposed phenomenon really happened in the sky at that time (Table 23, row 7).

Who were the magi, really?

A third factor usually receives less attention than Matthew or the Star, and that is the magi. To explore the nature of the Star of Bethlehem, the history of astronomy and what it can tell us about the magi will be even more important than the contributions of astronomy itself. In this chapter we will regard them, like Daniel much earlier, as Scribes of Enuma Anu Enlil. We need to ask for historical evidence whether any theory about the Star would have made sense to the magi (Table 23, last two rows).

How are our ideas shaped by legend and later lore?

And finally, we need to distinguish between contemporaneous evidence about the magi in the time of Christ and the accretions of legend and later lore. Just as the 4th-century Bishop of Myra who was the original St. Nicholas bears little relation to the modern Santa Claus, so our visions of the magi have been shaped through centuries of affectionate embellishment.

So: What did Matthew say? What have astronomers said down through the centuries about the Star? What do historians of science say about the magi? How much are our views embellished with legend and later lore?

2.2. The Star: Options for Interpretation

Option	Pro	Con
Myth or legend	Fanciful and spurious tales	Magi historical
Inexplicable	Went "before them," "stood over" the place...	Supernatural interpretation not required by Matthew
Natural, astronomical	Basis for magi's divination	Multitude of hypotheses...

Table 24*: Options for Interpreting the Star*

There are three main options for interpreting the Star: Perhaps it is a myth or a legend. Or, the Star may have been real, but with an inexplicable, unknowable cause. Perhaps it was a supernatural appearance. Or, it might have been a natural event that could in principle be explained by astronomy and the history of astronomy.

2.2(a). Option #1: Myth or Legend

First let's consider the argument that it is a fanciful tale, not a historical event. The journey of the magi did not end in Bethlehem. They have traveled in lore down to our times far and wide through story and legend.

> "The kings of Tarshish and distant shores will bring tribute to him; the kings of Sheba and Seba will present him gifts. All kings will bow down to him and all nations will serve him..." (Psalm 72:10-11, NIV)

Psalm 72:10 was interpreted by early Christians as a prophecy of the Messiah fulfilled by the magi. That they were kings, and the lands of origin attributed to them in later legend, seem based upon this verse (and a few others). We can see this in a 6th century Syriac writing, The Cave of Treasures, which named the three magi and designated them as kings of Persia, Saba and Sheba (Figure 25, top row).[42]

Melchior, Balthasar, and Gaspar are more familiar names for the magi. These derive from a Greek tradition dating back to the 6th century. Melchior was said to come from Persia; Balthasar from Arabia, and Gaspar from India (Figure 25, 2nd row). These names were popularized in the 19th century novel *Ben Hur*.[43]

42. Syriac 6th. Cite.

43. Greek 6th. Ben Hur. Cite.

Source	King	King	King
Syriac, 6th	Hormizdah, Persia	Yazdegerd, Saba	Perozadh, Sheba
Greek, 6th	Melchior, Persia	Balthasar, Arabia	Gaspar, India
Irish, 8th	Gold, King	Myrrh, Sacrifice	Incense, Deity
Marco Polo, 13th	Gold, King	Myrrh, Sacrifice	Incense, Deity

Table 25*: Lore of the Three Kings*

An Irish tradition from the 8th century used the same names, described their physical appearance, and explained the meanings of their gifts, as follows: "Melchior, an old man with white hair and a long beard... offered gold to the Lord as to a king." The second, "black-skinned and heavily bearded, named Balthazar... by his gift of myrrh testified to the Son of Man who was to die." The third, "Gaspar by name, young and beardless and ruddy complexioned... honored him as God by his gift of incense, an oblation worthy of divinity."[44]

When Marco Polo traveled across Persia in the late 13th century, he reported visiting the tombs of the magi near present-day Tehran. He wrote:

> "In Persia is the city called Saveh from which the three Magi set out when they came to worship Jesus Christ. Here too, they lie buried in three sepulchres of great size and beauty.... Their bodies are still whole, and they have hair and beards. One was named Baltazar, the second Gaspar, and the third Melchior. The inhabitants declare that in days gone by three kings of this country went to worship a new-born prophet and took with them three offerings – gold, frankincense, and myrrh – so as to discover whether this prophet was an earthly king, or a god, or a healer."[45]

Other claims to the tomb of the magi were asserted within Europe. In 490 CE, the Roman emperor Zeno obtained what were believed to be the bones of the magi – bodies not whole, nor with beards – from the town of Hadramat in South Arabia. From Constantinople they were sent to Milan. Later, in the 12th century, when the Holy Roman Emperor Frederick Barbarossa conquered Milan, the relics were sent to the great Gothic cathedral at Köln (Cologne), arriving there in jubilant procession in 1164. We commemorate their final journey in a popular Christmas carol:

> I saw three ships come sailing in, On Christmas Day, on Christmas Day,
> I saw three ships come sailing in, On Christmas Day in the morning.
> And who was in those ships all three, On Christmas Day, on Christmas Day?[46]

44. Irish 8th.
45. Marco Polo
46. Cite Carols

In the original version of this carol, the three ships referred to the three magi arriving in Köln via ships sailing on the Rhine. Köln is located in Germany on the Rhine river near the west border with France. The Köln cathedral is the largest Gothic cathedral in northern Europe. The gold-covered shrine holding the relics is the largest reliquary in Europe. Allegedly, their skulls are still there.

But what if we ask, "What if there had been three wise women?" According to what has become a social media meme, they would have asked for directions; arrived on time; helped deliver the baby; brought a casserole; cleaned the stable; provided bottles and formula; and changed his diapers.

Figure 72: Meme of the Three Wise Women[47]

Clearly the story of the magi has been embellished with fanciful and spurious tales.

Yet the magi of Matthew's day were historical figures, not legendary. Moreover, as we have seen, their astronomical knowledge in the first century BCE was sophisticated, not trivial. Much is now known about the magi and their astronomical practices.

The historical magi came from Rome's powerful rival, the vast Parthian empire to the east. The most important astronomical center was Babylon, where the magi were known as the Scribes of Enuma Anu Enlil. The journey along ancient major roadways would have been about 550 miles, and required perhaps 1 to 2 months.

In the previous section, we explored the birth of mathematical astronomy in ancient Mesopotamia. The magi used the ziggurat of Babylon and worked in Babylon's great Temple of Esagila up through the first century CE. This ancient tradition of mathematical astronomy is found on clay tablets in cuneiform script.

47. Photo credit: Unknown.

Figure 73: Choga Zanbil

This cuneiform brick, held by the OU History of Science Collections, dates to around 1300 BCE. It comes from the ziggurat of Choga Zanbil, near Susa, in southwest Iran. The ziggurat of Choga Zanbil is now a World Heritage site. It is the best preserved ziggurat of antiquity. The ziggurat was faced with baked bricks like this one, usually inscribed with dedicatory prayers.

The Mesopotamian astronomers, working in ziggurats, were more advanced than their contemporary Greek and Roman astronomers, and they were the original source of quantitative methods in ancient mathematical astronomy. People often think of the Greeks as the inventors of mathematical astronomy, but that is a misconception. Mesopotamian astronomy was transmitted to Greek, Roman, Middle-Eastern and Asian cultures in different ways and to varying degrees.

12 signs of the Zodiac, equal lengths	
Perfection of luni-solar calendar	
Prediction of Lunar eclipses	
Prediction of Solar eclipses	
Determination of planetary periods	
Mathematical calculation of the times of important events in regular planetary cycles	Risings (first appearance after daytime invisibility)
	Retrograde motion
	Stationary points
	Etc.

Table 26*: What the magi knew (3rd century BCE)*

But what did the magi know, considering what we can say from the cuneiform tablets that have been recovered so far? Figure 26 is a short list, based on Section 1 above, all of which were achieved by no later than the third century before Christ. We'll have more to say in a few minutes about retrograde motion, stationary points, and how planets move, all of which the magi not only watched and recorded, but could predict hundreds of years in advance.

Our point of reference is not astrology in the *Roman* empire, but how astrology was practiced in the *Parthian* empire, which is relatively unstudied. Unfortunately, our preliminary knowledge of Parthian astrology is simply insufficient to definitively interpret the Star.

But we can say a few things about the magi's contact with Jewish intellectuals. Few would doubt that the magi knew of the Jewish belief in a coming Messiah, a conquering king, because of Hebrew settlements in Babylon after the exile under Nebuchadnezzar in 586 BCE. An effective way to gain a sense of who the magi were, and what they might have been thinking, is to read a book all of us own – the biblical book of Daniel. According to that account, Daniel himself became the head of their order in Babylon:

> "Then the king promoted Daniel, gave him many great gifts, and made him ruler over the whole province of Babylon and chief prefect over all the wise men of Babylon...." (Daniel 2:48 NRSV)
>
> "There is a man in your kingdom who is endowed with a spirit of the holy gods... Your father, King Nebuchadnezzar, made him chief of the magicians, enchanters, Chaldeans, and diviners..." (Daniel 5:11 NRSV)

What if the magi knew the book of Daniel and its prophecies of the revolutions of empires?

Babylonian
Medo-Persian
Greek-Seleukid
Roman-Parthian
Everlasting Kingdom not made with human hands

Table 27*: Revolution of Empires in Daniel.*

The business of the magi, above all, was to advise the King on the revolution of empires. Their chief concern was the succession of rulers. Regardless of questions about its date or composition, the book of Daniel as it has come down to us accurately reflects this preoccupation. In Daniel's famous interpretation of the dream that troubled Nebuchadnezzar, he asserted that the God of heaven gives dominion, not the stars. And Daniel explained that there would be four empires until God's everlasting kingdom arrived. These four empires would last 70 weeks, or 490 years from the decree to restore Jerusalem and then the Messiah's everlasting kingdom would come. Unlike the long succession of Mesopotamian kingdoms, the Messiah's kingdom will never be destroyed, and all nations of the world will worship him. When this everlasting kingdom arrives, divination by the stars – the way of life of the magi – will pass away.

The book of Daniel describes the one whom Matthew's magi were seeking:

> "In my vision at night I looked, and there before me was one like a son of man, coming with the clouds of heaven. He approached the Ancient of Days and was led into his presence. He was given authority, glory and sovereign power; all peoples, nations and men of every language worshiped him. His dominion is an everlasting dominion that will not pass away, and his kingdom is one that will never be destroyed." (Daniel 7:13-14)

Through the book of Daniel, God prepared the way to bring the magi, hundreds of years later, to worship Christ at his birth. The magi represent how the coming of Jesus was the joy and desire of all nations.

However, the vigorous cuneiform tradition in astronomy soon came to an end for the magi in Babylon. Their temple and ziggurat were destroyed one or two generations after the magi's visit to Bethlehem. Just as the Jerusalem Temple was destroyed in 70 CE and brought an end to the Jewish system of sacrificial worship, so the cuneiform tradition of astronomy carried on by the magi also died out about the same time. The magi's way of life ended. Their work was forgotten for nearly 2,000 years, only to be recovered in the late 19th and 20th centuries with the rediscovery of astronomical cuneiform tablets dating three centuries before the birth of Christ.

We have now seen that the Magi were definitely historical, not legendary; that astronomical knowledge in the first century BCE was sophisticated, not trivial; and we have surmised that they were familiar with Jewish prophecies of a coming Messiah.

2.2(B). OPTION #2: INEXPLICABLE

Figure 74: The Star as an Inexplicable Event. (Source: Unknown)

But was the Star an inexplicable event, evidently supernatural? Matthew seems to describe no ordinary Star:

> "The star they had seen in the east *went ahead of them* until it *stopped over* the place where the child was." (2:9-10)

It sounds like the Star was acting as a spotlight, beaming down from an unidentified flying object! Do we need to choose between an Unidentified Flying Object and a miracle? If so, I'll choose a miracle.

In the 4th century, Chrysostom suggested that the Star was supernatural:

> "The wise men ... journeyed from Jerusalem to Bethlehem by the guidance of the star. From all this we learn that it was not an ordinary star, for no other star has this capacity to guide, not merely to move but to beckon, to 'go before them,' drawing and guiding them along their way."[48]

Many interpreters through history have regarded the Star as similar to the Shekina glory, the presence of God in the Temple, the pillar of fire that guided the Hebrews in the wilderness. Or perhaps it was an angel. There are many interesting parallels between the Star and angels: Angels are called the "morning stars" (Job 38:7). Angels are associated with singing for joy at the creation and incarnation. Angels are messengers from God. Angels led the shepherds to worship Christ, just as the Star led the magi to worship him. So might not the Star have been simply an angel?

In his classic book on the Bible and science, Bernard Ramm wrote:

> "We believe that it was a special manifestation for the birth of Jesus and that it was seen only by the wise men. Further, ... the knowledge and meaning of the star was given to the magi supernaturally, and was not arrived at any other way…."[49]

The Star of Bethlehem may have been an angel or a purely miraculous phenomenon, by its very nature inexplicable by astronomical science. This has been the view of many throughout church history, from Augustine to Wordsworth and today. I have no quarrel with this view.

On the other hand, if the Star were an angel or some other miracle, why did Matthew not say so? Several times Matthew refers to angels in his nativity account, so why would he not call the Star an angel if it were? In my reading of Matthew, without discounting the supernatural option altogether, I nevertheless take the text as suggesting that the magi interpreted the Star as if it were any other natural object they were accustomed to studying.

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48. Chrysostom. Cite

49. Bernard Ramm, *The Christian View of Science and Scripture* (Eerdmans, 1954), p. 114.

2.2(c). Option #3: Natural, Astronomical

Although the Star seems to have behaved in a strange way, a supernatural interpretation of the Star is not required by Matthew's account. Thus the Star might have been a natural phenomenon, of the sort studied by these ancient astronomers and used by them as the basis for their divination. Therefore an inquiry into a possible natural explanation is not inappropriate. Yet the strongest argument against a natural explanation of the Star is the sheer number of natural explanations that have been proposed: practically every astronomical object has been plausibly advocated at one time or another, which paradoxically makes it seem implausible that any one of them can be correct.

Figure 75: Albrecht Dürer, Nativity scene. 16th century. Metropolitan Museum of Art, New York.[50]

Many have imagined the Star as shining brightly in the sky like a *supernova*. Ignatius, in the late 1st century, reported:

> "Its light was unspeakable and its novelty caused wonder."[51]

Artists like Albrecht Dürer in the 16th century, or poets like Longfellow in the 19th century, imagined it the same way. Longfellow wrote:

> "The star was so beautiful, large and clear, that all the other stars of the sky, became a white mist in the atmosphere..." ("The Three Kings")

Longfellow's poem makes a wonderful family holiday read-aloud. Its delightful rhythm evokes the lore of the magi. In the 20th century, storytellers like Arthur C. Clarke have likewise invoked the image of a supernova:

> "The light of Supernova Bethlehem is still flooding out through space.... Now that light is spread over a sphere 10,000 light years across and must be correspondingly fainter. [Yet] to any beings who may be seeing it now as a new star in their skies... it will still be far more brilliant than any other star in the entire heavens.... At this very moment, therefore, [the Star] may still be

50. Photo credit: The Met, public domain; www.metmuseum.org/art/collection/search/90062114.

51. Ignatius, Bishop of Antioch, ca. 100 AD, Epistle XIX. Cite. Cf.

shining in the skies of countless worlds, circling far Suns...."[52]

Yet this is not what Matthew actually says about the Star.

Figure 76: Giotto, Adoration of the Magi. Fresco in the Scrovegni Chapel, Padua, Italy (ca 1305).[53]

Others have invoked *comets* to provide a common-sense explanation of how the Star might have "stood over" the horizon of Bethlehem, from Origin in the 3rd century to Giotto's painting "The Adoration of the Magi" in the 14th century.

A second family of explanations envisions the Star not as an unexpected, single point of bright light, but as a familiar planet moving through some portion of its planetary cycle.[54]

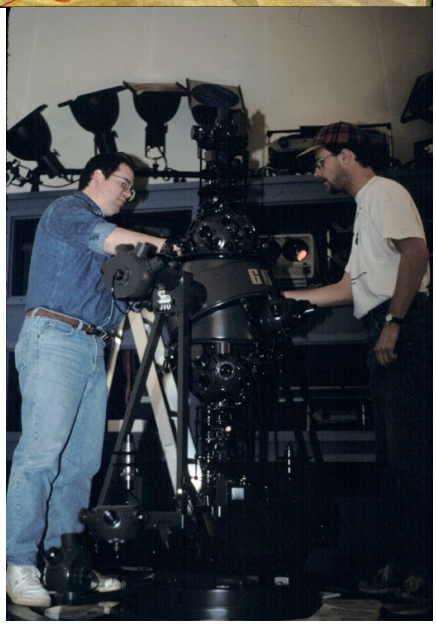


Figure 77: OBU Planetarium

In the second group, let's look more closely at the tradition of explaining the Star by means of the "triple conjunction" of 7 BCE.

This scenario is favored most often in holiday astronomer talks and seasonal planetarium shows. Figure 77 shows me, on the left, many years ago, working with my student "Ben Randell the Science Vandal" to set up the OBU star projector for a show.

52. Arthur C. Clarke, "The Star of the Magi," *Holiday Magazine* (1954).

53. Photo credit: Unknown. Public domain.

54. For a helpful survey of the most popular explanations, see Mark Kidger, *The Star of Bethlehem: An Astronomer's View* (Princeton: Princeton University Press, 1999). Kidger, Hughes, Parpola, Sachs, and D'Occheppio favor this explanation as well (see Further Reading at the end of this chapter).

Kepler's Conjunction Theory

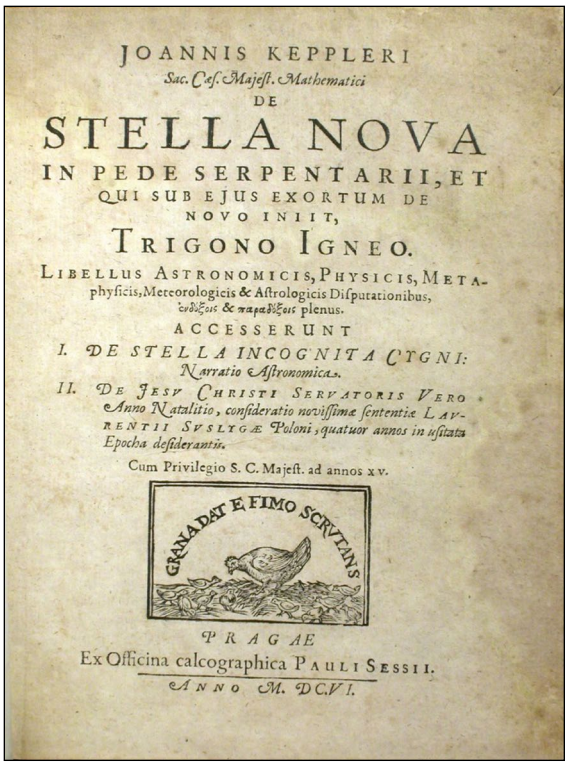

JOANNIS KEPPLERI
Sac. Cæs. Majest. Mathematici
DE
STELLA NOVA
IN PEDE SERPENTARII, ET
QUI SUB EJUS EXORTUM DE
NOVO INIIT,
TRIGONO IGNEO.
LIBELLUS ASTRONOMICIS, PHYSICIS, METAphysicis, Meteorologicis & Astrologicis Disputationibus, ἐνδείξεις & παραλλαγὰς plenus.
ACCESSERUNT
I. DE STELLA INCOGNITA CYGNI: Narratio Astronomica.
II. DE JESU CHRISTI SERVATORIS VERO Anno Natalitio, consideratio novissimæ sententiæ LAURENTII SUSLYGÆ Poloni, quatuor annos in ustata Epocha desiderantis.
Cum Privilegio S. C. Majest. ad annos XV.
GRANA DAT E FIMO SCRUTANS
PRAGAE
Ex Officina calcographica PAULI SESSII.
ANNO M. DC.VI.

Figure 78: Johann Kepler, De stella nova (1606).

Although conjunction theories have many variations, they derive from the work of Johann Kepler. Kepler published *De stella nova* ("The New Star") in 1606. In this book he proposed an explanation for the Star of Bethlehem based upon celestial events that occurred around the time of a new star observed in 1604.[55]

Kepler's explanation for the Star had three stages. We will simply list them now, and explain each one in due course: First, a "triple conjunction" between Saturn and Jupiter. Second, a "planetary massing" of these two planets with Mars. And third, the appearance of a new star, a nova or supernova.

Precisely this sequence of events occurred in Kepler's lifetime, with a sequence of triple conjunction in 1603, planetary massing in 1604, and a new star in 1604. But Kepler calculated that a similar triple conjunction and planetary massing occurred in 7 and 6 BCE, before the birth of Christ in 5 BCE, and proposed that this similar sequence might explain the Star of Bethlehem.

Event	Kepler's lifetime	Star of Bethlehem
1. Triple Conjunction (Saturn & Jupiter)	1603	7 BCE May 29, September 29, December 4
2. Planetary Massing (Saturn, Jupiter & Mars)	1604 September-October	6 BCE, in Pisces January-February
3. Nova (or Supernova)	1604 Supernova in Ophiuchus	5 BCE Star of Bethlehem Birth of Christ

Table 28*: Kepler's proposed explanation of the Star*

55. Johann Kepler, *De stella nova* (Prague, 1606), repeated in Kepler, *De anno natali Christi* (1614).

TRIPLE CONJUNCTION

Now let's look at these three steps more closely. First, what is a conjunction?

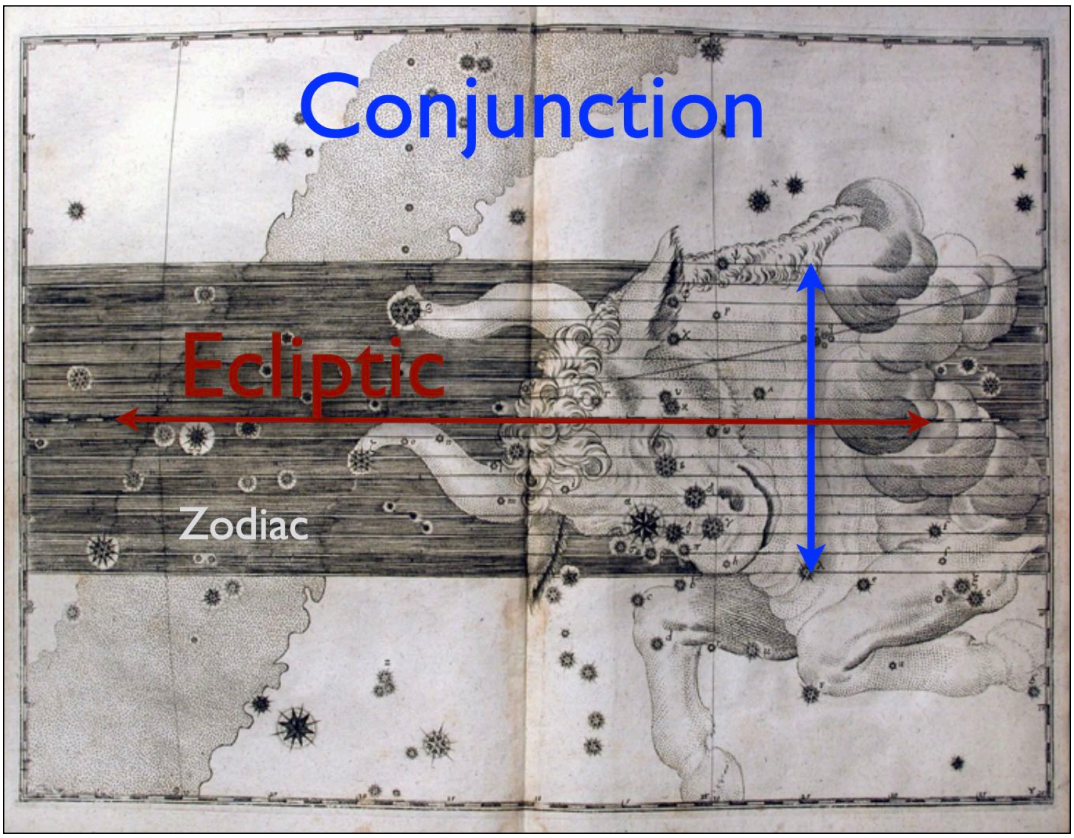


Figure 79: Taurus the Bull. Bayer (1661).

To illustrate a conjunction let's begin with the constellation Taurus the Bull. The ecliptic is the path the Sun follows as it moves bit by bit each day, circling once around the sky over the course of a year. Any constellation that contains the ecliptic is a zodiac constellation. The planets do not stray far from the path of the Sun; rather they stay within the band of the zodiac (shaded dark in the Bayer star atlas).

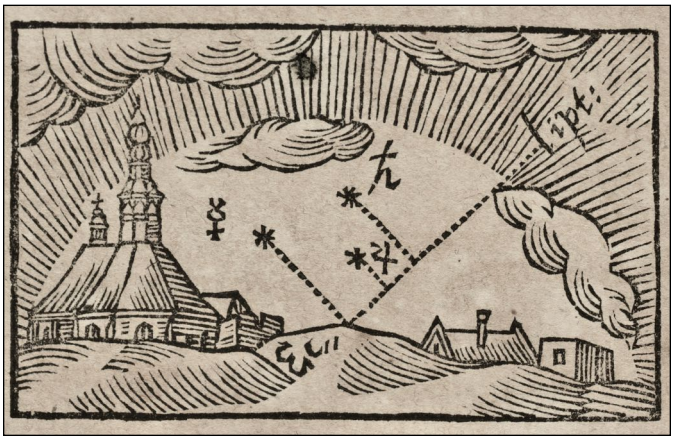


Figure 80: Kepler, planets approaching one another on the ecliptic

Let's suppose that tonight Saturn is located on the vertical blue line in Figure 79, which extends perpendicularly above and below the ecliptic. If any other object is located on this blue line, within the band of the zodiac, we can say that they hold the same position on the ecliptic as Saturn, and are thus said to be in conjunction. Let's say that on another night Jupiter arrives at the blue line, either above or below the ecliptic. Regardless of how close they appear to the eye, Jupiter and Saturn are now in conjunction, located at the same point of the ecliptic. Note that to be in conjunction does not mean that the two planets appear extremely close to one another; whether they appear close or seem to fuse has nothing to do with it. Planets in conjunction usually remain quite distinct, and may fall on different sides of the ecliptic.

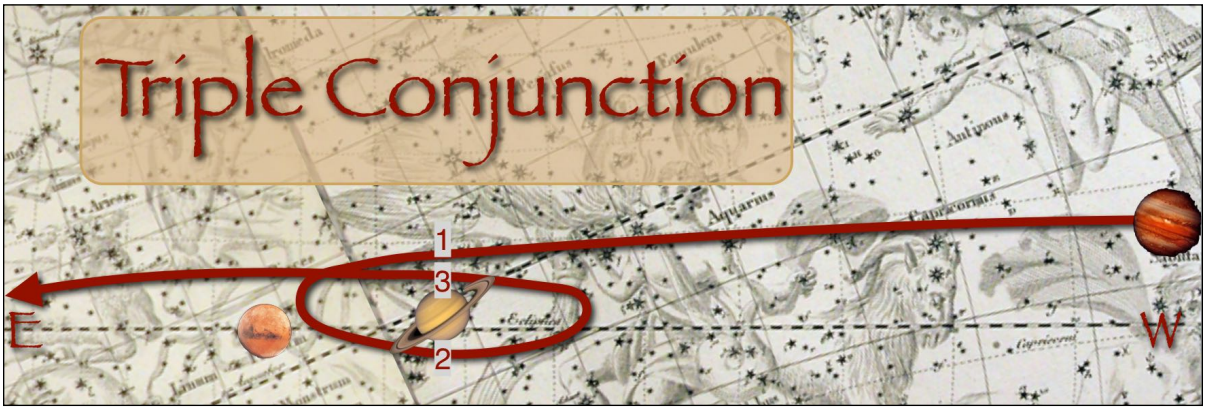


Figure 81: Triple Conjunction of 7 BCE.

Now suppose that, over the course of several months, Jupiter does a little loop in the sky. Figure 81 shows the path of Jupiter in 7 BCE. If the red line traces Jupiter's retrograde loop, how many times does it line up with Saturn? Jupiter is in conjunction with Saturn three times, as numbered "1," "2," and "3":

- Jupiter travels with its *direct motion*, roughly eastward (right to left), bit-by-bit night-by-night, eventually catching up with Saturn (at "1") and overtaking it against the background stars.
- At what is called its first *stationary point* (the left side of the loop), Jupiter's direct motion comes to a halt.

- Then Jupiter begins to reverse course, beginning a *retrograde* loop. As it then goes westward or retrograde (left to right), it passes Saturn a second time (at "2"). Strikingly, while a planet is in retrograde motion it also appears brighter than usual. Confusingly, this period of retrograde motion (containing "2") is sometimes also called a planet's "forward" motion, for the planet is rising sooner or "going before" or faster than the diurnal motion of the background stars.
- Then Jupiter's retrograde motion comes to a stop at the second *stationary point* (the right side of the loop).
- Jupiter then turns around and goes forward again, resuming its direct, eastward motion. And so it comes into conjunction with Saturn for a third time ("3").

Jupiter's retrograde loop, passing around Saturn, produces a sequence of alignments. This sequence is known as a triple conjunction, because Jupiter and Saturn are in conjunction a total of three times. These movements of the planets are a slow dance, taking place over the course of several months. In 7 BCE, the three conjunctions occurred on May 29, September 29, and December 4.

What Kepler Saw, 1603-1604

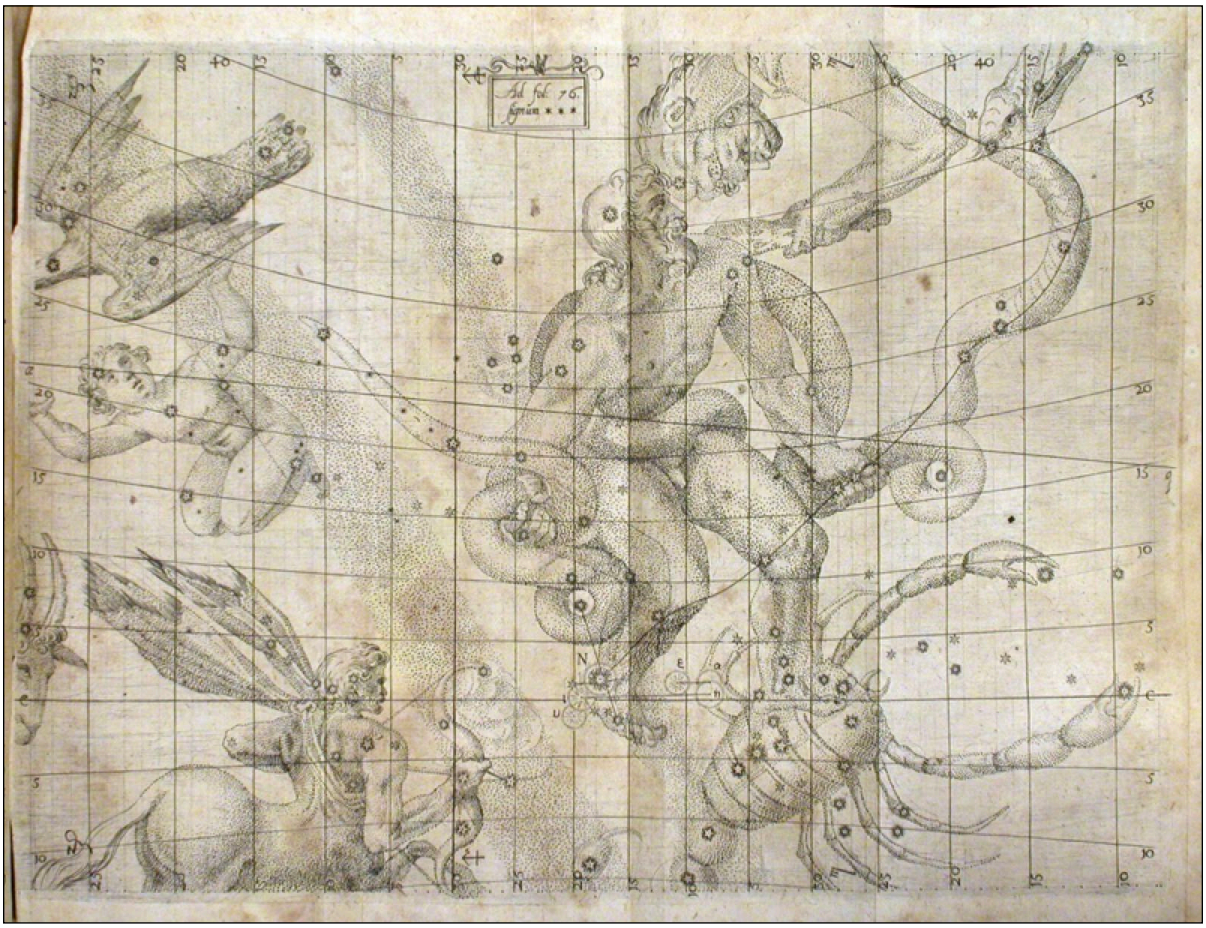


Figure 82: Kepler, De stella nova (1606)

Figure 82 is Kepler's star map, published in *De stella nova*, for the events he observed in 1603-1604. It shows the constellations of Ophiuchus, Sagittarius and Scorpius. Ophiuchus is wrestling Serpens the Snake. The Milky Way runs diagonally down from the left. The ecliptic runs horizontally through Sagittarius and Scorpius, crossing the right ankle of Ophiuchus.[56]

Let's look more closely at the area near the foot of Ophiuchus. Figure 83 shows the region where Kepler observed the events of 1603-1604.

56. Ophiuchus is not numbered among the 12 constellations of the zodiac for astrological purposes. Even if it is just a small area near his foot that dips down into the zodiac band, astronomically speaking, Ophiuchus does include the ecliptic and therefore the Sun and planets pass through it, as in this series of events.

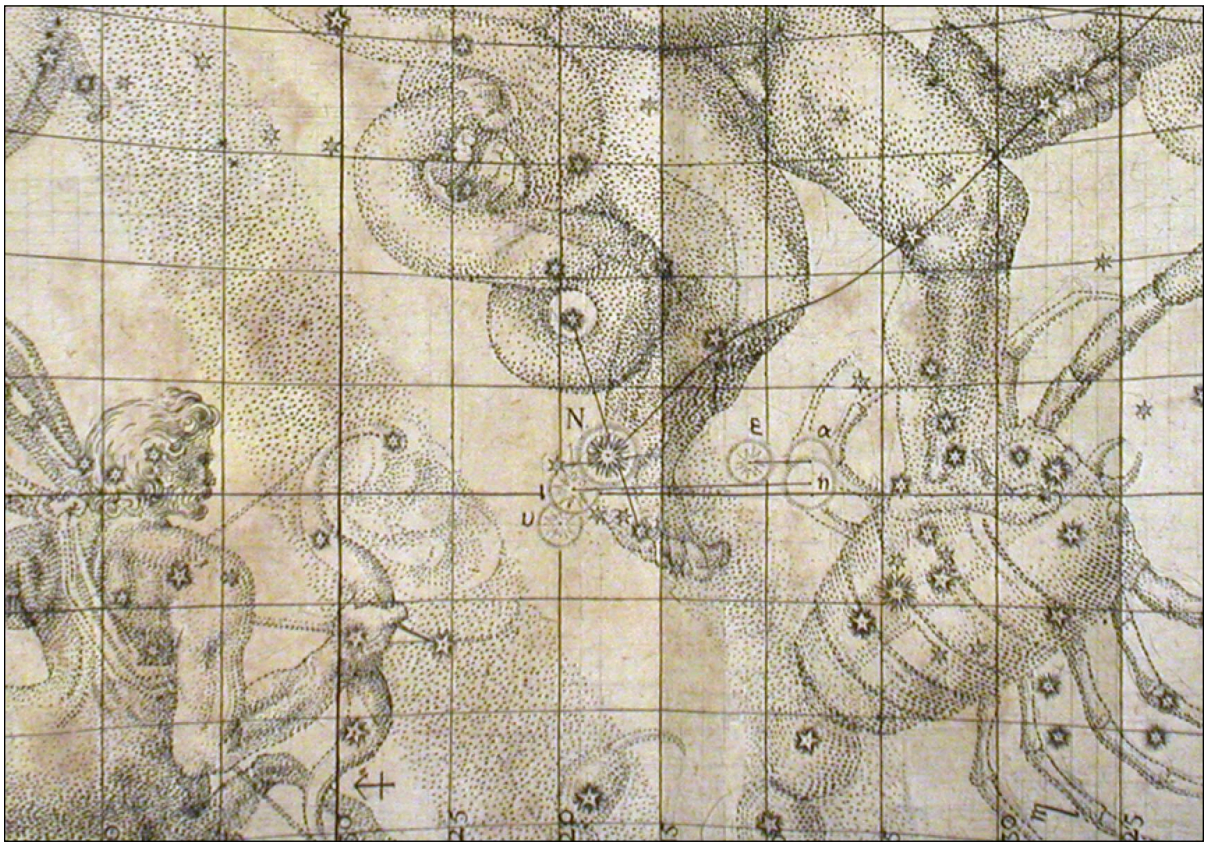


Figure 83: Kepler, De stella nova (1606), detail.

1. Saturn was located at alpha when Jupiter arrived at "n" in December 1603 for the first conjunction (Figure 84 on p. 201, top row). Jupiter appears to move much faster than Saturn.
2. Then Jupiter began a little retrograde loop in the sky, passing Saturn a second time going backwards and then, completing its retrograde motion and resuming its direct motion, returned to Saturn's position a third time. This sequence, which took place over several months, was the triple conjunction.
3. All the while during the triple conjunction, Saturn continued its slow, regular, direct motion along the ecliptic from alpha to epsilon. Jupiter, shortly after the 3rd conjunction, arrived at "i." By this time, in September and October of 1604, Mars had come along, moving faster than Jupiter, and arrived at "v." This gathering of three planets in the same area of the sky is called a planetary massing (Figure 84, 2nd row).
4. Finally, a new star – now known as "Kepler's supernova" – appeared suddenly and unpredictably at N, right in the ankle of Ophiuchus (Figure 84, bottom row). Aristotle taught that conjunctions and planetary massings produce comets. In 1604, less ominously, they seemed to have produced a new star. But this was no ordinary star; it was a

supernova, visible in the daytime sky for over a year. In fact, no supernova in our own galaxy has been observed since.

A supernova is manifest as a sudden, unexpected appearance of a single extremely bright star. It may be visible in daytime, and fades over period of months. It is definitely not like a strobe light going off in a planetarium! Today we know that a supernova results from the powerful explosion of a giant star, which appears in a very large telescope as an expanding cloud of gas.

Kepler mused that this new star might have been caused by the planets' proximity, might portend the fall of the Turks, or perhaps the second advent of Christ. Above all, it would definitely result in good business for booksellers, as a rash of hastily produced pamphlets would be rushed into print to explain it! Or maybe, he wondered, something similar might have happened for the Star of Bethlehem.

These phenomena are illustrated in Figure 84.

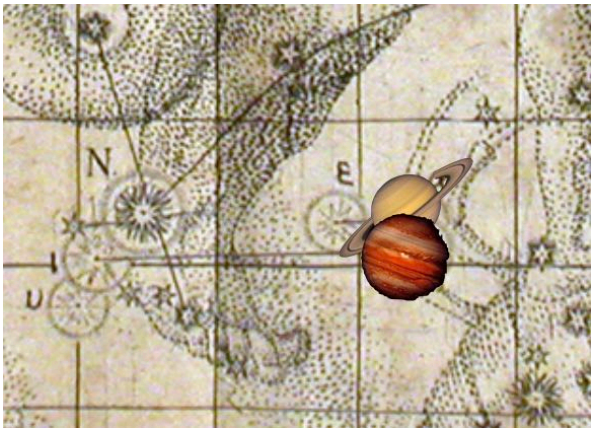
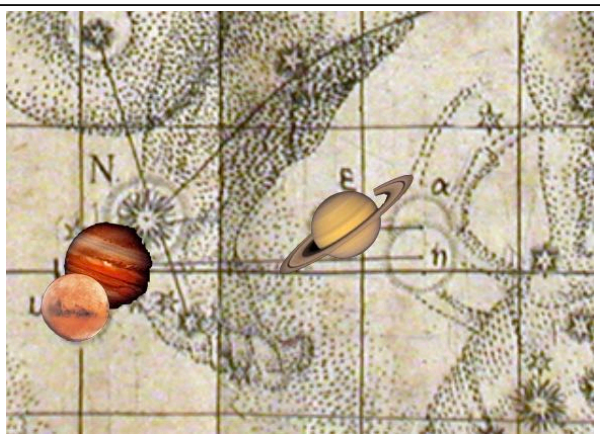
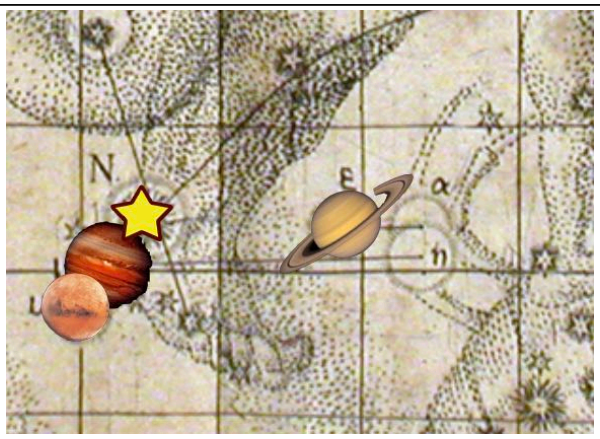
Event	*De stella nova*
1. Triple Conjunction begins (Saturn & Jupiter) December, 1603 Saturn at Alpha Jupiter at n	
2. Planetary Massing (Saturn, Jupiter & Mars) 1604 September-October Saturn at Epsilon Jupiter at i Mars at v	
3. Nova (or Supernova) 1604 Star at N	

Figure 84: What Kepler observed

What Happened in 7-5 BCE

1. Triple Conjunction, 7 BCE

Kepler observed a triple conjunction in 1603 and calculated that the same sort of triple conjunction also occurred in 7 BCE (Figure 81 on p. 196). He also determined that a similar planetary massing with Mars in 6 BCE followed the triple conjunction. Might a star in 5 BCE have completed a similar sequence like what he had just observed in 1603-1604?

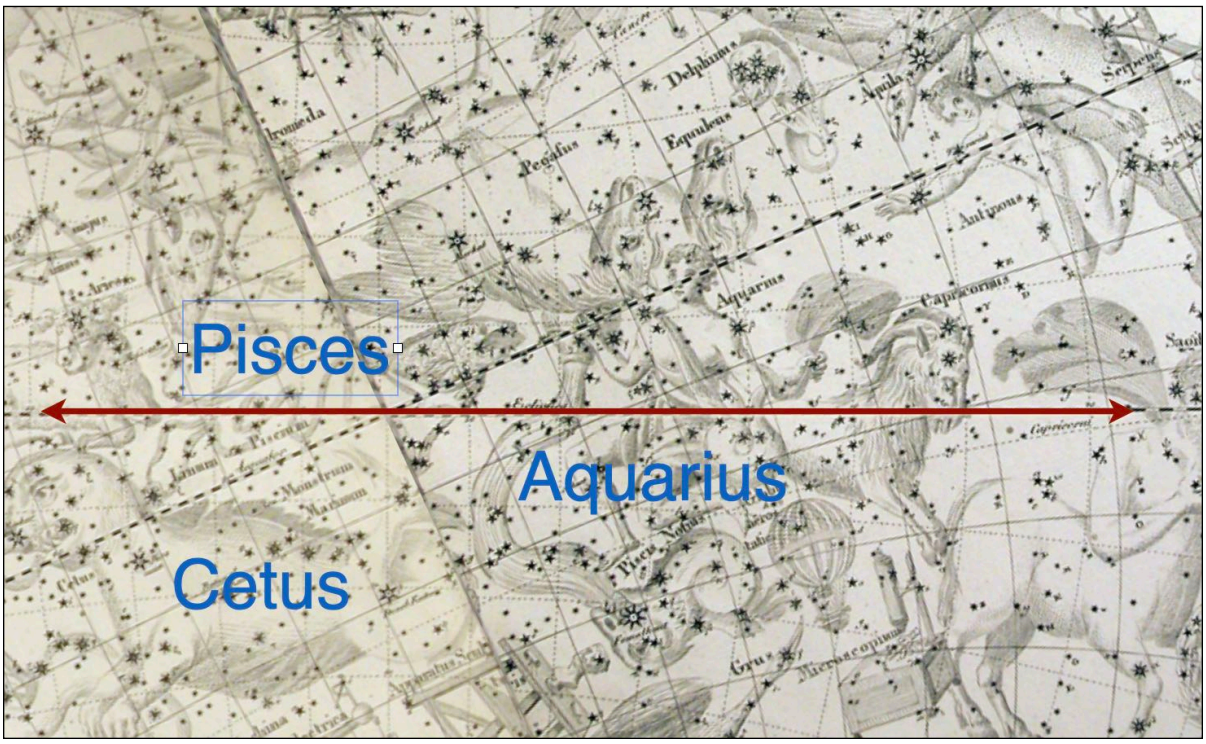


Figure 85: Star of Bethlehem Sky, 7-5 BCE. Bode (1801).

Let's take a look at the area of the sky where these events took place. The red line denotes the ecliptic. Notice the constellations Cetus the Whale, Aquarius the Water Carrier, and Pisces the Fish. Pisces consists of two fish, held together by a rope. Capricornus the Sea Goat lies just to the right of Aquarius. Sagittarius the Centaur is barely visible on the extreme right edge. Above are Andromeda, Pegasus the Flying Horse, and Aquila the Eagle.

In 7 BCE, Saturn was moving slowly eastward (right to left) between Pisces and Cetus (Figure 86, top row). As Jupiter approached Saturn for the first conjunction in early May, the two planets began to rise just before the Sun. Three conjunctions occurred over the course of the year. Parpola calculates that the first conjunction occurred on May 27, the second on

October 6, and the third on December 1. On April 12, just after the first conjunction, Jupiter and Saturn appeared at their heliacal rising in Pisces.[57]

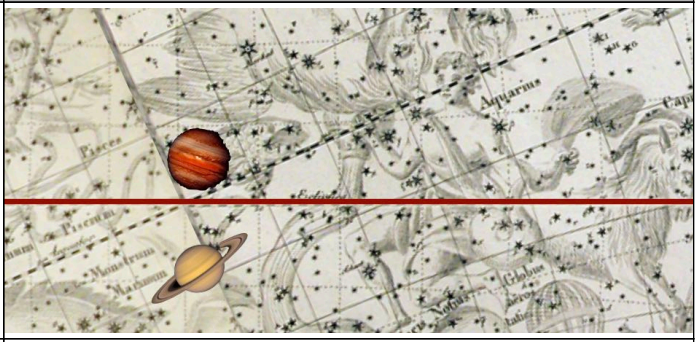
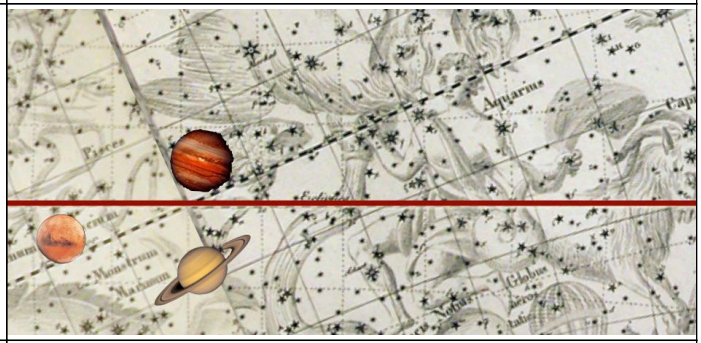
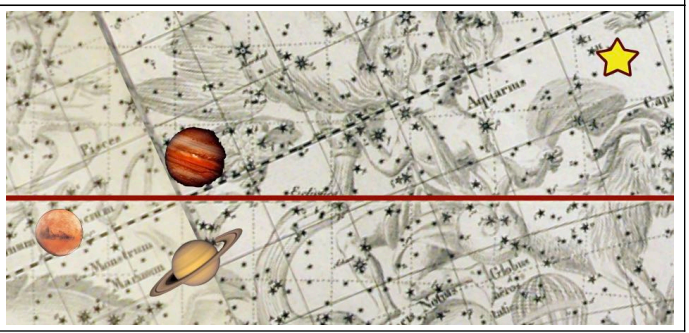
Event	Star of Bethlehem
1. Triple Conjunction (Saturn & Jupiter) 7 BCE May 29, September 29, December 4	
2. Planetary Massing (Saturn, Jupiter & Mars) 6 BCE, in Pisces January-February	
3. Nova (or supernova or comet) 5 BCE Star of Bethlehem Birth of Christ	

Figure 86: Events of 7-5 BCE.

2. Planetary Massing, 6 BCE

Yet for Kepler, the triple conjunction was just Phase I of a 3-step sequence. Phase 2 was a planetary massing the following year (Figure 86, middle row). Kepler observed a triple conjunction, as we have seen, in 1603. The following year, in 1604, Mars joined Jupiter and Saturn in the same region of the sky. Kepler calculated that a similar planetary massing also occurred in 6 BCE.

57. Simo Parpola, "The Magi and the Star," *Bible Review*, December 2001, p. 16-23, and p. 52 & 54. The article begins with a subtitle: "Babylonian Astronomy Dates Jesus' Birth."

3. Nova, 5 BCE

But for Kepler, the triple conjunction of 7 BCE and the planetary massing of 6 BCE were phases 1 and 2 of a 3-step sequence. In 1604, the triple conjunction and planetary massing observed by Kepler were followed by the startling apearance of a supernova. Might something similar have occurred in 5 BCE? If a triple conjunction and massing in Kepler's own lifetime had produced a nova, by analogy, the similar triple conjunction and planetary massing which occurred in 7 and 6 BCE might have produced a similar new star.

Like Kepler, the magi would have been able to predict the triple conjunction of 7 BCE and the planetary massing of 6 BCE, but any new star in 5 BCE would have been an unexpected surprise. Quite remarkably, although unknown to Kepler, it turns out that Chinese records confirm the occurrence of a bright star after the ancient planetary massing. In the spring of 5 BCE – during the lambing season, when shepherds would have been in the fields – a bright star, perhaps a nova, or perhaps a comet (the Chinese record is ambiguous), appeared in the vicinity of Aquila and Capricorn and remained visible at night for 70 days (Figure 86, last row).

Matthew's Description

Is a triple planetary conjunction consistent with the text of Matthew? Let's take a closer look at chapter 2, verse 9. What might an astronomer mean by "the star," and "in the east," or by saying the Star "went ahead of…" and "stopped over…" them?

The Greek word for star is *aster*. In contrast to English, where star means a single point of light, the Greek word *aster*, in its singular form, can refer to configurations of the planets in the sky. Something like this is reflected when we use the term "asterism" for a star pattern like the Big Dipper. So an ancient astronomer might have used the singular form *aster* to refer to a planetary configuration.

By "in the east" we might think of the location of the magi, who were in the east when they saw the Star, but the Greek phrase used here by Matthew is not the usual way of indicating which way is east. It is better translated as "at its rising," refering to the rising of the Star above the eastern horizon, perhaps the heliacal rising after a period of daytime invisibility.

But what might an astronomer mean by saying the Star "went ahead of…" them and "stopped over…" the place? The Greek word Matthew uses for "went ahead" is *proegesis*, a word ancient astronomers like Ptolemy used for retrograde motion. For example, in the *Tetrabiblos*, the standard ancient manual for Greek astrology, Ptolemy referred to retrograde motion as "moving forward" or "*proegoumenoi*":

> "Generally, when the planets are morning stars and make an appearance, they make the body large; at their first station, powerful and muscular; when they are *moving forward* ["*proegoumenoi*"], not well-proportioned; at their second station, rather weak; and at setting, entirely without repute but able to bear

hardship and oppression."[58]

The Greek word Matthew uses for "stopped over" is *epano*, a word ancient astronomers used for stationary points.

Non-technical paraphrase	Technical meaning
"the star they had seen in the east went ahead of them (proegen) until it stopped over (epano) the place where the child was ..."	"The star (planetary configuration) they had seen on the horizon at its rising went into retrograde motion (proegesis) until it reached its second stationary point (epano) as they arrived where the child was."

Figure 87: Matthew 2:9

In the Introduction, we suggested that the Two Books are written in different languages. How might that perspective apply in this case? Perhaps uniquely in scripture, we have an event being described from the vantage points both of technical experts (the magi) and of people without such technical expertise. If the magi were to describe the retrograde motion of Jupiter during a triple conjunction, they might have used technical language, later preserved in Greek translation by the terms *proegen* and *epano*. The right column of Table 87 amplifies the meaning of these terms, as shown in Figure 88. We can read Matthew's text, on the left, as a non-technical paraphrase of the magi's description of retrograde motion during a triple conjunction, provided by them to Joseph and Mary, later translated into Greek and simplified for the sake of those who were not familiar with the motion of the planets. As it was not the purpose of Matthew to instruct us concerning what the magi saw, it was not important to him to provide any explanation of retrograde motion, stationary points, and the like. Nevertheless, the text as he recorded it would have remained intelligible to an astronomer already familiar with contemporary technical descriptions of these phenomena.

But were triple conjunctions meaningful to the magi? We know that the magi were interested in triple conjunctions, and in fact, could predict them long in advance. Not just one but four extant cuneiform tablets record this very triple conjunction of 7 BCE, although the tablets do not tell us how they interpreted it. We know that they knew of it, but we do not know what they thought of it.

58. Ptolemy, *Tetrabiblos*, Book III, Chapter II, line 145ff. Trans. F. E. Robbins, Loeb Classical Library (Cambridge: Harvard University Press, 1940), pp. 313 (English) with facing Greek text on p. 312.

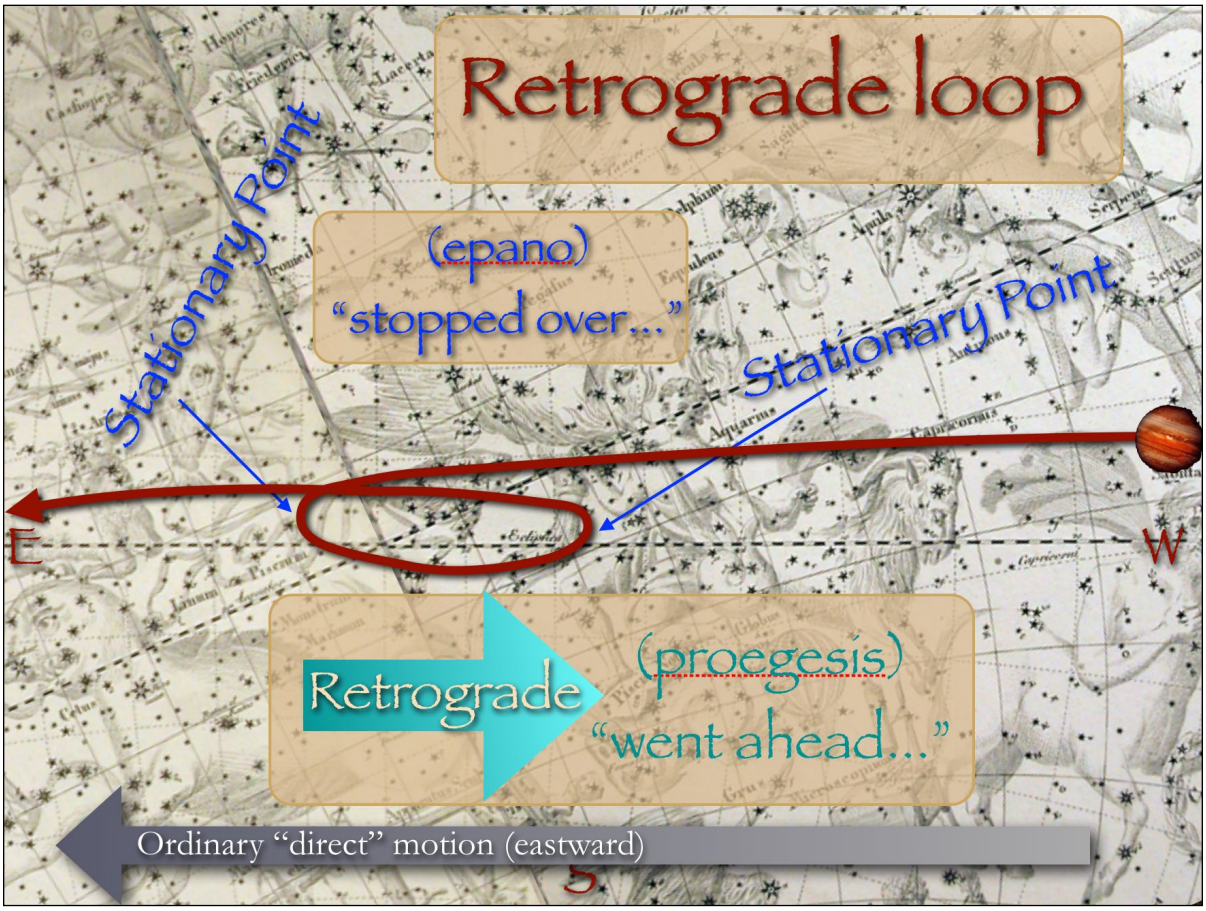


Figure 88: Retrograde loop and stationary points.

ASSESSMENT

Speculation regarding the possible meaning of these events is not entirely far-fetched. According to later accounts, Pisces was regarded as the House of the Hebrews. Jupiter and Saturn remained together in the constellation of Pisces for eleven months. If Jupiter represented royalty and Saturn divinity, then their cosmic dance in Pisces might imply the birth of a divine king born in Israel. The addition of Mars might imply that the divine king born in Israel would be a mighty warrior. Alternatively, others have suggested that, because Saturn is related to the Sabbath (Saturday takes its name from Saturn), then the divine king would be associated with the Sabbath-keeping Jews. Richard Allen explains the lore relayed by a Jewish rabbi named Abarbanel:

> "Rabbis held the tradition, recorded by Abarbanel in the 15th century, that a similar conjunction took place in Pisces three years previous to the birth of Moses, and they anticipated another at their Messiah's advent. Thus the

Fishes were considered the national constellation of the Jews."[59]

Abarbanel, who was writing in a commentary on Daniel, drew upon the astrology of Masha'allah (8th century CE). But whether Masha'allah had earlier sources is unkown. As of yet, these ideas have no cuneiform evidence to support them.

✓	*Magi from east of Judea?* The magi are from Parthia, east of Judea.	Matthew
✓	*Magi saw Star in the east < 2 yrs?* The triple conjunction began about 2 years before the birth of Christ.	
✓	*Star did not lead to Bethlehem? Star not obvious in Jerusalem?* The magi went straight to Jerusalem, the capital city of Judea, where the triple conjunction was not noticed.[60]	
✓	*Star went before them? Star stood over the place?* The Greek terms *proegen* and *epano* might make sense of Matthew's perplexing description of going before and standing over them.	
✓	*Star confirmed at the right time?* A triple conjunction did occur in 7 BCE, a planetary massing in 6 BCE, and some kind of new star (or comet) in 5 BCE.	Star
✓	*Star implied birth of king in Judea? Star intelligible to the magi?* According to a medieval Rabbinical tradition, it might have been interpreted by the magi as indicating the birth of a divine king of the Jews.	Magi

Table 29*: Star Checklist: Assessment.*

Let's consider: Does Kepler's theory meet our criteria to explain the Star? It looks like all points in our Star Checklist (p. 184) are addressed by Kepler's three phases, either separately or in combination.

2.3. What Do We Really Know?

Some variation of Kepler's explanation, either the triple conjunction or all three phases together, are the most common explanations offered in planetarium shows and astronomer talks today. If we adopt Kepler's theory in any form or fashion, then our checklist may draw upon any combination of the factors we have considered.

But there are other plausible natural astronomical options we have not even considered. There was a conjunction in 2 BCE which would have been a visually remarkable sight, in which Venus and Jupiter would have appeared to approach each other so closely that they

59. Richard Hinckley Allen, *Star Names: Their Lore and Meaning*, p. 341

60. "Because these planetary events are not visually striking to a casual observer, it is not surprising that Herod's court failed to notice the star, nor that Matthew's account seems confusing to readers unfamiliar with the apparent motions of the planets." Magruder, "Star of Bethlehem," p. 645.

nearly fused together. Due to the striking visual appearance of this conjunction, it was adopted by *The Nativity Story* (2006), directed by Catherine Hardwicke and written by Mike Rich.[61]

Or, remarkably, on April 17, 6 BCE, at the time of the planetary massing, a horoscope would have heralded the birth of an unconquerable king, according to the astrological principles of Ptolemy's *Tetrabiblos* which were widely adopted throughout the Roman empire. With Jupiter, Saturn, Mercury, Venus, and Mars all in an auspicious configuration, the horoscope for this date was greater than that of the renowned horoscope of Augustus Caesar. On this view, the text of Matthew refers to the heliacal rising and retrograde motion of Jupiter in 6 BCE rather than the dance with Saturn in 7 BCE. Michael Molnar makes a robust case for this natal horoscope theory and has persuaded many scholars. We would have been advised to give it equal attention here if space were not a consideration.[62]

Considering only Kepler's hypothesis, however, suffices to establish that there is no necessary conflict between Matthew's account of the magi and what is known to science and historical scholarship. While at present the nature of the Star must be left undecided, the "potential viability of several candidates for the star renders skepticism toward the historicity of Matthew's story unnecessary."[63]

We have considered the text of Matthew, what astronomers have said about the Star, and how it's important to distinguish our views from legend and later lore. We have noted that the magi were indeed actual historical figures, and that their cuneiform astronomical tradition was sophisticated and capable. The Star may have been supernatural, or it may have a natural explanation that was intelligible to the magi. If Kepler's hypothesis is somehow on the right track, then I suggest that the best hope for making progress in understanding the Star will come only with further historical research into ancient Babylonian astronomy and astrology and the practices of the magi in their own historical context.

So where does this leave us? What do we really know?

Actually, Matthew didn't need astronomy or the history of science to tell us what is most important. His narrative is more simple and profound than that. An amazing wonder lies inextricably at the heart of this story, where powerful men from afar seek out an obscure birth in one of the poorest families in all Israel. For some people, a story this wonderful is simply too joyous to be true.

The question of what the Star might have been simply fades in importance, and seems almost like a distraction from what the Star means, like debating whether Adam and Eve ate apples or pomegranites in the Garden of Eden. No wonder that Matthew tells us so little about it!

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61. An objection to this theory is the well-attested death of Herod in 4 BCE.

62. Michael Molnar, *The Star of Bethlehem: The Legacy of the Magi* (New Brunswick, New Jersey: Rutgers University Press, 1999).

63. Magruder, "Star," p. 645.

Closer to the mark is the saying, "The wise still seek him." Yet so far as we know, not one of the religious leaders or palace advisors in Jerusalem bothered to travel the 6-mile journey south to Bethlehem along with the magi. I fear I am like those leaders, too distracted and preoccupied to seek him. Yet the most important point is not whether I am seeking God, but that he is seeking me. I know of no other story in the gospels that shows more clearly the meaning of the words of Christ, when he said that:

> "The Son of Man has come to seek and to save that which was lost." (Luke 19:10)

Wisdom consists in recognizing that the One who drew the wise men to Himself is also drawing us.

In a modern re-telling by Michael Card, Melchior speaks to Gaspar:

> "I have been an arrogant fool, young one. I have boasted all my life of being a seeker of truth – I, always me. When I saw that star I knew in an instant… that star is an invitation. You see, Wisdom is seeking us. And He has sent that star as an invitation to come to Him, yes Him. Then the old man's entire frame shuddered, as a tear glided haltingly down his cheek and was lost in his beard. "All my life He has been seeking me. He is the one who has given to me and to you our hunger for him. And now this star is a precious gift. I have sold all that I have for the journey and for gold to offer when I meet Him…. Tonight I leave…."[64]

God goes to extraordinary lengths to draw us to him. All our lives, he has been seeking us. This is the message of the Star.

> Sages, leave your contemplations,
> Brighter visions beam afar.
> Seek the great Desire of nations;
> Ye have seen his natal star.

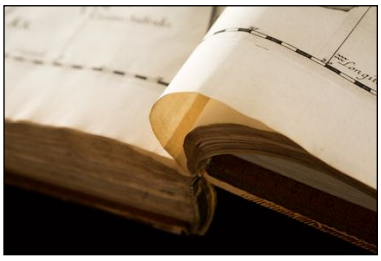
64. Michael Card, *The Promise* (Nashville: Sparrow Press, 1991), pp. 35-36.

3. Move to Appendix: Glossary

Term	Explanation
Diurnal	Daily. Think of “diary” or “journal.”
Ecliptic	The annual path of the Sun as it moves around the sky against the background of fixed stars (about 1° per day)
Zodiac constellation	Any constellation that includes the ecliptic. Since the planets never stray far from the path of the Sun, the planets also will pass through the zodiac constellations.
Angular degrees	Apparent distances between objects in the sky are measured by angular degrees, just like the degrees marked off on a protractor.
Opposition	An angular separation of 180°. For example, if the Moon is rising while the Sun is setting on the opposite horizon, their distance is 180 degrees and they are said to be in “opposition.”
Elongation	How far a planet lies from the Sun, measured in angular degrees. For example, Venus never moves farther than 46° from the Sun, so its elongation is said to be “bounded.”
Direct motion	The ordinary eastward motion of the Sun, Moon and planets along the ecliptic against the background of fixed stars. The direct motion of the Sun is about 1° per day roughly eastward along the ecliptic, completing an entire circle around the sky in about a year.
Direct motion – Moon	The Moon moves an average of about 10° a day roughly eastward along the ecliptic, completing an entire circle around the sky in about a month.
Direct motion – Planet	The motion of any planet in a roughly eastward direction along the ecliptic is called its direct motion.
Retrograde motion	“Retrograde” means to reverse direction. For a planet, retrograde motion occurs in a roughly westward direction, reversing the usual direct motion.
Heliacal rising	The rising of a star or planet just before sunrise. (From “helios” = Sun.) A heliacal rising occurs after the star or planet has been invisible for a while in the daytime sky, and marks the reappearance of the star or planet as a body visible in the pre-dawn sky. Thereafter it appears as a morning star.
Ephemerides	Calculated tables predicting the times and locations of planets during significant planetary events.
Astrology	Divination, or the attempt to predict the future, on the basis of celestial events, particularly planetary motions (e.g., daily horoscopes). Astrology served as the chief motivation for the development of mathematical astronomy up through early modern times, but has no physical basis in modern astronomy.

4. After Words

— Classic Texts —



> "It is a good rule, after reading a new book, never to allow yourself another new one until you have read an old one in between…"[65]

- Book of Daniel.
- Matthew 2:1-12.
- Dorothy L. Sayers, "A Vote of Thanks to Cyrus."[66]
- Epic of Gilgamesh.[67]

Doxological classics:

- Chet Raymo, *365 Starry Nights: An Introduction to Astronomy for Every Night of the Year* (New York: Simon & Schuster, 1990).
- Starstruck Tonight: video (1 hr), kerrysloft.com/events/starstruck-tonight.

— Further Reading —

- British Museum: An interactive website on ancient Babylonian astronomy includes translations of portions of some of the cuneiform tablets discussed in this chapter: www.mesopotamia.co.uk/astronomer/home_set.html. Browse the entire website, or search for "cuneiform," "Babylon," etc.
- Bill Casselman: To explore in more depth one example of an early Babylonian mathematical tablet, see "The Babylonian tablet Plimpton 322," www.math.ubc.ca/~cass/courses/m446-03/pl322/pl322.html. Bill Casselman, of the University of British Columbia, walks you line by line through the Plimpton 322 tablet. Do not panic if some of the mathematics is over your head – rather, reflect on the fact that this tablet reflects a more advanced mathematical knowledge than you probably expected to find in the Near East, ca. 1800 BCE. Be sure to click on definition links (like the one for "Pythagorean triples") when you are unsure of the meaning.
- Jona Lendering, a historian of antiquity at the Free University of Amsterdam, sponsors the www.livius.org website. This website includes many pages relating to the ancient Near East which amplify material presented here. See the following pages by Lendering: Ziggurat, Temple of Esagila, Astronomical Diaries, Kidinnu, Babylonian account of the Battle of Gaugamela, Alexander's Final Days: A Babylonian Perspective, and Berossus.

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65. C. S. Lewis, *God in the Dock: Essays on Theology and Ethics* (Grand Rapids, Michigan: William B. Eerdmans Publishing Company, 1970), pp. 201-202.

66. Dorothy L. Sayers, "A Vote of Thanks to Cyrus," in *The Whimsical Christian* (New York: Macmillan, 1978), pp. 53-59. The essay originally appeared in Dorothy L. Sayers, *Unpopular Opinions* (1947), and has been reprinted in various collections.

67. N. K. Sandars, trans., *The Epic of Gilgamesh* (Penguin Classics, 1972).

- Kerry Magruder, "Star of Bethlehem," in the *Zondervan Dictionary of Christianity and Science* (Grand Rapids, Michigan: Zondervan, 2017), pp. 644-646.

Section 1, Babylonian Astronomy • Select bibliography

- Asger Åboe, "Scientific Astronomy in Antiquity," *Philosophical Transactions of the Royal Society of London*, 1974; 276: 21-42. A readable assessment of the historical significance of ancient Babylonian mathematical astronomy.
- James Evans, *The History and Practice of Ancient Astronomy* (Oxford, 1998). A helpful introductory survey of mathematical astronomy from the ancient Near East to Copernicus.
- Hermann Hunger and David Pingree, *Astral Sciences in Mesopotamia* (Brill, 1999).
- Hermann Hunger, *Astrological Reports to Assyrian Kings*, State Archives of Assyria, vol. 8 (Helsinki, 1992).
- Otto Neugebauer, *The Exact Sciences in Antiquity* (Dover, 1969). A classic short introduction to ancient mathematical astronomy.
- Otto Neugebauer, *Astronomical Cuneiform Texts*, Sources in the History of Mathematics and Physical Sciences, no. 5 (New York: Springer-Verlag, 1983), 3 vols.
- Simo Parpola, *Letters of Assyrian and Babylonian Scholars*, State Archives of Assyria, vol. 10 (Helsinki, 1993).
- Abraham J. Sachs and C. B. F. Walker, "Kepler's View of the Star of Bethlehem and the Babylonian Almanac for 7/6 B.C.," *Iraq* 46 (1984): pp. 43-55.
- Noel Swerdlow, *The Babylonian Theory of the Planets* (Princeton, 1998). The best book-length introductions to Babylonian astronomy are the works by Swerdlow and by Hunger and Pingree.

Section 2: Star of Bethlehem • Select bibliography

- Peter Barthel and George Van Kooten, eds., *The Star of Bethlehem and the Magi: Interdisciplinary Perspectives from Experts on the Ancient Near East, the Greco-Roman World, and Modern Astronomy* (Leiden: Brill, 2015).
- David Hughes, *The Star of Bethlehem: An Astronomer's Confirmation* (New York: Walker and Company, 1979).
- Johann Kepler, *De stella nova* (Prague, 1606).
- Mark Kidger, *The Star of Bethlehem: An Astronomer's View* (Princeton, New Jersey: Princeton University Press, 1999). A superb overview of theories about the Star.
- Michael Molnar, *The Star of Bethlehem: The Legacy of the Magi* (New Brunswick, New Jersey: Rutgers University Press, 1999).
- Konradin Ferrari D'Occhieppo, *Der Stern von Bethlehem in astronomischer Sicht: Legende oder Tatsache?* (Brunnen, 1994).

- Konradin Ferrari D'Occhieppo, "Star of the Magi and Babylonian Astronomy," in *Chronos, Kairos, Christos*, ed. Jerry Vardaman and Edwin M. Yamauchi (Winona Lake, Indiana: Eisenbrauns, 1989), pp. 41-54.
- Simo Parpola, "The Magi and the Star: Babylonian Astronomy Dates Jesus' Birth," *Bible Review* 17(2001): 1723, 5254.
- Richard C. Trexler, *The Journey of the Magi: Meanings in History of a Christian Story* (Princeton: Princeton University Press, 1997).

— Reflect and Discuss —

It's now time to put on our thinking caps and interpret the significance of what we've been exploring! If this chapter has been successful, then you are now doing some real thinking.

1. Are the wheels spinning? Did you discover anything new, surprising, or unexpected? What was most meaningful to you?
2. In "A Vote of Thanks to Cyrus," Dorothy L. Sayers writes:
   "I owe a certain debt to Cyrus the Persian. I made his acquaintance fairly early... He belonged quite definitely to classical times.... And then, one day, I realized with a shock of sacrilege, that on that famous occasion he had marched clean out of our Herodotus and slap into the Bible... And there was Esther... [and Ahasuerus or Xerxes]... I think it was chiefly Cyrus and Ahasuerus who prodded me into the belated conviction that history was all of a piece, and that the Bible was part of it." Discuss.
3. What questions are raised by this case study to challenge our assumptions about science and religion? About science and scripture?
4. Babylonian culture was very religious. How did this affect their science?
5. How do you define science? Use the mathematics and astronomy of the Babylonians as a case study to explain what your definition of science is. What does your definition of science include (that is, how broad is it)? What does your definition of science exclude (that is, does it mean anything at all)? Was Babylonian astronomy "scientific"?
6. Discuss the claims and implications of this chapter for the relations between astrology and astronomy, such as the following (p. 167):
   "Yet this modern separation between astronomy and astrology does not mean that astronomy began only when astrology was set aside; rather, astrology remained the most important incentive for the development of mathematical astronomy up through early modern times."
7. Critique the following view:
   "The duties of Mesopotamian priests included gathering omens from stars and livers, exorcising demons, and healing diseases.[68] The scribes of ancient Babylonia developed the art of reading omens and portents in, say, sheep entrails. This does not make them biologists! Eventually they also devoted themselves to reading omens and portents in the

68. There is an extensive Mesopotamian medical literature in addition to the astrological traditions.

celestial motions. This does not make them astronomers! They were merely practicing a celestial art; a type of priestcraft (technology or magic) analogous to and no more scientific than reading liver entrails. Such astrology is far removed from scientific astronomy. The latter we owe entirely to the Greeks."

8. Are you persuaded by the argument of Åboe?
"Mathematical astronomy was, however, not only the principal carrier and generator of certain mathematical techniques, but it became the model for the new exact sciences which learned from it their principal goal: to give a mathematical description of a particular class of natural phenomena capable of yielding numerical predictions that can be tested against observations. It is in this sense that I claim that Babylonian mathematical astronomy was the origin of all subsequent serious endeavour in the exact sciences." (41-42).[69]

9. Discuss the following quotation from Anton Pannekoek, *A History of Astronomy* (Dover, 1989), p. 13:
"When the [modern] astronomer looks back at his predecessors, he finds Babylonian priests and magicians, Greek philosophers, Mohammedan princes, medieval monks, Renaissance nobles and clerics – until in the scholars of the seventeenth century he meets with modern citizens of his own kind. To all these men astronomy was not a limited branch of specialist science but a world system interwoven with the whole of their concept of life. Not the traditional tasks of a professional guild but the deepest problems of humanity inspired their work."

10. Are either scripture or science or the history of science able to resolve the question of what the Star of Bethlehem was?

11. Assuming it would be simplistic and misconceived to try to prove scripture from science or to prove science from scripture, what exactly is the nature of their relationship? Is it ever possible to draw upon information from science or the history of science in our attempts to interpret the biblical text?

12. The Introduction argued for an approach to the "Two Books" that would be doxological, compatibilist rather than concordist, and perspectival. Would you describe the approach taken in this chapter as concordist? Compatibilist? Perspectival? Is there any virtue in the discipline of entertaining multiple competing interpretations of the Star? Does this chapter respect the multiple languages of science and scripture? Does it hold the meta-levels of cognitive love and doxological love together? How does this chapter measure up compared with the arguments of Ch. 1 and Ch. 3? Does this chapter add anything significant for you to the Perspective chapters so far?

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69. Asger Åboe, "Scientific Astronomy in Antiquity," Philosophical Transactions of the Royal Society of London, 1974; 276: 21-42.

13. Ideas lack power to change us until we relate them to our particular stories. Do you have any stories about the material in this chapter, either that you have experienced yourself or heard about?
14. Imagine yourself in conversation with a friend who enjoys theology: How does this case study relate to Christian belief in the Trinity?
15. Imagine yourself in conversation with a friend who cares about science: How does this case study relate to natural science?
16. What are the implications of these things for "Love and the Cosmos"?

— Doxology —

Let's pray and sing in worship of Father, Son and Holy Spirit.

"A boy he is, but it is God who is adored… The Son of God, who is God of the universe, is born a human being in the flesh. He permits himself to be placed in a manger, and the heavens are within the manger. He is kept in a cradle, a cradle that the world cannot hold… Thus he is the One, the God of Glory and the Lord of majesty, whom as a tiny infant the magi recognize."[70]

The magi "rejoiced exceedingly because they had not been deceived in their hope… By the sign of the star they understood that the birth of the King was revealed to them by divine authority. Through the mystery of the star they understood that the dignity of the King who was born exceeded the measure of all earthly kings. For it was inevitable that they considered this King more glorious than the star, which devotedly paid homage to him."[71]

"If then they had been seeking a king of this world… they would have undertaken the effort of so great a journey for nothing. Yet because they were seeking the heavenly king, even if they saw nothing regal in him, they were nevertheless delighted, content in the testimony of the star…. They adored him and returned home." (Anonymous early commentator)[72]

Wisdom consists in recognizing that the One who drew the wise men to Himself also draws us. God goes to extraordinary lengths to bring us to him. God is drawing all of us to him. We will follow the magi to the place where the Messiah was born.

Amen.

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70. Chromatius, ca. 400. Quoted in *Matthew 1-13*, ed. Manlio Simonetti, in *Ancient Christian Commentary on Scripture*, ed. Thomas C. Oden, New Testament 1a (Downers Grove: InterVarsity Press, 2001), hereafter ACCS-1a, p. 27.

71. Anonymous early commentator. ACCS-1a, p. 27.

72. Anonymous early commentator. ACCS-1a, p. 28.

✦ Part III ✦

First Steps in Science and Religion

In Part III we explore how we think about science and religion.

First, in the Perspective chapter, we consider what we even mean by the words "science" and "religion," "faith" and "reason," and "God" and "nature." We then explore six models of reality as analytical tools to help us clarify the roles of faith and reason in our conversations about science.

Then, in the Case Study chapter, we consider how the story of Nicolaus Copernicus shows just how significant a change in perspective can be. Everything looks different if we change our point of view.

Part III ✦ Chapter 5

Perspective: Approaching Science and Religion

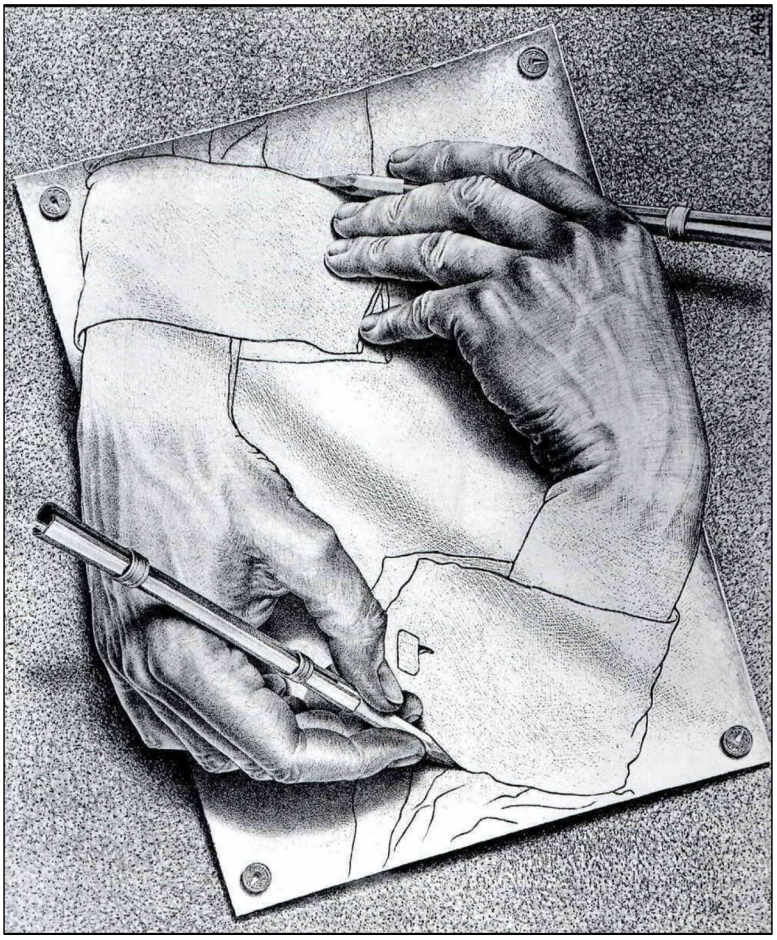

Figure 89: "Drawing Hands" by M. C. Escher (Lithograph, 1948)

In the "Drawing Hands" lithograph by M. C. Escher, which hand came first? Or, paradoxically, are they mutually dependent?

What if the two hands are science and religion? Or faith and reason? Or nature and grace? If so, what might it mean for their relationship?

— Scripture —

> "In the beginning was the Word, and the Word was with God, and the Word was God. He was with God in the beginning. Through him all things were made; without him nothing was made that has been made." (John 1:1-3)

— Prayer —

> Dear Father, Son and Spirit,
>
> Teach us today to see Creation in light of the Living Word, the Logos, who is Jesus Christ. Help us to develop a theological instinct to apprehend you as the reality sustaining all creation. Lead us to know you as the Logos actively present in, and working behind, all things in heaven and earth, so that our knowledge of creation is not set apart from, or in conflict with, our knowledge of you.
>
> Give us the binoculars of Trinitarian perspectives to help us see further into the wonder of your Creation, through Jesus Christ our Lord.
>
> Amen.

Einstein said "Science without religion is lame, religion without science is blind." He saw our understanding of nature and our understanding of God as mutually related, like Escher's drawing hands.[1] Have you thought in this way about science and religion, or faith and reason, or nature and grace? Does the idea that they are mutually dependent seem natural to you, or strange and a little jolting? Might science and religion actually be interrelated and mutually supportive on a profound level, as in the two hands? If so, it would be arbitrary to entirely separate them as mutually exclusive, never to be associated together in a single frame of view.

In our case study of ancient Babylonian astronomy in the cuneiform tradition, we saw that science and religion were then intimately associated in the development of the quantitative ideal for science. Does Escher's drawing fit with the relations between science and religion in Babylonian astronomy?

Yet we also know that sometimes science and religion collide, as if one hand in Escher's drawing were holding an eraser instead of a pencil. Can you think of examples when religion has tried to erase science, or when science has tried to erase religion? In Escher's drawing, the hands are dynamic, in ongoing motion, the tasks not yet completed. If so, what might happen to one hand if it succeeded in eradicating the other?

However many diverse ways science and religion have been related in the past, some assume that today science holds the eraser and religion should gradually fade away, at least in public life. They might be astonished at the existence of a book like this devoted to questions of how science and religion may be beneficially related in any form or fashion. To some, adopting a perspective in which Einstein's statement makes sense would be as shocking as encountering Copernicus' discovery that the Earth is moving, and realizing for the first time that everything we think we see in the universe around us is actually dependent upon our own point of view.

Similarly, many consider faith and reason as opposites, which ought to be drawn in separate frames. If they are not engaged in actual conflict, at least they are mutually exclusive, so that where one operates the other recedes. Where one picks up, the other leaves off. For example, it is sometimes said that our natural reason will take us some far distance along the road toward knowledge of God, and then at some point revealed knowledge or faith will step in and take us the rest of the way. Or that faith and reason are separate magisteria, each competent in its own sphere but largely irrelevant for the other. But what if faith and reason are interrelated from the start, as in Escher's drawing? What would that mean for our thinking about science, religion, and natural theology?

This chapter has two major components: first, we clarify terminology related to "Science and Religion." In the process, we describe an older inquiry called "natural philosophy," consider its relationship to "natural theology," and reassess the relationship between faith and reason. Second, we explore the "Models of God and Nature" to which we have alluded already. These analytical "Models of Reality" illustrate the interrelations of faith and reason discussed in the first section, providing a ground-floor window upon the relations of faith and reason in the sciences at the foundational level of basic assumptions about reality.

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1. The original version of this chapter was prepared for seminary students in a course offered through Grace Communion Seminary in Spring 2020. For a video presentation see kerrysloft.com/education/trinitarian-perspectives-on-faith-and-science/.

1. Science and Religion: Basic Categories

In this section we will look more closely at the meanings of words like natural science, theology, technology, magic, medicine, mathematics, philosophy, natural philosophy, natural theology, and faith and reason. Refer to Table 30 throughout.

	Nature	God and Nature
To understand and to explain	Natural Science	Theology
To control	Technology	Magic

Table 30*: Natural science and related terms*

1.1. Natural Science

Our working definition of natural science is "the attempt to understand and explain nature."

What is *nature*? The Greek word for nature is "physin" or "phusis."

How is nature known? In this course, we are describing the best way of knowing anything as knowing it "according to its nature," in contrast to, say, knowing it in terms of categories and principles that are foreign to it, brought in from knowledge of other sorts of things. We don't study tornados the same way we study quarks or robins; rather, we try to adapt our methods of study according to the nature of each. In Greek, knowing "according to nature" is knowing *kata physin*.[2]

What is *science*? How do natural science and its methods of knowing differ from, and relate to, other fields such as theology, philosophy, technology, mathematics, medicine or magic? How do we distinguish boundaries between these and other disciplines?

Natural science may involve more than the attempt to understand and explain nature, and if we were philosophers we would have some interesting quibbles about what the words "understand," "explain," and "nature" might mean. Yet something along these lines offers us a reasonably flexible definition, at least to begin with. In any case, a provisional definition must not be too narrow lest it turn out to exclude activities that fall clearly within acknowledged practices of natural science. For example, a definition of science based on physics would be inadquate if it would regard historical geology as unscientific.

2. In future chapters we will consider *kata physin* methodology in detail, and argue that it is a better approach than trying to define science according to induction, logical positivism, falsificationism, hypothetico-deductivism, or any other school of the philosophy of science.

If we accept "the attempt to understand and explain nature" as a definition of natural science, or something like it, then we may construct a grid to provide a provisional guide to the usage of related terms (Table 30).

1.2. Theology

Given the description of natural science as the attempt to understand and explain nature (left-hand column), we may consider the attempt "to understand and explain God and nature" as a rough first approximation of theology (Table 30, right-hand-column).

Why is the column header "God and nature," instead of just "God"? Isn't theology merely the attempt to understand and explain God?

Actually, from a Christian perspective, particularly one that honors and respects the Incarnation, theology cannot be about God alone, apart from nature, for theology always considers the saving work of Christ in history and creation, in the circle of space and time. There can be no Christian theology without a theology of nature even if it is only implicit.[3] More accurately, however, we are speaking here not about God in all respects, plus nature in all respects, but about God and God's relations with nature.

In later chapters, from a Trinitarian standpoint, we will refine this definition to distinguish two types of inquiry: we will then reserve the word *theology* proper for a *kata physin* approach based on God's own self-disclosure; and we will use the term *mythology* to refer to other attempts to understand God on the basis of projection from nature, in contrast to *kata physin* methods. But for a rough starting point, theology generically, according to any model of reality, is an inquiry into God and nature and their relations.

1.3. Technology and Magic

To expand our list of related terms in Table 30, we next distinguish attempts "to understand and explain" (top row) from attempts "to control and master" (bottom row) Then the attempt "to control and master nature" would be technology (left-hand column). The attempt "to control and master God and nature" would be magic (right-hand column).

If natural science becomes applied to controlling natural phenomena, has it become an endeavor of technology? If theology becomes an exercise in attempting to control God's behavior toward us, does it verge into the domain of magic?

How does this grid compare with your own definitions?

These usages are very flexible, and only rough approximations to launch our explorations. They are not meant to confine any of these fields in a straight-jacket. They are heuristic, that is, intended to serve as a useful starting point for further inquiry. Nor are these definitions

3. Torrance writes that theology deals not with God and humanity, but with God/humanity/world relations; e.g., *Ground and Grammar of Theology* (#1980-369e), p. 75.

absolute. Rather than conceiving the four related terms in this grid as rigidly separate categories, think of them as overlapping clouds, as domains with movable boundaries.

1.4. Crossing Boundaries: Natural Science and Theology

What if the boundaries blur? What if the border between "nature" and "God and nature" changes through time or between different communities of practice? Then the boundaries between natural science and theology, and between technology and magic, will also change.

Let's consider first the boundary between natural science and theology, the line between the two columns of the top row (Table 30).

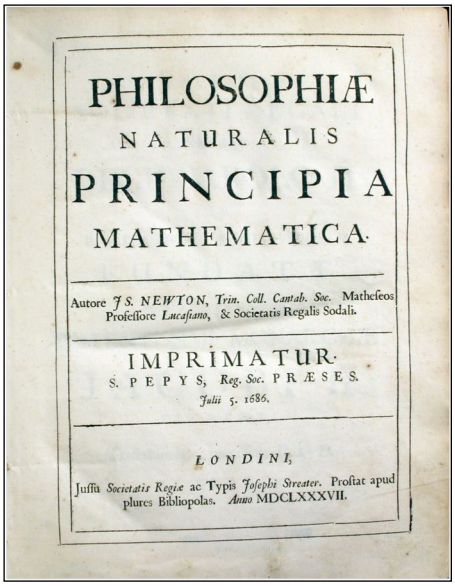
PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.
Autore *Is. NEWTON, Trin. Coll. Cantab. Soc.* Matheseos Professore *Lucasiano*, & Societatis Regalis Sodali.
IMPRIMATUR.
S. PEPYS, *Reg. Soc.* PRÆSES.
Julii 5. 1686.
LONDINI,
Juſſu *Societatis Regiæ* ac Typis *Josephi Streater*. Proſtat apud plures Bibliopolas. *Anno* MDCLXXXVII.

Figure 90: Isaac Newton, Principia (1687).

Newton's *Principia*, his masterwork of mathematical physics, announced the laws of motion and the theory of universal gravitation. The Latin title translates as *Mathematical Principles of Natural Philosophy*.[4] "Natural philosophy" included more than just mathematical physics. Physics was then seen as a discipline coordinated with broader inquiries, including philosophy and theology. In these pages, Newton could write:

> "This Being governs all things, not as the soul of the world, but as Lord over all: And on account of his dominion he is wont to be called Lord God pantokrater, or Universal Ruler… The supreme God is a Being eternal, infinite, absolutely perfect…"[5]

After going on for two pages about God's dominion and providence, right in the middle of his treatise on mathematical physics, Newton concluded,

> "And thus much concerning God; to discourse of whom from the appearance of things, does certainly belong to Natural Philosophy."[6]

So natural philosophy was a discipline that crossed the boundaries of natural science and theology.

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4. Isaac Newton, *Philosophiae naturalis principia mathematica* (London, 1687).

5. Florian Cajori, *Sir Isaac Newton's Mathematical Principles of Natural Philosophy* (Berkeley, California: University of California Press, 1934/1962), vol. 2, *The System of the World*, p. 544.

6. Ibid., p. 546.

1.5. CROSSING BOUNDARIES: TECHNOLOGY AND MAGIC

Similarly, the boundary may blur between technology and magic, between the two columns on the bottom row (Table 30). For example, in the Renaissance, inventions such as steam engine technology were developed by practitioners of so-called "natural magic," which was the study of natural but hidden causes.

Similarly, many Renaissance natural magicians regarded numbers as natural causes, and therefore carved amulets displaying numbers and geometrical figures. These amulets were designed to prevent illness by countering harmful celestial influences, or "*influenza*(s)," of a mathematical and astronomical nature. If one considers numbers as part of nature, that is, as natural causes in themselves, then such amulets would count as technology; others might regard the practice of relying upon such amulets as falling within the domain of magic.

1.6. CROSSING BOUNDARIES: SCIENCE AND TECHNOLOGY

What if the boundaries blur up and down, between both rows in a single column? That is, might what counts as "to explain" or "to control" also change through time and between different communities of practice? If so, the boundaries between natural science and technology, and between theology and magic, also change.

In the left column of Table 30, on the boundary of natural science and technology, consider: Is the harnessing of the power of the atom an example of science or technology? A good case may be made that it is both.

1.7. CROSSING BOUNDARIES: THEOLOGY AND MAGIC

In the right column of Table 30, we might place some forms of funerary practices across the boundary of theology and magic.

So instead of conceiving the related terms in this grid as rigidly separate categories, think of them as overlapping domains with negotiated boundaries.

1.8. MEDICINE

Where does *medicine* fall in the grid? Is medicine a practice of natural science, theology, technology or magic? It is intimately related to all four, as the history of medicine bears out.

For example, Robert Fludd, one of the leading physicians in London contemporary with Galileo, approached medicine as about equal parts natural science, theology, technology, and magic (Figure 91). Nature is portrayed as the great chain of being, represented by a female figure who spans all the hierarchical regions from the divine to the center of the universe, the lowest region of generation and corruption. The ape in the center of the frontispiece represents the human physician who is able to achieve the imitation of nature through the medical and alchemical arts.

Figure 91: Robert Fludd, Microsmi (1619).

1.9. MATHEMATICS

What about *mathematics*?

Like medicine, mathematics has been practiced in each of the four modes. In natural science and theology, questions arise such as:

- How does one explain or control numbers and the relations between numbers?
- Are numbers abstractions from nature, and wholly imaginary?
- Or, are they self-existent, in that they would exist apart from the physical universe, and perhaps serve as fundamental causes?
- If so, are they divine or semi-divine, an inherent aspect of the mind of God, to be prayed to and worshiped as did the ancient Pythagoreans?

1.10. Prayer Wheels

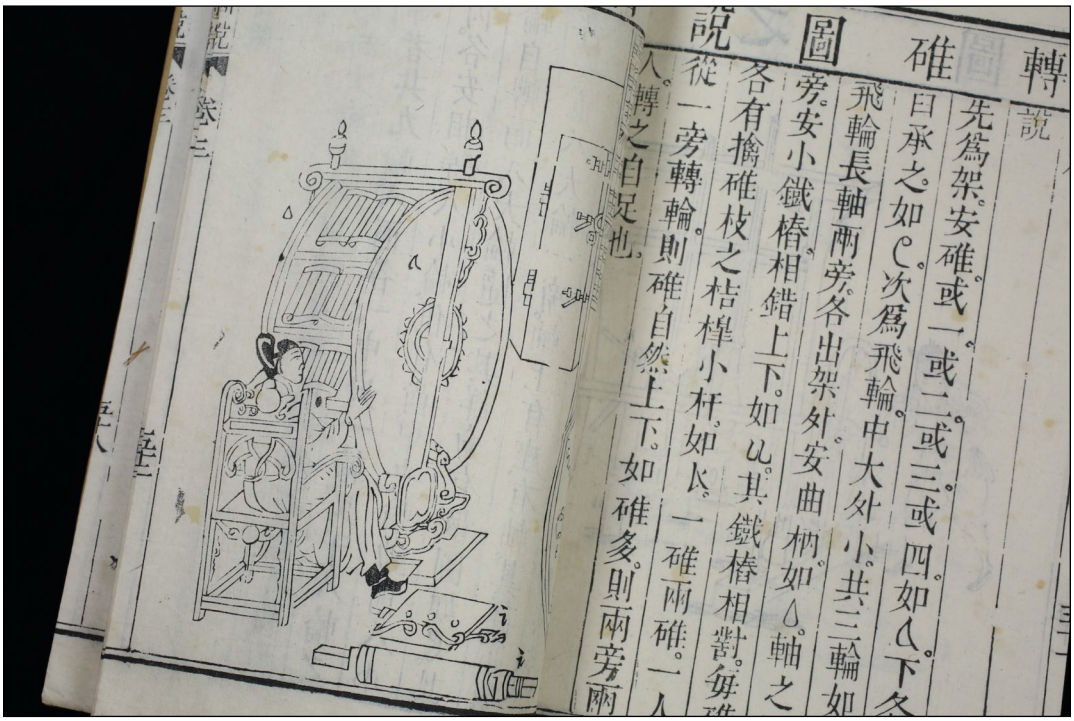

Figure 92: Asian Book Wheel.

Consider another example of crossing boundaries: How would you describe Buddhist prayer wheels? A monk could recite prayers so much more quickly by rotating them on a prayer wheel. Eventually, monks devised a way for the wind to turn the prayer wheel, cranking out merit more efficiently than ever, not even needing the monk to be sitting there. When the wind wheels were brought west from Asia into Europe, the idea led to wind mills, grinding grain instead of churning out prayer recitations. So this instrument tradition combined theology, magic, technology and natural science.[7]

Inevitably, there's much overlap and variation in our usage of these common terms.

1.11. Philosophy

Where is *philosophy*?

Philosophy is absent from the grid, not because it is unrelated to natural science and theology (far from it!), but because we are doing philosophy now in discussing the grid, just as we will be doing philosophy and not natural science *per se* in the next section discussing the models of reality. One of the prime tasks of philosophy has always been to explain how disciplines relate to one another, including theology and natural science.

7. Lynn White, *Medieval Technology and Social Change* (Oxford University Press, 1966).

All of these endeavors – natural science, theology, technology, magic, medicine, mathematics, philosophy – play important roles in the dialogue between science and religion. Although we cannot do justice to any of them in the course of a single book, I hope we will not ignore any of them.

1.12. Natural Theology – Foundationalist (Dualist)

"Faith" and "reason" are two of the most dangerous words in intellectual history. Until they are defined, people may think they are conversing along quite well and sensibly when in actuality completely different meanings are intended. Moreover, different conceptions of faith and reason lead to quite different conceptions of "natural theology."

To sort out these conundrums, we will characterize two broad traditions of natural theology: foundationalist (discussed here) and relational (discussed next). They differ in large part because of their contrasting conceptions of "faith" and "reason."[8]

- In foundationalist natural theology, there is a dualism between "faith" and "reason." "Faith" is defined as knowledge pertaining to religious belief, or derived from divine revelation, while "reason" is regarded as "natural reason," i.e., knowledge that is independent somehow from religious or faith commitments.
- In relational natural theology, "faith" and "reason" are regarded as interdependent in all inquiries and acts of knowing, like Escher's hands, rather than as mutually exclusive sources or domains of knowledge.

If "faith" and "reason" are viewed in the first sense as mutually exclusive, a dualism, then the problem of faith and reason is how to bring them into agreement.

The great medieval synthesis of Christianity and Aristotle, exemplified in the work of Thomas Aquinas, is often regarded as a paradigm example of this approach. In the world of Paris in the 1200's, the vast writings of Aristotle were coming into Europe and transforming the university curriculum. Thomas sought to baptize Aristotle, to defuse objections to the faith arising from Aristotelian premises, and to show that Aristotle rather might be harnessed to articulate and defend the Christian faith. Is the medieval synthesis a model for Christians today?

On one level, not unique to Thomas, the conclusions of theology and the conclusions of other sciences will always agree because there is a unity of truth. Therefore the Christian philosopher may freely pursue rational inquiry, and the theologian may freely pursue revealed truth, each confident that the results of their separate inquiries will ultimately agree. In cases of apparent conflict, renewed inquiry in one or both domains may be undertaken in confidence that the conflicts can be resolved. As an example, Thomas engaged arguments from natural reason for the eternity of the world and reconciled them with a theological understanding of creation by refocusing the doctrine of creation to refer to ontological dependence rather than an absolute beginning in time. In other words, the creation depends for its being upon the creative activity of God, even if God has been creating throughout all of time. Concepts of *being* and *time* can be probed and refined as may be necessary in order to bring revealed faith and natural reason into harmony without compromising the integrity of either domain. These two perspectives – the unity of truth, and the integrity of different disciplinary domains – are common to Christian traditions, although there are various ways

8. These two traditions are historically complex and interwoven. It may be helpful to think of them as two poles on a continuum, marked by contested relations.

of implementing them. They were associated with Augustine as well as Thomas, for example.[9]

On another level, the "Thomist synthesis," at least as it came to be understood by its 20th-century advocates, includes two auxiliary perspectives:

1. first, the independent operation or even religious neutrality of natural reason, and
2. second, the idea that "grace completes nature," with its corollary that "faith" brings to completion what is begun by "reason."

Given these two assumptions, natural theology attempts to construct a logical bridge from natural reason to faith. Faith completes the intellectual ascent to God begun by reason or science. Natural reason serves as a foundation for natural theology in which one may reason one's way to God.

Thus we have Thomas' "five ways to God," each of which is a version of what we call the "cosmological argument." They remain of central importance to 21st-century exercises in foundationalist natural theology.

Argument from...	to...
Motion	Unmoved Mover
Efficient causality	First Cause
Contingent order	Only Necessary Being
Degrees of perfection	Only Perfect Being
Design	Intelligent Designer

Table 31*: Thomas' Five Ways*

- In the first way, one argues from motion back to a first mover, who must be himself unmoved. That Unmoved Mover is God.
- In the second way, one argues from efficient causes back to a First Cause, which is God.
- Third, one argues from the contingency of creation back to something that must be necessary. Something must have necessary being; nature does not, because it appears contingent; therefore nature is not God but must depend upon God.
- Fourth, from the existence in nature of degrees of perfection, there must be a source that has complete perfection. There is an "analogy of being," where the Only Perfect Being is like us, except perfect.

9. We will return to consider the perspectives of the unity of truth and the integrity of disciplinary domains in greater detail in Chapter 11, "Perspective: Knowing Kata-physin," Chapter 12, "Case Studies: Interdisciplinary Relations," and Chapter 14, Case Studies: Relational Physics (and Genesis 1)."

• And finally, the argument from design.

A 6th argument was commonly advanced from the nature of time. Not one of Thomas' "five ways," the so-called "kalam argument" came into medieval Europe from a tradition of Islamic philosophical theology known as *kalam*. This argument seeks to demonstrate that there must be a first moment in time, which in turn implies that there must be some being, namely God, who transcends time.

What each of these arguments have in common is an explicit dualism between faith and reason, between natural and supernatural knowledge. Torrance described the "five ways" in terms of Aristotelian cosmological and epistemological dualism:

> "It was inevitable that a natural theology should be thrown up, the primary task of which was to close the gap between the world and God by means of a logical bridge…"[10]

A classic articulation of this approach to faith and reason is found in the little book by Étienne Gilson, *Reason and Revelation in the Middle Ages*.[11] "Faith" is represented in the title by "revelation," signifying an exclusive domain of revealed knowledge separate from natural reason. Gilson's dualism between faith and reason is explicit:

> "... let us begin by defining the proper nature of religious faith. To have faith is to assent to something because it is revealed by God. And now, what is it to have science? It is to assent to something which we perceive as true in the natural light of reason. The essential difference between these two distinct orders of assent should be carefully kept in mind..."[12]

In the first chapter, "The Primacy of Faith," Gilson considers figures who defended conclusions based on revelation, such as Tertullian, Anselm, Augustine, Roger Bacon, and Ramon Lull. To Gilson, these are *fideists*, who follow faith over reason. Gilson describes Augustine, for example, as regarding faith as the starting point and then going on from revelation to reason.[13]

In the second chapter, "The Primacy of Reason," Gilson considers those who defended conclusions based on philosophy, in this case, Aristotelianism, such as Ibn Sina (Avicenna), Ibn Rushd (Averroes), John of Jandun, Siger of Brabant, and Fontenelle. These are *rationalists*, who follow reason over faith. Gilson describes John and Siger and other Latin followers of Averroes, for example, as maintaining a "watertight separation" between reason and faith. Other historians have described them as holding to "double truth" – one set of conclusions as

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10. *Ground and Grammar of Theology*, p. 80.

11. Étienne Gilson, *Reason and Revelation in the Middle Ages* (New York: Charles Scribner's Sons, 1938).

12. Ibid., p. 72. Obviously, Gilson would find objectionable the very title of T. F. Torrance's *Theological Science*, which proceeds from a fundamentally different, non-dualist conception of faith and reason.

13. "Augustine was never to forget that the safest way to reach truth is not the one that starts from reason and then goes on from rational certitude to faith, but, on the contrary, the way whose starting point is faith and then goes on from Revelation to reason." Ibid., p. 17.

the necessary demonstrations of reason, held alongside a different and contradictory set of conclusions as the teaching of revelation.[14]

Finally, in the concluding chapter, "The Harmony of Reason and Revelation," Gilson explores how other figures reconciled the two domains by ordering them in separate but compatible spheres, such as Maimonides, Albert the Great, and Thomas Aquinas. These achieved compatibility between faith and reason, despite conceiving of them in dualistic opposition. For example, Gilson quotes Thomas Aquinas:

> "It is impossible that one and the same thing should be believed [by faith] and seen [demonstrated by reason] by the same person, ... it is equally impossible for one and the same thing to be an object of science and an object of belief for the same person."[15]

This profound dualism between faith and reason underlies the foundationalist tradition of natural theology.

We noted back on p. 92 that *natural theology* is often understood as an attempt to use natural science or natural reason to establish the Christian faith. We referred to this prevalent model of faith and reason as foundationalist apologetics, or foundationalist natural theology, which takes the form of trying to prove the existence of a Creator using arguments from the natural sciences or from philosophy. In this tradition, the attempt to harmonize natural reason with the articles of faith begins with reason in an effort to build a ladder up to faith (Table 32, left column). To ascend the ladder, we start at the bottom rung with natural reason or natural science alone. We start climbing and see how far up we can go before we have to resort to faith and revelation to complete the ascent.

Different schools debate how far one may ascend by natural reason, or natural science, before faith has to take over. How far can natural reason take us, before we need to call upon revelation? Can one come to a knowledge of the *One God* by reason and science alone? Or merely reach an *intelligent designer*, which might even be an agent acting within nature?

Gilson distinguishes between revealed truths which are accessible to natural reason, on one hand, and "articles of faith" proper which surpass reason and must be accepted on the basis of revelation only.

> "The first... comprises a certain number of revealed truths which, though they be revealed, are nevertheless attainable by reason alone. Such are, for instance, the existence of God and his essential attributes, or the existence of the human soul and its immortality."[16]

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14. Ibid., p. 58. Cf. "The existence of a medieval rationalism should never have been forgotten by those historians who investigate into the origins of the so-called modern rationalism, for indeed the Averroistic tradition forms an uninterrupted chain from the Masters of Arts at Paris and Padua, to the 'Libertins' of the seventeenth and of the eighteenth centuries"; ibid., p. 65.

15. Ibid., p. 74.

16. Ibid., p. 82.

These tenets of Christianity are accessible to natural reason. The second, articles of faith proper, while not attainable by reason are nevertheless not able to be disproved by reason. It is in this sense that Gilson asserts that faith and reason are in agreement.

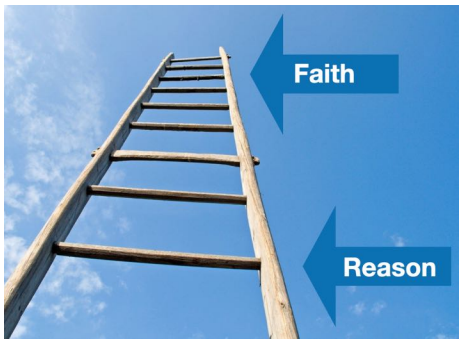
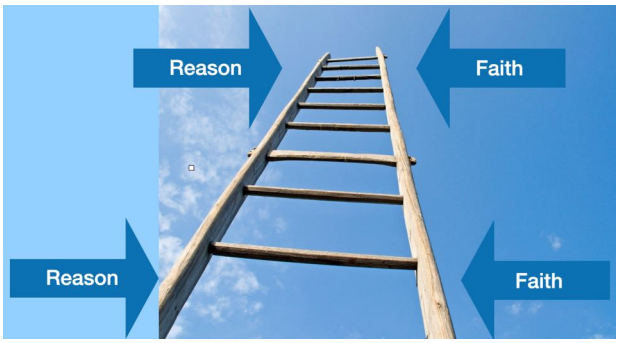
Natural Theology – Two Kinds	
Foundationalist	Relational
	
A ladder of rational ascent to faith. To ascend the ladder, we start with reason or science alone. We start climbing and see how far we can go before we have to resort to faith to complete the ascent to the top.	Faith and reason are the two rails of the ladder, which work together at every rung. The ladder is no longer an ascent to God, but a metaphor for the unity and relations of the sciences. • Unity of a science: rungs = different sciences. • Relations of the sciences: The sciences may be related either horizontally or vertically. The ladder represents vertical relations.

Table 32*: Ladder diagrams*

In the 14th century, William Ockham denied the validity of the five ways as logical demonstrations or proofs of the existence of God. Therefore, to Gilson, Ockham represented the "divorce" of faith and reason, a breakdown of the Thomist synthesis: "When the best minds began to despair of harmonizing the teachings of Christian revelation with those of philosophy, the end of the Middle Ages was at hand."[17]

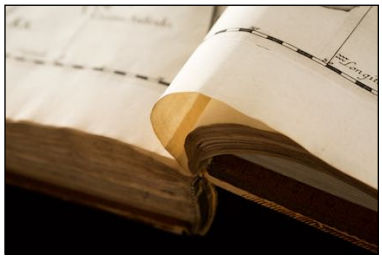
Gilson defended the Thomist *synthesis* in which faith and reason reached *agreement* or *harmonization* as a model for philosophy and science today. In my opinion, the terms "synthesis," "agreement," and "harmony" are not adequate for the outcome he has described. More accurately, as Gilson described them, faith and reason were shown only not to contradict one another. Compatibility is not precisely the same as being in agreement, since one may be silent when the other speaks. Similarly, a synthesis should mean to bring together in an integrated fashion, which again is more than a failure to contradict. And harmony is too strong a word also, given that in actuality a harmony is produced by an intermingling of different voices within a single tonal space. To speak of the harmony of faith

17. Gilson, ibid., p. 91.

and reason is best reserved for a non-dualistic conception of faith and reason in which they are intimately interrelated in all domains.

Gilson took Ockham's rejection of unaided reason as a rejection of harmonization, which most historians today agree misrepresents Ockham. Gilson's construction of the three categories announced in the titles of his three chapters is vigorously contested by those who do not share Gilson's dualistic conception of faith and reason. However, reading this little work by Gilson is a superb introduction to the way of thinking about faith and reason that underlies foundationalist natural theology.[18]

Close Reading #1: Blaise Pascal, *Pensées*, 449, 199, and 110.



A long list of those who have rejected the dualistic tradition of natural theology which Gilson describes includes Duns Scotus, William Ockham, Jean Calvin, Blaise Pascal, Søren Kierkegaard, Karl Barth, and Thomas F. Torrance. In Pensée 449, Pascal explained:

> "I shall not undertake here to prove by reasons from nature either the existence of God, or the Trinity or the immortality of the soul, or anything of that kind: not just because I should not feel competent to find in nature arguments which would convince hardened atheists, but also because such knowledge, without Christ, is useless and sterile.... All those who seek God apart from Christ, and who go no further than nature, either find no light to satisfy them or come to devise a means of knowing and serving God without a mediator, thus falling into either atheism or deism, two things almost equally abhorrent to Christianity.... What can be seen on earth indicates neither the total absence, nor the manifest presence of divinity, but the presence of a hidden God. Everything bears this stamp."[19]

Pascal's affirmation of the presence of a hidden God, inaccessible to natural reason alone, resonates with the above description of the Trinitarian model of reality. In general, in the history of the church, where Trinitarian theology has flourished, foundationalist natural theology has declined, and vice-versa.

To this alternative, non-dualist conception of faith and reason we now turn.

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18. It is rightly a classic. For more in-depth presentations from this point of view, see Étienne Gilson, *History of Christian Philosophy in the Middle Ages* (New York: Random House, 1955); Étienne Gilson, *The Spirit of Medieval Philosophy* (New York: Charles Scribner's Sons, 1936*),* which were the Gifford Lectures for 1931-1932; and Stanley L. Jaki, *The Road of Science and the Ways to God* (Chicago: University of Chicago Press, 1978), which were the Gifford Lectures for 1974–75 and 1975–76.

19. Blaise Pascal, *Pensées*, trans. A. J. Krailsheimer (New York: Penguin, 1966), pp. 169-170. Cf. Pensée 199, pp. 88-95.

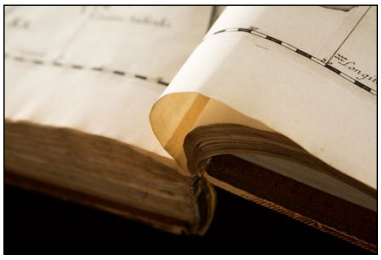
1.13. Natural Theology – Relational (Non-Dualist)

An alternative approach is *relational natural theology*. In this tradition, there is no such thing as foundationalist reason, a completely autonomous reason, that is, a natural reason that moves under its own power apart from fundamental beliefs and personal commitments. Reason is never religiously neutral, nor is unaided reason capable of providing a foundation from which to build a logical bridge to God. And in turn, faith is more than merely a domain of knowledge; it refers to a posture of personal commitment and trust that has a wider applicability than just the theological response to revelation in the articulation of articles of religious belief. To insist upon the sufficiency of natural reason ultimately undermines all knowledge in every field. Nor does faith have a hierarchical priority over reason.

Consider three metaphors:

1. Like Escher's two hands, faith and reason each facilitate and promote the other. In relational natural theology, faith and reason are interdependent, rather than mutually exclusive sources of knowledge. They interact from the start and continuously throughout the process of inquiry in any discipline or science. They are not in opposition, and neither has priority over the other.
2. Adapting the ladder metaphor, faith and reason are the two rails which work together at every rung on the ladder (Table 32, right column). There is no reasoning, even at the first rung, without radical assumptions and personal commitments. In the ladder metaphor, faith and reason are both needed to take the very first steps on the lower rungs, and both are necessary even at the very top.
3. A third metaphor is that faith and reason are the two wings by which we fly in any science. With just one set of wings, there is no dualism.[20]

Close Reading #2: Anselm of Canterbury, *Proslogium*, 1.



In any knowing, we must believe. And yet we believe in order to understand, as Anselm affirmed:

> "... for in no wise do I compare my understanding with [yours]; but I long to understand in some degree thy truth, which my heart believes and loves. For I do not seek to understand that I may believe, but I believe in order to understand (*credo ut intelligam*). For this I also believe, – that unless I believed, I should not understand."[21]

For centuries since Anselm wrote down these prayerful words, foundationalist philosophers have recast Anselm's meditation into a so-called "ontological argument." Briefly summarized, he is said to have argued that since creaturely being exists, therefore perfect being must exist.

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20. John Macmurray, cite

21. Anselm of Canterbury, *Proslogium*, 1. *St. Anselm: Basic Writings*, trans. S. N. Deane (La Salle, Illinois: Open Court Publishing, 1962), p. 53.

This is to misread his writings, to attempt to make them fit within the framework of foundationalist natural theology, when actually his conception of faith and reason was relational. His approach was not dualist. Anselm's original title for the meditation was "faith seeking understanding"; *fides quarens intellectum*.[22] This was precisely the title Karl Barth chose for a book on Anselm he published in 1931 as an objection to a lecture on the ontological proof by his friend the philosopher Heinrich Scholz.[23] Barth regarded his book on Anselm as a decisive turning point in the development of his own theological methodology, just before commencing the writing of his mature *Church Dogmatics*.[24] For Barth ever after, any discipline is properly "scientific" not because it proceeds on the basis of natural reason, nor even on the basis of faith apart from reason, but if and only if it adheres to a methodology appropriate to its subject matter. For theology, that method is *fides quarens intellectum*, "faith seeking understanding." Barth began the opening pages of the *Church Dogmatics* with a defense of this methodology, again referencing his opposition to the views of Scholz.[25]

"Faith" in this sense encompasses first principles of reasoning in any discipline. First principles lie beyond the demonstrative power of independent reason but are required for reasoning to proceed in any subject area. The point that revelation provides the first principles of theological science is but one example of the general methodological reality that a personal commitment to first principles, which are believed in order to understand, characterizes any science. As the process of knowing unfolds in any science there is a dialectic between faith and reason in which each refines the other until both the first principles and the methodology of reasoning or investigation become more and more appropriate to the subject

22. Ibid., p. 48.

23. Karl Barth, *Anselm: Fides Quaerens Intellectum; Anselm's Proof of the Existence of God in the Context of his Theological Scheme*, trans. Ian Robertson (Eugene Oregon: Pickwick Publications, previously published London: SCM Press, 1960), p. 7. Originally published as Karl Barth, *Fides quaerens intellectum, Anselms Beweis der Existenz Gottes* (Munich, 1931); 2d ed (Zurich, 1958). See the Preface to the first edition.

24. Ibid., "Preface to the Second Edtion," p. 11. In 1939, Barth recalled: "In these years I have had to rid myself of the last remnants of a philosophical, i.e., anthropological (in America one says 'humanistic' or 'naturalistic') foundation of Christian doctrine. The real document of this farewell is, in truth, ... the book about the evidence for God of Anselm of Canterbury which appeared in 1931. Among all my books I regard this as the one written with the greatest satisfaction." Ibid., quoted in Arthur C. Cochrane, "Preface to the Reprint Edition," p. 12B. For commentary on Anselm and Barth, see Thomas F. Torrance, *Karl Barth: An Introduction to His Early Theology, 1910-1931* (London: SCM Press; New York: Harper & Row, 1962); #1962-177. Barth's book on Anselm represents his own break with dualism and foundationalist natural theology, in transition to a relational conception of faith and reason as described here.

25. We will return to this debate between Barth and Scholz below, in Chapter 11, "Perspective: Knowing Kata-physin," Section 1, "Karl Barth," beginning on p. 463.

matter being known.[26] That achievement eventually results in *kata-physin* knowing, knowing "according to nature."

Consider, for example, the first principle of non-contradiction. In the *Metaphysics*, Aristotle wrote:

> "Some indeed demand that even this [principle of non-contradiction] shall be demonstrated, but this they do through want of education, for not to know of what things one may demand demonstration, and of what one may not, argues simply want of education. For it is impossible that there should be demonstration of absolutely everything; there would be an infinite regress, so that there would still be no demonstration. But if there are things of which one should not demand demonstration, these persons cannot say what principle they regard as more indemonstrable than the present one. We can, however, demonstrate negatively even that this view is impossible, if our opponent will only say something; and if he says nothing, it is absurd to attempt to reason with one who will not reason about anything, in so far as he refuses to reason. For such a one, as such, is seen already to be no better than a mere plant."[27]

Aristotle exhorted his students never to argue with one who denies the first principles of a science, for with such a person it is impossible to have a productive inquiry into truth. Reason alone cannot demonstrate anything, not even that reason is not an illusion.[28] We believe in order that we may understand. Faith and reason are the two wings by which we fly in any science.

I remember a seminar on Plato and Aristotle in graduate school. After lunch, we were all nodding off a little bit. Suddenly we were jolted awake by a powerful slam of the professor's fist upon the table! He exclaimed, "There is *no* science without *monstrous* presuppositions!" I and several of my fellow students have never forgotten it. The moment was typical of Prof. David Kitts' penchant for aphorisms. He opened one of his articles on the history and philosophy of paleontology with the provocative line: "By itself, a fossil teaches us nothing,

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26. Note that the "first" in "first principles" does not mean chronologically prior, as in some forms of "presuppositionalism" which work out conclusions from premises in an axiomatic-deductive methodology. Rather, in this view there is an ongoing conversation between faith and reason, a dialectic of mutual refinement between them. It would be a mischaracterization to describe this view as giving priority to one over the other; both fideism and evidentialism already operate with a dualism between faith and reason which this approach rejects.

27. Aristotle, Metaphysics. 1006a1-16. Trans. W. D. Ross, in *The Complete Works of Aristotle: The Revised Oxford Translation*, ed. Jonathan Barnes, Bollingen Series (Princeton: Princeton University Press), vol. 2, p. 1588.

28. In a public radio broadcast on March 5, 1941, Sayers argued that "enlightened human reason... cannot *prove* that reason itself is not an illusion." Dorothy L. Sayers, "The Religions Behind the Nation," in *The Christ of the Creeds*, ed. Suzanne Bray (Dorothy L. Sayers Society, 1941, 2008), p. 45.

not even that it is a fossil."[29] None of us in Kitts' seminar on Plato and Aristotle found that surprising.

As biochemist-turned-philosopher of science Michael Polanyi also emphasized, personal commitments and radical assumptions are indispensable to every tradition of inquiry in any science.[30]

In Pensée 110, Blaise Pascal affirmed the interrelated character of faith and reason in terms of the interdependence of reason and the heart:

> "We know the truth not only through our reason but also through our heart. It is through the latter that we know first principles, and reason, which has nothing to do with it, tries in vain to refute them.... For knowledge of first principles, like space, time, motion, number, is as solid as any derived through reason, and it is on such knowledge, coming from the heart and instinct, that reason has to depend and base all its argument... Principles are felt, propositions proved, and both with certainty though by different means. It is just as pointless and absurd for reason to demand proof of first principles from the heart before agreeing to accept them as it would be absurd for the heart to demand an intuition of all the propositions demonstrated by reason before agreeing to accept them."[31]

Pascal's understanding of the search for truth in any discipline is neither one of faith alone (*fideism*) nor of reason alone or science alone (*rationalism* or *evidentialism* or *scientism*), but of both working together in an interrelated fashion like Escher's two hands.

In my opinion – one shared by many modern interpreters – regardless of his methodological pronouncements, in actual practice, Thomas Aquinas did not base his methodology on "natural" or "unaided" reason, but on a "baptized" reason which already reflected his precommitments and faith perspectives. In this interpretation, the figures specifically discussed by Gilson, and the intellectual achievement of the Middle Ages more generally, will be viewed quite differently. A vigorous academic literature contests the neo-Thomist interpretation of such figures as John Duns Scotus, William Ockham, and the others, as well as Thomas Aquinas. Rather, Scotus and Ockham were continuing the ongoing reform of knowledge, and development of realist methodology, to which Thomas himself had contributed so much. Reformation historian Heiko Oberman, for example, refers to the achievements of Scotus and Ockham as the "harvest of the Middle Ages" rather than as a "breakdown" of the Thomist synthesis.[32]

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29. David B. Kitts, "Paleontology and Evolutionary Theory," *Paleontology and Evolutionary Theory* 28, (1974): 458-472; reprinted in David B. Kitts, *The Structure of Geology* (Dallas: SMU Press, 1997), p. ?.

30. Michael Polanyi, Personal Knowledge...

31. Blaise Pascal, *Pensées*, trans. A. J. Krailsheimer (New York: Penguin, 1966), p. 58. See Roy Clouser, *Knowing with the Heart: Religious Experience and Belief in God* (Downers Grove, Illinois: InterVarsity Press, 1999).

32. Heiko A. Oberman, *The Harvest of the Middle Ages: Gabriel Biel and Late Medieval Nominalism*

Instead of Thomas' motto of "grace completes nature," with its corollary of "faith completes reason," Escher's drawing of the two hands suggests a motto of grace and nature, or faith and reason, "in intimate relation." Grace has been present within nature from the start.[33] We never come to know grace apart from nature.[34] The same is true of faith and reason: faith has been present within the operation of reason from the start, and in the same way, we never come to know faith apart from reason. In deep and profound interrelations, each completes, motivates, energizes, corrects, facilitates, restores, and nourishes the other. Faith and reason, and grace and nature, parallel the relations in the Chalcedon formula for the divinity and humanity of Christ, in which there is no dualism, but rather a profound interrelation.[35]

(Cambridge: Harvard University Press, 1963). See also Oberman's many other publications. A historical survey by Steven Ozment provides another snapshot of the emergence of non-Thomist interpretation: *The Age of Reform, 1250-1550: An Intellectual and Religious History of Late Medieval and Reformation Europe* (New Haven: Yale University Press, 1980). In some cases, the characterization of the significance of Thomas, Scotus, Ockham, and others reveals as much about the interpreter's conception of faith and reason as about the actual writings or context of the historical figures themselves; in other words, faith and reason are interrelated even in the investigations of intellectual historians.

33. This point underlies the above description of doxological love, which insisted upon the daily work and experience of the natural sciences as already infused with the grace of God, whether the scientist recognizes nature as creation or not. See Chapter 3, Section 5, "Doxological Love" on pp. 104-115. Theologically speaking, the covenant of creation was already from the start a covenant of grace. In later Calvinism, federal theology created a dualism between a covenant of creation and a covenant of grace. That development of Protestant scholasticism resuscitated aspects of Thomism with its dualism of nature and grace. On this, the work of James B. Torrance is particularly helpful; see "Covenant or Contract?: A Study of the Theological Background of Worship in Seventeenth-Century Scotland," *Scottish Journal of Theology* 23 (1970): 51-76, #1970-JBT-2; "The Covenant Concept in Scottish Theology and Politics and Its Legacy," *Scottish Journal of Theology* 34 (1981): 225-243, #1981-JBT-1; "Calvinism and Puritanism in England and Scotland: Some Basic Concepts in the Development of Federal Theology," in *Calvinus Reformator: His Contribution to Theology, Church and Society* (Potchefstroom, Transvaal, Republic of South Africa: Potchefstroom University for Christian Higher Education, 1982), 264-286, #1982-JBT-1; and "The Concept of Federal Theology: Was Calvin a Federal Theologian?," in *Calvinus Sacrae Scripturae Professor: Calvin as Professor of Holy Scripture*, ed. Wilhelm H. Neuser (Grand Rapids, Michigan: Wm. B. Eerdmans, 1994), 15-40, #1994-JBT-4.

34. This would amount to sidestepping the Incarnation as unnecesary for true knowledge of God. Torrance argues: "Thus the ascension means that we cannot know God by transcending space and time, by leaping beyond the limits of our place on earth, but only by encountering God and his saving work within space and time, within our actual physical existence… The ascension, on the contrary, sends us back to the incarnation, and to the historical Jesus, and so to a Word and Act of God inseparably implicated in our space and time. It sends us back to a Gospel which is really accessible to frail creatures of earth and history, and a Gospel that is relevant to their bodily existence day by day in the structures and coherences of space and time. Thus all true and proper knowledge of God is mediated through the historical Jesus Christ. Now that God has taken this way of revealing himself to us in and through the incarnation of his Word in the space-time existence and structure of Jesus Christ, he has set aside all other possibilities for us, no matter how conceivable they were a priori." *Space, Time, and Resurrection*, p. 134.

35. On the Chalcedon formula's articulation of the relations between Jesus' divine and human natures, see p. 269, and the general discussion of "The Trinitarian Model," pp. 264-272.

In conclusion, the two approaches to natural theology share several features, including a commitment both to the unity of truth and to the integrity of disciplines devoted to various subject domains. Their radical differences become apparent, however, in how they conceive of faith and reason. The two approaches to natural theology move in opposite directions:

• In foundationalist natural theology, the goal or movement is from reason to faith, or from nature to God. It is a classical, foundationalist form of apologetics, going up the ladder rung by rung. Foundationalist natural theology is a rival to theology as they both seek knowledge of God through different methods. Foundationalist natural theology flourishes in dualist milieus.

• In relational natural theology, the goal or movement is between faith and reason in every science, on every individual rung. There is no similar rivalry with theology, for theology occupies its own rung on the ladder as one science among others.[36] Relational natural theology flourishes in Trinitarian milieus.

In actual practice, many writers may display a conglomeration or incongruous mixture of these two contrasting forms of natural theology. Delineating them here may help us avoid inconsistences in our own thought, just as Barth found his study of Anselm helpful in rooting out the remnants of dualism in his own thinking. Think of this brief analysis as a heuristic model to clarify your thinking when grappling with the complexities of any particular issue, historical figure, or case study.

We will have much more to say about natural theology throughout this book, culminating in Chapter 23, "Perspective: Reconstructing Natural Theology."

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36. Knowledge of God is assumed to come *kata physin* from its appropriate source, i.e., theological science.

1.14. Natural Theology and Natural Philosophy

Natural philosophy and natural theology both involve the questions of what accounts for the unity of a science and of how different sciences are related.

We saw that *natural philosophy* was an older term for more than just mathematical physics. Rather, natural philosophy coordinated the disciplines of the natural sciences with other endeavors, including philosophy, particularly the foundations of knowledge or epistemology, as well as ethics or moral philosophy, and possibly (as in the case of Newton) theology.

Thus, natural philosophy explores two questions:

1. What is the interplay of science and philosophy in every discipline? This is a way to address the general question of what accounts for the unity of a science.
2. How do the various sciences and philosophy coordinate together? This is a way to address the general question of the relations between different sciences.

Now we're able to compare the disciplines of natural philosophy and natural theology. As we have seen, relational natural theology explores two questions:

1. What is the interplay between faith and reason in every discipline? (Unity of science)
2. How do different disciplines coordinate together, including theology? (Relations of the sciences)

Natural theology, in the relational sense that Thomas F. Torrance used, is similar to natural philosophy, but adds the discipline of theology into the mix, and raises questions of the interplay between faith and reason in every discipline.

	Unity of the sciences	Relations of the sciences
Natural Philosophy	What is the interplay between science and philosophy in every discipline?	How do the sciences and philosophy coordinate together?
Natural Theology	What is the interplay between faith and reason in every discipline?	How do different disciplines coordinate together, including theology?

Table 33*: Natural Philosophy and Natural Theology*

Unfortunately, when someone uses the term "natural theology," we may not know which form of natural theology they mean: whether the foundationalist sense or the relational sense. A key indicator will be whether they conceive of faith and reason as interrelated or in a dualist manner as mutually exclusive. Relational natural theology engages and extends the traditional inquiry of natural philosophy into the unity and relations of the sciences.

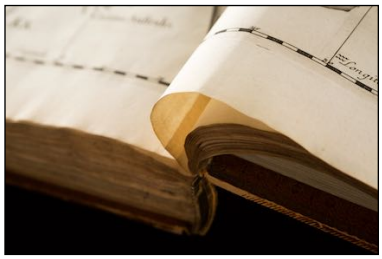
2. Models of God and Nature[37]

In this section we will illustrate the interrelations of faith and reason described in the previous section by considering the question, "What is reality?" This question is related to the question "What are the relations between God and nature?"

Let's stipulate six different models of reality. They are "heuristic," which means they're not the "last word," but a starting point for the sake of initiating inquiry. These models may help us understand how our own conceptions of reality compare or relate to another's. The models also establish a common usage of terms we can use in future conversations. If you like philosophy, this chapter will be your cup of tea.[38]

Consider the story of Moses and the burning bush as relayed in the third chapter of Exodus. Out of the burning bush, God revealed himself to Moses as "I am who I am." The bush was burning with the presence of God, yet the bush remained a bush and was not consumed. For the Theist, the burning bush is a model of nature ablaze with the presence of God, whether we can see it or not. The very presence of God makes the bush what it is, affirms it as a bush, and sustains it in its being. Yet too often for us the flame is hidden. If only we had special goggles that would allow us to see all of nature as a burning bush, proclaiming the presence of God!

Close Reading #3: Roy Clouser, *The Myth of Religious Neutrality*, chs. 2-3.



Now, for the sake of creating our six models, let's reflect on the phrase "I am who I am" as a statement of God's presence in the world.[39] If we consider "I am who I am" in abstraction, we're not far from Aristotle's definition of the "divine" as the first principle on which all else depends.[40] By the word "divine," we mean whatever occupies

37. Revise this section by incorporating illustrations from Dorothy L. Sayers, Lewis (but not the Ransom trilogy), MacDonald, Chesterton, and Torrance***.

38. I am indebted to Roy Clouser for this comparative approach to religion with respect to the status of the "divine." See Roy Clouser, *The Myth of Religious Neutrality: An Essay on the Hidden Role of Religious Belief in Theories*, Revised Edition (Notre Dame University Press, 2005), ch. 2, "What is Religion?" My approach to models of God and nature is based upon Clouser, ch. 3, "Types of Religious Belief." These are revised from the 1st edition published in 1991. The attentive reader will notice non-trivial differences in the ways we have developed our models, but I follow and depend upon Clouser's fundamental work in this area.

39. Exodus 3:13.

40. For example, in the *Metaphysics*, Aristotle rehearsed the ideas of his predecessors, the presocratic natural philosophers and Plato, about the nature of divine first principles from which all things come to be. For example, Thales of Miletos attributed all things to a first principle of water (Book I, ch. 3). In Book XI, ch. 7, Aristotle defines metaphysics as the inquiry into that first principle which can exist apart and

the status of "I am who I am" in a given model of reality. There is no god like Yahweh, who alone truly is "I am who I am." Yet we may inquire: what occupies his rightful place in other models? We will call that the "divine." Roy Clouser explains:

> "This distinction between the status of divinity and what occupies the status is not new; it had a wide acceptance among ancient pagan thinkers. They conceived the divine status as that on which all else depends, yet which does not depend on anything else for its own existence. For example, the ancient Pythagoreans believed the divine reality to be numbers because they believed all things are generated out of, and depend upon number combinations...."[41]

The divine is that which, in any model, is regarded as sufficient in itself, for it depends on nothing else, and all else that is real depends on the divine.

With this definition of the "divine" in place, we're ready to compare different models of reality and God/nature relations. We will consider six major models:

1. The Pagan Model
2. The Atheist Model
3. The Pantheist Model
4. The Deist Model
5. The Theist Model
6. The Trinitarian Model

At the end, we will consider a hybrid between the Pantheist Model and the Theist/Trinitarian models. To conclude, we will test the models by applying them to some concrete examples. The models serve as analytical tools to clarify our conversations about faith and reason, and science and faith.

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separate from nature, which must be divine (1064a28-b5). See also my discussion of the presocratics on my teaching website, kerrymagruder.com/hsci/03-Egypt-Aegean/presocratics/index.html.

41. Clouser, 1st ed. (1991), pp. 16-17. See Clouser, ch. 2.

2.1. The Pagan Model

The first of the six heuristic models we will consider is the Pagan model. In the Pagan model of reality, the divine is found within nature. We may diagram it as shown in Figure 93. As an emblem of the Pagan model, I like an illustration of the divine eye within the universe from an 18th-century work.

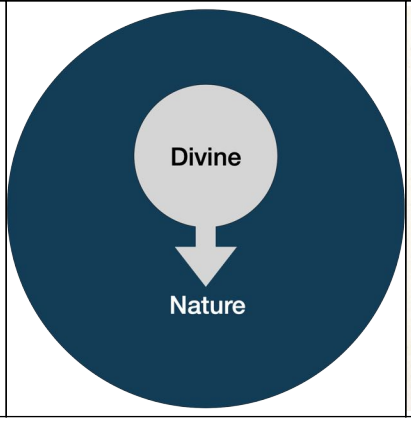
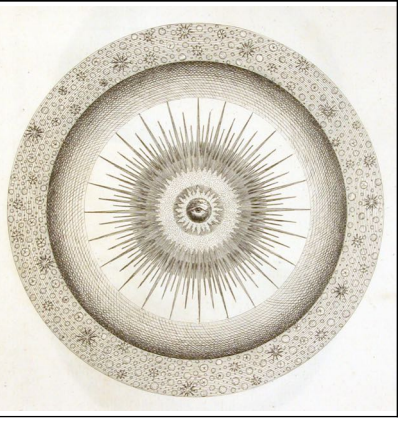
Motto	Diagram	Emblem
The divine is within nature		

Figure 93: Pagan model diagram.[42]

We have already encountered the Pagan model of reality in the previous chapter with Marduk and Ishtar and the other gods of the Babylonians. They were found within nature, as part of nature, yet on them all other things depend. Therefore the Scribes of Enuma Anu Enlil had an incentive to study the natural phenomena with which they were associated, resulting in the emergence of ancient mathematical astronomy.

Figure 94: Egyptian five pound note.

Hapi, the Egyptian god of the Nile, provides another example. Hapi and the Egyptian five pound note which bears Hapi's image are not as different as one might suppose, for money is a modern example of a Pagan divinity.

42. Image source: Thomas Wright, *An Original Theory of the Universe* (London, 1750).

How many people today pursue money as the one part of reality on which all else depends? And money certainly comes in handy! But worship of either Hapi or of money would be in accord with the Pagan model, where the divine is within nature.

Figure 95: Ba'al with thunderbolt
Credit: Ugarit

Ba'al, the ancient Near Eastern storm and fertility god, is shown in Figure 95 holding a thunderbolt in a stele from Ugarit. It was believed that life depends upon Ba'al, a part of nature, present in the storms. In the Pagan model, the divine is conceived of as something within nature. Ba'al, the god of the storms, is within and continuous with nature; there is no break in being that separates them.

In the same way, the 12 Olympian gods and goddesses are familiar examples of Pagan deities. In each case, with Athena or Zeus or Poseidon or any of the others, that on which nature depends is some special part of nature, found within nature itself.

The Pythagoreans offer an example of a Scientific Pagan model with their ancient "Prayer to the Number 10":

> "Bless us, divine number, thou who generatest gods and men! O holy, holy *tetraktys*, thou that containest the root and source of eternally-flowing creation!" [43]

The Pythagoreans held to the divinity and self-existence of Number. To them, numerical entities were eternal and immutable. All things in the universe depended, in their view, upon Number and the relations between numbers.[44]

The Pythagoreans invented square numbers. Three squared, or 3^2, is 3*3 or 9, written as three rows of three dots each, nine dots in a square.

$$3 + 3 + 3 = 9$$

But squares are not the only geometrical shapes numbers may have.

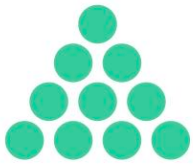


Figure 96: Triangular number 10

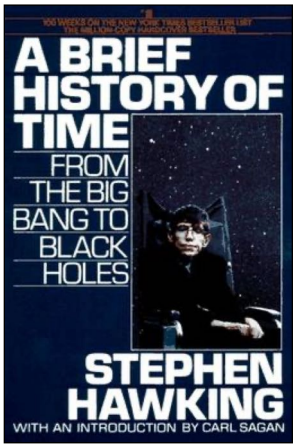
The number 10 is a special *triangular* number. Count with me according to Figure 96, top to bottom, one row at a time:

$$1 + 2 + 3 + 4 = 10$$

43.

44. Cf. the discussion of the Pythagoreans above in Chapter 2, Section 4 "Argument from Analogy: The Macrocosm-Microcosm," on pp. 49-53.

To the Pythagoreans, ten was the perfect number, worthy of worship, the divine *tetraktys*, addressed in the prayer just recited. The Pythagoreans also worshipped other geometrical numbers, including the five regular solids, as the ultimate source of all things in nature.[45]



Before we all laugh at a thing made of numbers, because of the unexpected presence of religion in what we thought was mere mathematics, consider Stephen Hawking. In *A Brief History of Time*, Hawking described his search for a mathematical equation for the universe. That equation would prove so compelling that, of itself, he thought, it could call the universe into existence. Hawking then was adopting a Pythagorean Pagan model, and he is joined in this by many modern theoretical physicists.

The Pagan model is compatible with holding to multiple gods and goddesses, simultaneously, even in contradiction to themselves. The Pagan worships the divine spark within. The divine spark may be anywhere.

If the divine center lies within one's own self, the Pagan model leads to self-worship. As a Pagan, I will worship the divine spark within me to the degree that I can possess whatever I regard as the key attribute of the divine, be it fame, money, beauty, or power.[46] The pursuit of these things is worship, the pursuit of the divine, according to the Pagan model. Whether it's an idolatry of body building, banking, social media influencing, or politics, the Pagan model is the search within nature for what really makes the world go round.

If the divine center lies in some sort of privileged knowledge – a special temptation for those of us reading books like this – then the Pagan model leads to "gnosticism," the pursuit of secret knowledge. To the degree that I can possess the divine secret, I hold the key to all knowledge. I can have the true gift to discern all conspiracies. Or that divine secret might become mine if only I can achieve the honor role, or become a member of the Jedi order, a high-up member of the right political party, a master of the equations of physics, a visionary of the evolutionary basis of all ethics, a surgeon who holds the power of life and death, a master and commander of my world and yours.

We may summarize the Pagan model as shown in Table 34.

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45. See Interdisciplinary relations. We can define a solid as regular when every face, edge and corner angle is identical, whether a square on every side of a cube, or a triangle on every side of a tetrahedron. The Pythagoreans proved that there are only five regular solids: The octahedron has 8 sides; the dodecahedron has 12 sides; and the icosahedron has 20 sides. There are no others. Image: Johann Kepler, Mysterium cosmographicum (1596) or http://lynx-open-ed.org/OERs/Pythagorean-Solids-LL.pdf or https://lynx-open-ed.org/node/685 or https://lynx-open-ed.org/node/233.

46. Tom Holland, Dominion. Charity, life for the weak, etc. Christian rather than pagan. Contrast Nietzsche.

Attractions	Inspires self improvement, cultivation of the divine center, the key attributes or knowledge held to be divine
	Inspires investigation and understanding of whatever aspect of nature is regarded as divine
Weaknesses	Pride (humility and charity are not pagan virtues)
Scientific	Reductionism: A single aspect of nature is the divine key that explains and compels all others
In practice	Sense of divine presence: "Get in touch with the divine in you"; "be your divine self"
	Dismissal of non-divine (e.g., disabled) as unworthy
Bridge	Incarnation – Christus Victor

Table 34*: Pagan model summary*

In the cultivation of moral virtue, one of the attractions of the Pagan model, Lewis argued that the Pagan and the Christian share more in common than does the Christian with modern post-Christian culture.

The "Bridge" row, the final row of Table 34, represents an idea of what might help us, as Trinitarian Christians, go deeper in conversation with those who adhere to another model by listening with greater attentiveness and empathy. For the Pagan model, such a bridge might be that, as a result of the Incarnation, the divine now really is found within the space and time of nature. The gospel of Mark was written in a way that appeals to Pagan sensibilities in the way that it portrays Jesus Christ as the Victor over all things in heaven and earth. For Paul, "Christ in you" is "the hope of glory." So Christians also share a sense of God's immanent presence within nature, most clearly with respect to the Incarnation and the sacraments.

2.2. The Atheist Model

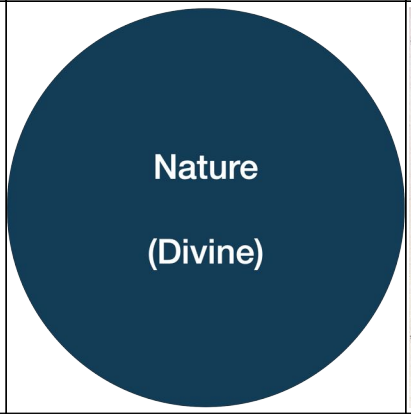
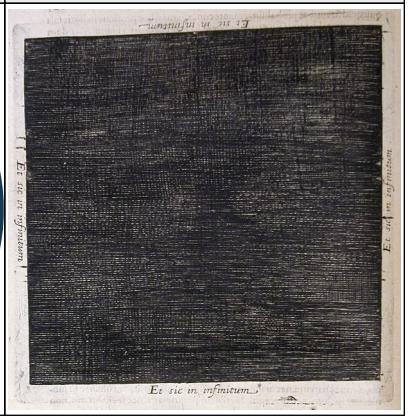
Motto	Diagram	Emblem
Nature is All		

Figure 97: The Atheist model.

The second model of reality is the Atheist model. In the Atheist model the divine is hidden, for the Atheist asserts that nature is All.

In the opening line of *Cosmos*, Carl Sagan proclaimed the Atheist gospel, the divinity of the cosmos:

> "The cosmos is all that ever was, is, or shall be."[47]

But wait, what just happened here? Given our definition of the "divine" as "that on which all else depends," is it necessary to believe that *something* is divine?

Sagan here attributed the status of divinity to the cosmos as a whole. Rather than explaining the results of astronomical inquiry, Sagan began his classic work by asserting his own model of reality. For Sagan, nature is divine in the sense that nature is self-sufficient, that on which all else depends.

The emblem for the Atheist model is Robert Fludd's depiction of the infinite nothingness before the six days of creation.[48] Fludd was rigorously criticized by Marin Mersenne and others for appearing to make the nothingness co-eternal with God. In the Atheist model, as soon as anything is made, that nature (or the nothingness from which it came) constitutes the hidden divine on which all things depend.

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47. Carl Sagan, *Cosmos* (New York: Random House, 1980), p. 1.

48. Robert Fludd, *Utriusque cosmi maioris scilicet et minoris* (Oppenheim, 1617-21), Tractatus I, Book I, Caput IV, p. 26.

Over the lifetime of a culture, Atheism is unstable; it conceals the fact that there is always a hidden deity. In due course we shall see that Sagan himself did not remain within the Atheist model, nor did the Atheist physicist in Lewis' Ransom Trilogy.

There are many reasons someone might find the Atheist model attractive. These include a sense of heroic virtue to stand against the crowd, or against what is wrong with the world. In his atheist years, Lewis agreed with the sentiment of Lucretius,

> "Had God designed the world, it would not be
> A world so frail and faulty as we see."[49]

Lewis was traumatically affected by the loss of his mother to cancer. With her death, the happy world of his childhood vanished.

Another attraction may be a sense of release, born out of desperation, perhaps from the wounds of oppressive religion. Lewis looked back upon the religion of his childhood as characterized by a severe legalistic code with threats of eternal damnation. Just as important as traumatic experiences with the church are traumatic experiences with one's father.[50] In his atheist years, Lewis was also working through a profound estrangement from his father.

Or an Atheist may point to a desire to transcend religious violence or sectarian divisiveness. Perhaps it was because of the experience of his atheist years that Lewis came to prize "mere Christianity," the shared heritage of the Nicene faith across the various denominational and church traditions.

Some Atheists are dogmatic about atheism, such as Richard Dawkins, intent upon evangelizing others.[51] Others are passive, functional Atheists, who have slipped almost unknowingly into living in a world without God due to the pressures of modernity such as pluralism, technology, and loss of community. These conditions of life seem to make belief in God implausible or, at the most, merely a private option in a secular public square.[52]

A weakness of Atheism is that, when accompanied by a utopian view of human culture, the 20th century shows that atheism quickly becomes as coercive and violent as religious, national and other ideological movements. Over the long term, Atheism creates a spiritual void unable to sustain a culture.

Scientific Atheism tends to lead toward *materialism* (the affirmation that physical reality is all there is), and *reductionism* (that higher things, such as beauty, love, truth and ethics can be reduced to material causes), and *scientism* (that natural science produces the only knowledge that counts).

One way to find common ground to start a conversation with an Atheist is to ask: "Tell me what god you don't believe in, and I probably won't believe in that god either." Then we can search for "signals of transcendence," as Peter Berger called them.[53] Signals of transcendence

49. Downing, MRC, p. 53.

50. Vitz

51. Dawkins

52. Taylor, Berger

53. Berger

somehow pass through the haze of ordinary life, if we have sufficient imagination to attend to them. A signal of transcendence might be a meaningful experience of beauty, or love, a moment of deep rational intuition, a longing for justice, an inconsolable longing for joy, a desire for hope, or a sense of true community. We can join with any atheist in affirming the reality of these intimations. It was in the sense of pursuing a signal of transcendence that Lewis entitled his autobiography *Surprised by Joy*. Lewis eventually gave up his atheism when his friend Owen Barfield persuaded him that materialism offers no basis for the validity of rational argument, nor a sufficient grounding in reality for morality and justice. These were signals of transcendence for Lewis, but the deepest of all was the sense of longing he called Joy. We will explore Lewis' conversion in a later chapter.

The Atheist model is summarized in Table 35.

<table>
<tr><th></th><th>Active</th><th>Passive</th></tr>
<tr><td rowspan="3">Attractions</td><td>Heroic virtue to stand against the crowd or what is wrong with the world</td><td rowspan="3">Plausibility pressures of modernity: e.g., pluralism, technology, loss of community, secular public square.</td></tr>
<tr><td>Release from oppressive religion</td></tr>
<tr><td>Call to transcend religious violence or divisiveness</td></tr>
<tr><td rowspan="2">Weaknesses</td><td colspan="2">Utopianism may become coercive</td></tr>
<tr><td colspan="2">Spiritual void unable to sustain a culture</td></tr>
<tr><td>Scientific</td><td colspan="2">Materialism, Reductionism, Scientism</td></tr>
<tr><td>Bridge</td><td>"Tell me what god you don't believe in, and I probably won't believe in that god either."</td><td>"Signals of transcendence"</td></tr>
</table>

Table 35*: The Atheist model summary*

2.3. The Pantheist Model[54]

Motto	Diagram	Emblem
Nature is divine	**Nature = Divine**	

Figure 98: The Pantheist model. Emblem = Yin and Yang.[55]

In both the Atheist and Pantheist models of reality, nature and the divine are co-extensive. The Atheist model ignores or conceals the divine, while the Pantheist model acknowledges it, saying nature is divine, and vice versa. The Pantheist model reveals the hidden deity of the Atheist model. For this reason, from a cultural standpoint, over a few generations, Atheism often tends toward Pantheism.

A decorative screen adorns the History of Science Collections of the University of Oklahoma. The bronze medallions and metalwork illustrate significant moments in the history of science and technology. One medallion is of Yin and Yang, as shown, a concept central to many traditions of Asian science. Yin and Yang represent the universe as the result of an interplay of opposites which comprise a whole. Yin and Yang are eternal dualities, such as light and dark, or fire and water. Their interaction generates the universe. If Yin and Yang represent the hidden divine side of all of nature, then Yin and Yang can be seen as an emblem of the Pantheist model.

With Yin and Yang, the choice of label may be one of degree. There is a continuum between the Pagan and Pantheist models. For instance, consider the admonition from Star Wars:

> "Use the Force, Luke!"

If the Force is within nature, a part of nature, but not all of nature, then it is functioning according to the Pagan model. But if the Force is everywhere in nature, co-extensive with nature, the reality behind all of nature, sustaining nature in a hidden fashion if only we had eyes to perceive it, then it is functioning like the Pantheist model. Yin and Yang function on a continuum between the Pagan and Pantheist models in the same way.

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54. Chinese or Indian science, Yin and Yang in science

55. Yin and Yang medallion, from a decorative screen by Joe Taylor and Duane H. D. Roller, located in the History of Science Collections, University of Oklahoma Libraries.

We may be most familiar with Pantheism in eastern religion or in New Age spirituality, but it also comes in philosophical and scientific forms.

2.3(a). Philosophical Pantheism

C. S. Lewis himself moved from atheism to pantheism, adopting a European philosophical variety, particularly through the influence of F. H. Bradley. For Bradley, materialism was not an option, for it undermined rational thought and moral justice. Bradley's philosophical idealism envisioned an ultimate Absolute in which all material contradictions are resolved. Matter is appearance; the Absolute is the reality. The Absolute is immanent throughout the universe. Although it is immaterial, it is not transcendent; for there is no discontinuity in being between nature and the divine. The Absolute is not personal, but functions as an impersonal soul of the world. Lewis recognized Bradley's idealism as a form of pantheism, and Lewis found it attractive because it provided an alternative to the materialism and reductionism of atheism, without imposing any personal or ethical obligations.[56]

Later, in *Miracles*, Lewis wrote:

> "The Pantheist's God does nothing, demands nothing. He is there if you wish for Him, like a book on a shelf. He will not pursue you."[57]

Lewis suggested that pantheism and Christianity are:

> "the only two serious philosophical options… far from being the final religious refinement, Pantheism is in fact the permanent natural bent of the human mind."[58]

2.3(b). Scientific Pantheism

Pantheism, either eastern pantheism, New Age pantheism, western philosophical idealism, or some other form, is one of the most popular models of reality today among scientists. The Scientific Pantheist holds that, as with the Atheist model, there is no supernatural, nor is there a personal God. But unlike the Atheist model, pantheism seeks to evoke a reverence for nature and for all of life. Scientific Pantheism views nature more like an organism than a machine, with built-in purpose or meaning.

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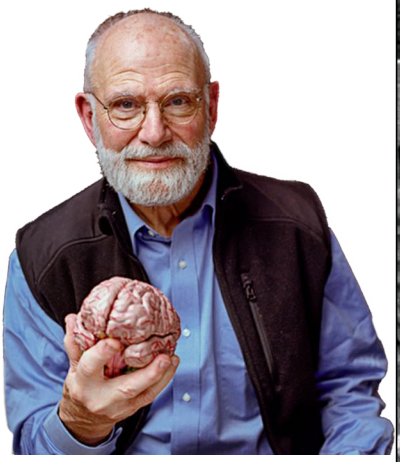
56. See Downing, MRC, pp. 128-131.

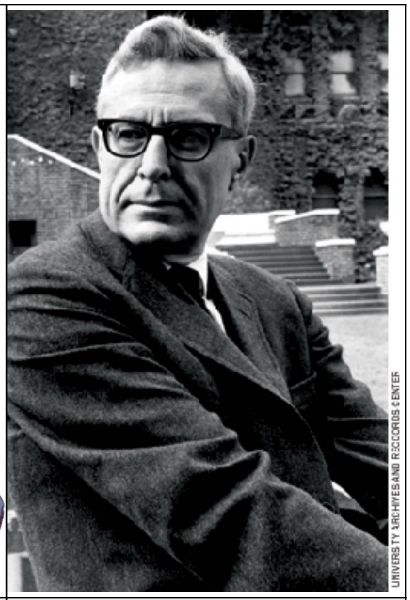
57. C. S. Lewis, Miracles

58. C. S. Lewis, De Futilitate

Baruch Spinoza



Oliver Sachs



Loren Eiseley, 1907-1977

Figure 99: Three Scientific Pantheists

The 18th-century scientist and philosopher Baruch Spinoza regarded God and nature as two names for one reality. One might hear a modern Scientific Pantheist say something like "nature is my religion" or "the Earth is my temple." Another term sometimes used for scientific pantheism is "religious naturalism." Oliver Sacks, the great writer and neurologist, wrote:

> "My religion is nature. That's what arouses the feelings of wonder and mysticism and gratitude in me."[59]

Loren Eiseley, the great mid-20th century scientist and naturalist, wrote in the tradition of Thoreau. He spoke often of the "inscrutable wisdom of Nature…"[60] against critics "in some scientific quarters" who upheld an "attachment to an extremely materialistic worldview."[61]

We have already cited Carl Sagan's opening line in *Cosmos* as a manifesto of Atheism. But perhaps that was hasty. Later in life, Sagan wrote:

> "A religion old or new, that stressed the magnificence of the universe as revealed by modern science, might be able to draw forth reserves of reverence and awe hardly tapped by the conventional faiths. Sooner or later, such a religion will emerge."[62]

Sagan here seems to mark a transition from atheism to Scientific Pantheism, like Lewis in his 20's, and as did many scientists of Sagan's generation. It is philosophically and humanly

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59.

60. See, for example, How Flowers Changed the World, The Immense Journey, p. 75.

61. Quoted in Gale E. Christianson, Fox at the Wood's Edge: A Biography of Loren Eiseley, p. 388.

62. Carl Sagan, Pale Blue Dot

unsatisfying to say that nothing is divine, so with Atheism the hidden divinity tends to become more obvious as time passes. Atheism tends toward either the Pagan or Pantheist models. We can see that transition occurring in the contrast between our two quotes from Sagan, or from the Scientific Atheism of the early Star Trek, which provided naturalistic explanations for the Olympic gods and other planetary religions, to the quite different universal religious sensibility of Star Wars; or in the Ransom Trilogy by C. S. Lewis, where the physicist in *Out of the Silent Planet* is an atheist, but by the second volume the same character has become something of a Pantheist.

2.3(c). Emergent Pantheism

Emergent Pantheism is a version of Pantheism that has become particularly common among scientists. Unlike the static flavor of pantheism, in this variation nature is the Intelligent Designer, with a capital "I," and a capital "D," because nature is divine. Nature is intelligent, perhaps conscious, although not necessarily personal.

In some versions, a future state of nature is designing itself, with humans as the emerging signal of where it is headed. Like an organism in development, nature is emerging into higher levels of intelligence and consciousness. We are participating in the birth of nature as divine.[63]

63. See, for instance, Fred Hoyle, *The Intelligent Universe* (1988); James Gardner, *The Intelligent Universe* (2007); or Menas Kafatos and Robert Nadeau, *The Conscious Universe* (1999).

2.3(d). Pantheism recap

The Pantheist model is summarized in Table 36.

Pantheists cultivate a sense of divine presence pervasive throughout nature. As Christians, we sympathize with the Pantheist sense of an intimate relation between God and nature, that they are not absolutely separated as in Deism. But nevertheless as Christians we know that nature and Yahweh, the bush itself and the blazing presence, are not the same. When Moses encountered the burning bush, the bush was not God, though it blazed forth with the presence of God. Similarly, you and I are not God, although we may (if we had eyes to see) blaze forth with the presence of God through the Spirit. And if we are not God, then we may testify to the Pantheist the promise that God will indeed show up, as he did for Lewis.

Attractions	Versatile, can incorporate the Pagan model by simultaneously accepting multiple and contradictory gods or spirit guides
	Fills the spiritual void of Atheist materialism: nature & the divine are one.
Weaknesses	Nature itself has no reality/integrity apart from the divine: They are one.
	No personal god. Ultimately no foundation for "persons in relation" distinct from the Universe: All is one.
	No ultimate answer for the problem of evil: either there is no true distinction between good and evil, or there is an eternal dualism that leaves their contest ultimately unresolved.
Scientific	Becoming more widespread than scientific atheism.
In practice	There is no evil in nature; good and evil are an illusion; the cycle of life and death is good.
Bridge	Sense of divine presence pervasive throughout nature
	Promise: God will show up

Table 36*: Pantheist model Summary*

2.4. The Deist Model[64]

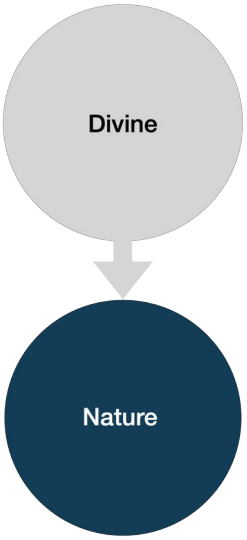
Motto	Diagram	Emblem
No overlap between nature and the divine		

Figure 100: The Deist model. Emblem = Mechanical Clock, Prague.

Our next model is the Deist model of reality. It is a polar opposite of the Pantheist model, for the Deist sees the being of God and nature as distinct (Figure 100). Nature is not an emanation of the divine, as in Pantheism. God is transcendent, meaning that there is no overlap in being between nature and the divine.

With respect to Escher's drawing hands, the Deist model, like the Theist and Trinitarian models, would see our *understanding* of the divine and of nature as hands drawn on the paper, but not the divine itself. The divine could not be one of the hands, because it transcends the paper the hands are drawn upon. More accurately, the divine would be the artist, like Escher himself, who freely creates the two hands.[65] To say it again, for the last three models, there is no overlap in being between nature and the divine.

Scientific Deism sees the divine as a clockmaker. Nature is the clock. Nature is like a machine, a beautiful, intricate clockwork mechanism like the astronomical clock in Prague, the Czech

64. Early deists

65. The two hands metaphor then resembles the "two books" of God's Word and God's Works, discussed in the Introduction.

Republic.[66] The divine is the clockmaker, the designer of the machine, external to the machine itself.[67]

Attractions of the Deist model include that it offers a clear distinction between the Creator and the Creature, and a clear distinction between the natural and the supernatural. In the Deist model, nature is autonomous. Like the Eveready Bunny, nature keeps on going. Deism is attractive to many theists who hold to various forms of foundationalist natural theology, in which an Argument from Design is used to attempt to prove the Deist model in some form of philosophical monotheism.[68]

A weakness of the Deist model is that it assumes a container view of space and time, which makes it difficult to imagine nature and the divine, acting and being, in the same place, at the same time.

Scientific Deism sees nature more like a machine, a giant clockwork mechanism, than a living organism.

The Deist model often succumbs to a mode of thinking about God and nature described as "god of the gaps." The contact between Nature and the divine is minimal; perhaps God was only needed for the original creation, to wind things up and get the clockwork started. Or, perhaps like a clockmaker who on rare occasions needs to reset the hands of the clock, God may come into the Room of Nature occasionally to tinker and make things right again. Nature becomes a relatively closed system, in which God is a fix-it man on call to fill any necessary gaps. The "Laws of Nature" then become deterministic, referring to this closed system of cause and effect.

In practice, for the Deist, "God is watching us from a distance." God is out there, but he's not involved in my personal life or in the world. God's Being is static, immutable; does he hear us? He is not active by nature.

The Deist model is summarized in Table 37.

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66. Photo source: Unknown.

67. In the Pantheist and Pagan models, if nature is a clock, then the designer or clockmaker is instrinsic to nature, or nature itself. Nature is the intelligent designer, designing and making itself.

68. E.g., the Newtonian tradition from William Derham and the 18th-century Boyle Lectures, to William Paley and the 19th-century Bridgewater Treatises,... See Xref

Attractions	Creator/creature distinction
	Natural/supernatural distinction
	Nature autonomous
	Natural theology, Design Argument
Weaknesses	Container view of space and time
Scientific	Nature more like a machine
	"God of the gaps"
	Determinist understanding of the "Laws of Nature"
In practice	"God is watching us from a distance"
Bridge	

Table 37*: Deist model Summary*

2.5. The Theist Model[69]

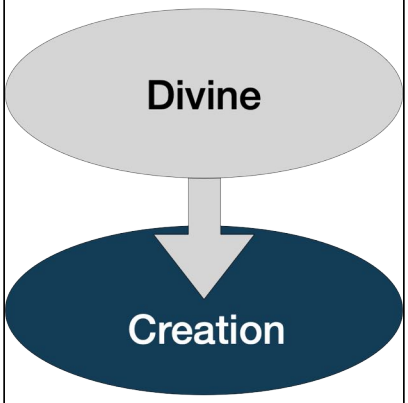
Motto	Diagram	Emblem
The divine and nature are closely related		

Figure 101: The Theist model. Emblem = The Burning Bush (artist unknown)

The Theist model of reality is shared by the Abrahamic religions of Judaism, Christianity, and Islam. As with the Deist model, God and nature are not the same. The divine is transcendent. There is no overlap in being between nature and the divine. Yet unlike Deism, God is minutely involved in his creation.

The burning bush is an emblem of the Theist model. The burning bush suggests something of the hidden, dynamic intimacy between God and divine. Yet the bush was not consumed by the presence of God, but sustained.

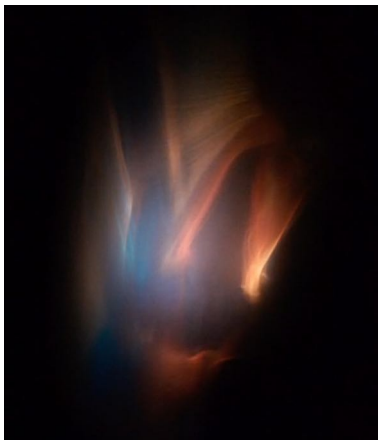


Figure 102: The secret flame. Screenshot from The Tree of Life (2011), directed by Terrence Malick.

Historically, a secret fire has often served as an iconological motif of the presence of God, working in the creation, to sustain and renew it. In a manner that recalls the burning bush, the movie *The Tree of Life* cuts abruptly from narrative scenes to momentary glimpses of the secret fire at the heart of all things (Figure 102). Another example appears in *The Lord of the Rings*, when Gandalf confronts the Balrog on the Bridge of Khazad-dûm and reveals his true nature as he opposes the evil before him:

> "'You cannot pass,' he said. The orcs stood still, and a dead silence fell. 'I am a servant of the Secret Fire, wielder of the Flame of Anor. You cannot pass.

69. Jewish monotheism, Islam

> The dark fire will not avail you, flame of Udûn. Go back to the Shadow! You cannot pass.'"[70]

Like the story of the burning bush in Exodus, Tolkien's Middle Earth is set in an era before the Incarnation. In manuscript fragments later published in *Morgoth's Ring*, Tolkien explains:

> "This is actually already glimpsed in the Ainulindalë [literally, the "Song of the Ainur," the title of the creation account in *The Silmarillion*], in which reference is made to the 'Flame Imperishable'. This appears to mean the Creative activity of Eru [God]... by which things could be given a 'real' and independent (though derivative and created) existence. The Flame Imperishable is sent out from Eru, to dwell in the heart of the world, and the world then Is, on the same plane as the Ainur [created beings analogous to angels], and they can enter into it. But this is not, of course, the same as the re-entry of Eru to defeat Melkor [i.e., the Incarnation]. It refers rather to the mystery of 'authorship', by which the author, while remaining 'outside' and independent of his work, also 'indwells' in it, on its derivative plane, below that of his own being, as the source and guarantee of its being."[71]

For the Theist, the secret flame symbolizes the hidden presence of the transcendent God within the world, sustaining it in being and delivering it from the evil that would unmake it. For the Trinitarian, this secret fire is the eternal person of the Holy Spirit, hiddenly yet already active in bringing about the New Creation in Christ. As in Exodus, God is not aloof from his creation nor deaf to its cries. Deliverance is coming. There is a closeness and an intimacy between nature and the divine not found in the Deist model.[72]

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70. J. R. R. Tolkien, *The Fellowship of the Ring*, Book II, Chapter 5, "The Bridge of Khazad-Düm" (New York: Ballantine Books, 1965), p. 429. "Anor" is the Sun. "Udûn" is a deep valley in Mordor. A similar contemporary allusion is the song "Carry the Fire" by Andrew Peterson.

71. J. R. R. Tolkien, *Morgoth's Ring: The Later Silmarillion, Part One: The Legends of Aman*, The History of Middle-Earth, ed. Christopher Tolkien, vol. 10 (Boston: Houghton Mifflin Company, 1993), note 11, p. 345; and "Ainulindalë," in J. R. R. Tolkien, *The Silmarillion*, ed. Christopher Tolkien (Boston: Houghton Mifflin Company, 1977), pp. 15-22. Cf. Stratford Caldecott, *Secret Fire: The Spiritual Vision of J. R. R. Tolkien* (London: Darton, Longman and Todd, 2003), pp. 107-111.

72. Other images of this closeness is the Islamic saying that God is closer to us than the veins in our neck, or the Hebrew affirmation that He is as close to us as our breath.

The Theist model is like the Deist model in that Creator and creation are ontologically distinct, each with its own identity and integrity. God is not creation and creation is not God. The divine is transcendent (Table 38, left column, first two rows).

	God & nature distinct	God & nature in close relation
Deist	✔	
Theist	✔	✔
Pantheist		✔

Table 38*: Deist, Theist, and Pantheist models compared*

But unlike the Deist model, the Theist model brings the Creator and creation into a close relationship (Table 38, right column, first two rows). In contrast to the Deist model, the circles in the Theist model diagram are drawn as ovals to suggest perspective; they are lying on their sides. The circles overlay one another; the divine circle turned downward and the Creation circle turned upward, each facing the other. This 3-D orientation places the emphasis upon their *relation* and *interaction* rather than upon their separation.

Like the Pantheist model, in the Theist model nature is *sacramental*, meaning that God is present in close relationship, in the bush, in a mountain, in the sunrise, in a mother's touch. But unlike the Pantheist model, in the Theist model nature is sacramental not by nature but by grace. Nature is not itself divine; God's presence is disclosed in nature by grace, by God's freedom to love. God and nature are distinct. He freely chooses to be in close relation, to be present in the bush, the mountain, the sunrise, and the mother's touch.

The Theist model represents a theological level of understanding creation in which we, basing our thinking on revelation, organize our knowledge of nature in relationship to God the Creator. As such, it is the level that lies between the doxological level and the higher scientific level as we discussed in "Meta Levels" on pp. 115-126.

The Pagan, Pantheist, and Deist models all relied upon container conceptions of space. The Theist model, in contrast, is a relational rather than container view of God and creation. The bush and the blaze are intimately related, but impossible to distinguish spatially. Their relationship is not that one contains the other, nor that they are separated, but rather that they are in abiding relationship in which nature remains dependent upon the sustaining grace of God. Being is not static in this model, but dynamic: God acts. The world is ablaze with divine activity, although it is typically hidden from us because of our profoundly impaired vision.

In her poetic novel, *Aurora Leigh*, Elizabeth Barrett Browning wrote:

> "Earth's crammed with heaven,
> And every common bush
> afire with God;
> But only he who sees,
> takes off his shoes,
> The rest sit round it

> and pluck blackberries…[73]

Augustine wrote:

> "For the power and might of the Creator... makes every creature abide; and if this power ever ceased to govern creatures, their essences would pass away and all nature would perish. When a builder puts up a house and departs, his work remains in spite of the fact that he is no longer there. But the universe will pass away in the twinkling of an eye if God withdraws his ruling hand."[74]

In other words, Creation, on its own, tends toward annihilation, except for God's sustaining presence. This dependency of Nature's being upon divine action is part of what theologians have attempted to capture, as we shall see, in their explorations of *creatio ex nihilo*, *creatio continua*, *concursus*, and providence.

The Theist model establishes the Creator/creature distinction more vividly and definitively than Deism, because even the being of nature is sustained by God. Yet the Theist model maintains nature and the divine in a dynamic relationship (like the burning bush) that is even more intimate than pantheism for, ultimately, the Pantheist model dissolves and assimilates them into one, annihilating the differences.

A weakness of the Theist model is that it will degrade into the Deistic model if the sense of the active presence of the divine is diminished (for example, if the doctrines of providence or concursus are lost).

A Scientific Theist model was held by Pierre Gassendi, Robert Boyle, Isaac Newton, and others who developed the mechanical philosophy during the Scientific Revolution. They, unlike later mechanical philosophers, deployed the mechanical philosophy in opposition to the Pagan and Pantheist views associated with Alchemy, Astrology, and Renaissance Natural Magic.

In practice, the Theist model is characterized by a personal sense of the dynamic action of God, who exercises his particular Providence in the specific circumstances of our lives. He is present, living and active in nature and in history. He is as close to us as God in the burning bush; the antithesis of a God watching us from a distance.

As a result, God's revelation of himself in nature is seamlessly related to his action and revelation in history. In this view, it becomes natural to think of nature historically, as having a story of its own.

These characteristics of the Theist model are summarized in Table 39.

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73. Elizabeth Barrett Browning, "Aurora Leigh," Bk 7 (1856)

74. Augustine, Literal Meaning of Genesis

Attractions	Relational rather than container view of space and time
	Distinction between Creator/creature more vivid than Deism
	The divine presence is personal, more intimate and astonishing than Pantheism
Weakness	Slips into Deism if theological context eroded, active divine presence diminished
Scientific	Mechanical philosophy of Pierre Gassendi, Robert Boyle, Isaac Newton
In practice	Personal sense of the dynamic particular providence of a present, living and active God
	God's revelation in history & nature is seamless

Table 39*: Theist model Summary*

2.6. The Trinitarian Model[75]

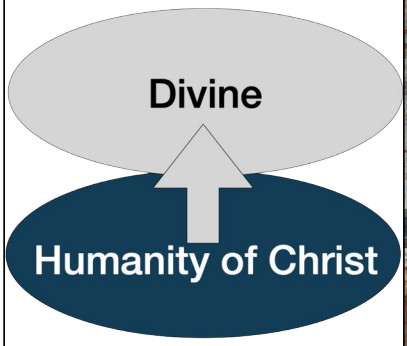
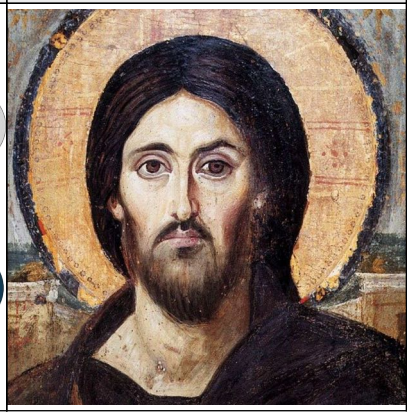
Motto	Diagram	Emblem
New Creation in Christ		

Figure 103: The Trinitarian model. Emblem = Jesus as Pantokrator, St. Catherine's Monastery, Sinai Peninsula.

Our last major model of reality is the Trinitarian. It is a continuation of the Theist model just described, but with an even stronger emphasis upon the following aspects:

1. The dynamic and intimate relationship of the divine and nature, which now are surprisingly and particularly manifest in the Incarnation and death, Resurrection, Ascension, and eventual Second Advent of Jesus Christ;
2. A depth of reality, an inexhaustible wisdom in creation, that far transcends not only reductionism of every kind, but even the highest form of scientific imagination;
3. Love as the ultimate reality and future of the cosmos, already and not yet manifest as a New Creation in Christ.

An emblem for the Trinitarian model of reality is the ancient convention for depicting Jesus as the Pantokrator, or Ruler of the Universe. This version comes from St. Catherine's Monastery, in the Sinai peninsula, the 6th century CE. What is common in icons of the Pantokrator is that Jesus is shown with two different facial expressions. The left side is different than the right. For our purposes it doesn't matter which side is which, but that together they represent the mystery of Christ's two natures, the divine and the human, joined in the unity of his one Person.

This great mystery of Trinitarian faith involves three unions, not all the same, each of which remains in many ways inscrutable to us:

75. Basil, Augustine

- *Eternal union:* First is the union of the eternal Son with the Father and the Spirit in One Triune Godhead, in which the three Persons of the Trinity are *homoousious* ("of the same being") with one another in a communion of love.
- *Created union:* Second, in the Incarnation, when the eternal Son took on human flesh and came into the world he had made, Jesus' eternal divine nature and created human nature (so to speak) were joined in a *hypostatic union*, a bond of love.
- *Participatory union:* Third, in union with Christ's humanity through the Spirit, we and all creation are brought into an intimate and irrevocable communion with the Triune God.[76]

All three aspects of this mystery are symbolized in the Pantokrater emblem: Jesus is God, Jesus is human, Jesus is Ruler of the entire cosmos.

Our inquiry in this book is what these mysteries mean for the cosmos and for science. Implications include the three emphases noted on p. 264, all the perspectives discussed throughout this book, and especially the vision of "love and the cosmos" introduced in the opening pages with the Parable and the outline of our response according to four loves (doxological, cognitive, ethical, and eschatological).

It is worthwhile at this point to unpack the Trinitarian model a little more, since it is probably the least familiar of the six models for most people today.

In the great mystery of Trinitarian faith, Jesus of Nazareth is fully divine, the transcendent One, but also fully human, God with us. In this the Trinitarian model of reality stands with the Theist model with respect to both (1) the divine transcendence of nature in being, and (2) the divine closeness to nature by grace in his unbounded freedom to love. All that was said in the previous section with respect to the Theist model about the closeness and intimacy between nature and the divine is true many times over in the Trinitarian model, to a truly astonishing extent. We saw above that Tolkien conceded that the presence of the secret fire did not entail that Eru would re-enter the world himself to defeat Melkor. Nevertheless, in his legendarium the Incarnation was envisioned as a far-off prophecy.[77] And indeed, the gospel proclaims that the divine did in the fullness of time freely choose to come into the world in the Incarnation to push back the darkness and heal the marring of the world. In the Trinitarian mystery, the divine is revealed in the Son who came into the world to complete its deliverance from evil (John 3:16-17). The incarnate life, death, and Resurrection of the eternal Son of God is the measure of the divine's unbounded and irrevocable commitment, compassion, and care, to and for the creation.

> "The virgin will be with child and will give birth to a son, and they will call

76. These things are developed further in Section 3.1, "Three Unions," beginning on p. 551.

77. Interestingly, in Tolkien's pre-Incarnation setting, Andreth, a wise woman, reported the ancient foretelling that Eru would one day become incarnate to heal all that was marred: "If we are indeed the Eruhin, the Children of the One, then He will not [allow] Himself to be deprived of His own, not by any Enemy, not even by ourselves. This is the last foundation of Estel [hope], which we keep even when we contemplate the End: of all His designs, the issue must be for His Children's joy." "We knew that in our beginning we had been born never to die. And by that, my lord, we meant: born to life everlasting, without any shadow of any end." "They say that the One will himself enter into Arda, and heal Men and all the Marring from the beginning to the end." *Morgoth's Ring*, pp. ?, 314, and 321.

> him Immanuel – which means, 'God with us.'" (Matthew 1:20–23)

Torrance reflects upon the significance of the Incarnation, whereby God became *Immanuel*, "God with us":

> "God with us" means that in the birth of Jesus Christ, God has given Himself wholly to us, in a love that is absolutely unstinting and infinitely lavish. It is God's utmost self-giving that stopped at nothing. God could do no more than come Himself into our humanity, and give Himself entirely to us – and that is exactly what He has done in Jesus. The sheer extent, the boundless range, of His act of love takes our breath away.
>
> "God with us" means that God Almighty insists on sharing His life with us. Far from abandoning us…, God has identified Himself with us. Once and for all He has become one of us, bone of our bone and flesh of our flesh. God has committed Himself to us in such unrestrained love in the birth of Jesus, and in such a way that now He cannot abandon us any more than He can abandon Himself in Jesus Christ.
>
> That is why the birth of Jesus was heralded with such sublime joy among men and angels, for now that God is with us, the whole situation in heaven and earth is entirely altered, and all things are made new. Now that God is actually with us and of us, everything else is assured. Whatever may happen in the future, God's purposes of love and fellowship and peace with man will all be fulfilled.
>
> "God with us" means God with us sinners in our lost and bankrupt state. Where we have sold ourselves irretrievably into slavery and perdition and are hopelessly broken and damned, God has joined Himself to us. God has refused to let us go. He has insisted on making Himself one of us, and one with us, in order to make our lost cause His very own, and so to restore us to Himself in love.
>
> "God with us" means that God is for us, God is on our side; that He has come among us to shoulder our burden, and to rescue us from disaster and doom and to reinstate us as sons of the heavenly Father. That is the meaning of the whole life of Jesus from His birth to His death. It was God taking upon Himself our poor human life in all its wretchedness and need, God living out our human life from beginning to end, in order to redeem it…, in order to make our lost cause His own.[78]

The Incarnation was not only something new for God, but something new for creation, in which all of creation is implicated. Nothing remains the same. No part of reality is

78. Thomas F. Torrance, *When Christ Comes and Comes Again* (London: Hodder & Stoughton, 1957); #1957-109, pp. 20, 40, 41.

untouched. The risen and ascended humanity of Christ elevated the creation into a new, irrevocable, and everlasting standing for communion with the Godhead.

The Trinitarian model of God and nature was expressed in the Nicene tradition and is summarized in the Nicene Creed (see Table 1 on p. iii). The Nicene creed was formulated at the First Ecumenical Council held at Nicea, located in what is now Turkey, in 325 CE, as a response to the Arian heresy which denied the divinity of Christ. It was revised at the Second Ecumenical Council held at Constantinople in 381 in response to the Macedonian or Pneumatomachian heresy, which denied the divinity of the Holy Spirit. It was officially ratified at the Fourth Ecumenical Council of Chalcedon in 451 CE. After these Councils, whenever we recite the Nicene Creed together, we are making a confession of faith common to the Christian church through history and around the globe.

The first word of the Creed is *credimus* (Latin) or Πιστεύομεν (*pisteuomen*, Greek), for "We believe." As Anselm of Canterbury wrote, echoing Isaiah 7:9,

> "We believe in order that we might understand" (*credo ut intelligam*).[79]

The rest of the creed is structured in three articles: The "first article" confesses God the Father; the second article confesses God the Eternal Son and his Incarnation as Jesus of Nazareth; and the final article confesses God the Holy Spirit and his present work in the world and the new creation. *"We believe"* appears only once, at the beginning, because all three articles are intricately interrelated and hang together in one Trinitarian confession. Torrance's book, *The Trinitarian Faith*, is a masterful account of the theology of the creed and of the formation of the Nicene tradition.[80]

In the second article, Christians confess:

> "[We believe] in one Lord Jesus Christ, the Only begotten Son of God, begotten from his Father before all ages, Light from Light, true God from true God, begotten, not made, of one Being with the Father, through whom all things were made. Who for us and our salvation came down from heaven; and was made flesh from the Holy Spirit and the Virgin Mary, and was made man and was crucified for us under Pontius Pilate. He suffered and was buried, and the third day he rose again according to the Scriptures and ascended into heaven, and sits on the right hand of God the Father. And he shall come again in glory to judge both the living and the dead; his kingdom shall have no end."

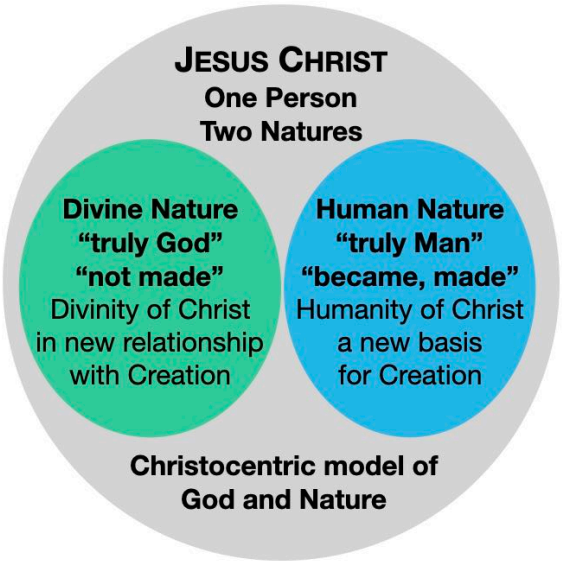
The Trinitarian, Nicene understanding of Jesus Christ as both God and human is the starting point for a Christ-centered model of God and nature. Jesus is one Person, with both an eternal divine nature and a created human nature. Jesus' divine nature means that he is "truly God," begotten, "not made," of "one being with the Father." Jesus' human nature means that he is also "truly human," that he "became flesh," and "was made" like us. In Jesus, the two natures are joined in a "*hypostatic union*" (Figure 104), a unity of his Person in which

79. Anselm of Canterbury, *Proslogium*, 1.

80. T. F. Torrance, *The Trinitarian Faith*, #1988-489. Note that, in the text of the Creed, the word "catholic" with a lower case "c" does not mean the Roman Catholic Church, but the universal Christian church as a whole.

> "there is no diminishing or impairing of his divine nature and no diminishing or impairing of his human nature. That is to say, in the hypostatic union the human nature of Jesus Christ is taken up, established, secured, and anchored for ever in its undiminished integrity in the Son of God."[81]

Figure 104: Hypostatic Union



The Trinitarian model for the relations between God and creation derives from the unique Person of Christ. The paradigm model for God and nature, for the relation between the divine and what is not divine, is the unique relation of them within his own Person. In Christ, "death is swallowed up in life" (1 Corinthians 15:54).

The hypostatic union opens up a new basis for an emerging New Creation. He will never set his human nature aside. Therefore hope for all creation is assured in Christ's Incarnation, Resurrection, and Ascension. Through Jesus the Mediator we may now, already and not yet, participate in the New Creation, which is first accomplished in him. In relation to him, by grace, through the secret fire of the Holy Spirit, we are now included in union with him, with ramifications for the entire cosmos.

The diagram for the Trinitarian model represents this transformation into the New Creation by the vertical arrow going from the humanity of Jesus up to the divine. Sometimes that upward transformation is referred to as "theosis," but this does not mean either that Jesus' human nature nor that the rest of creation are transformed into the divine nature. As in the Theist model, nature and the divine remain distinct; there is no overlap in being between nature and the divine. Rather, *theosis* means that Jesus' human nature was transfigured into a New Creation. The New Creation was created not *ex nihilo* (from nothing), but within his Person, from the human nature he assumed in the Incarnation. He accomplished this creative work throughout the whole course of his life, from the moment of conception through all that is narrated in the four biblical gospels up through his death, Resurrection, and Ascension.[82] The rest of creation rides along, by grace, through the Holy Spirit, in union with Christ.[83]

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81. Thomas F. Torrance, *The Mediation of Christ*: *Evangelical Theology and Scientific Culture*, 2d ed. (Edinburgh: T&T Clark, 1992); #1992-542, pp. 69-70.

82. Cf. Thomas F. Torrance, *The Mediation of Christ*; #1992-542, ch. 3, "The Person of the Mediator," esp. pp. 62-67.

83. See Myk Habets, *Theosis in the Theology of Thomas Torrance*, Ashgate New Critical Thinking in

Thus nature, although not divine, is established, secured, and anchored forever in its own undiminished integrity. This theological hope of a New Creation, established in love, is essential to a fuller Christian understanding of nature, including the Earth and cosmos.[84]

In the Nicene understanding of the Incarnation, the Creator and creature are involved in an even more intimate, personal and loving relationship than in the Theist perspective, because now the relation between God and nature has taken place within the Person of Christ. The Risen Humanity of Christ has elevated the creation into an irrevocable and everlasting communion with the Godhead.

Colossians 1:15-20 speaks of Christ's redemption as co-extensive with creation (p. 90).

Paul spoke of the fullness of time as "summing up all things in Christ" (Ephesians 1:10).

In the Chalcedon definition, we find the classic statement of Jesus Christ as a hypostatic union in One Person of Two Natures:

> "truly God and truly Man… one and the same Christ, Son, Lord, only begotten, to be acknowledged in two natures, without confusion, change, division, or separation; the distinction of natures being by no means taken away by the union, but rather the property of each nature being preserved, and concurring in one Person… one and the same Son, and only begotten, God the Word, the Lord Jesus Christ…"[85]

If we are to plumb the depths of what this means for Creation, then we will need to shift our thinking about Creation to a new basis in Christ, to resolve to have no Creation without Christ in our thinking. In Christ, the New Creation in Christ becomes the key to the present. This is a mystery, the already and the not yet, but what we can say is that we seek to understand Creation in light of Christ.

In speaking of the "cosmic range of eschatology," TFT writes:

> "He who was made flesh is the Creator Logos by whom all things were made and in whom all things are upheld. When he became incarnate, and divine and human natures were united in his one person, *his humanity was brought into an ontological relation with all creation*. So far as our humanity is concerned that means that all men are upheld, *whether they know it or not*, in their humanity by Jesus Christ the true and proper man, upheld by the fulfilment and establishment of true humanity in him, but also through his work in the cross and resurrection in which he overcame the degenerating forces of evil and raised up our human nature out of death and perdition. But the range of Christ's mighty acts in incarnation, reconciliation and resurrection *apply to the whole universe of things, visible and invisible*… The whole of creation falls within the range of his Lordship, as he works out his purpose by *bringing redemption together with creation*, and actualizing the holy will of the Father in everything. Eschatology has here a teleological relation to the *whole realm of*

Religion, Theology and Biblical Studies (London and New York: Routledge, 2009).

84. T. F. Torrance, *Space, Time, and Resurrection* (#1976-331) is a classic account of the Incarnation.

85. Definition of Chalcedon (451 CE)

> *created existence*, and leads into the doctrine of 'the new heaven and the new earth'. God does not abandon his creation when he has saved man, for *all creation*, together with man, will be renewed when Christ comes again. Since he is the *first-born of the new creation*, the head in whom all things, visible and invisible, are reconciled and gathered up, the resurrection of Christ in body becomes the pledge that the whole physical universe will be renewed, for in a *fundamental sense it has already been resurrected in Christ*."[86]

TFT frequently articulated a conception of humanity as the priest of creation, mediating the order of the Incarnation and giving voice to creatures, as Paul suggested in Romans 8 when referring to creation's participation in the freedom and redemption of the sons of God. "Already and not yet," creaturely reality is participating in the re-ordering of the Resurrection. Already in the risen humanity of Christ, and in the work of the church, and, still to come, in the future restoration of all things.

The Trinitarian model of reality is the third level encountered earlier, after the doxological level and the theological meta-level.[87] More than the *daily experience* of the doxological level, and more than the *organized knowledge* of the theological meta level, the higher scientific Trinitarian level understands creation "*according to its nature*," that is, in relationship to Christ. For the Christian, the creation cannot be understood according to its actual nature apart from the person of Christ. There is no true and full understanding of creation without Christ.

Figure 105: Okie-Tex star party, near Black Mesa, Oklahoma

Parable: The Nicene tradition is like a mesa top in northwestern Oklahoma (Figure 105). Down in the valley beyond we can see the annual Okie-Tex star party. The climb up the mesa to see the two flamingo mascots is a popular diversion during the daytime hours. As we step onto the top of the mesa, we are entering within the historic faith of the Nicene tradition, based on devout contemplation of the Incarnation and Trinity. On top of the mesa we encounter all those traditions of Christianity which affirm the Nicene faith: Roman Catholic, Orthodox, Protestant, and various others. These streams constitute the Christian church which down through history has affirmed the ecumenical creed of Nicaea. Those statements of faith use the various terms in Figure 104, not in order

86. Torrance, STR, pp. 154-155.

87. See "Meta Levels" on pp. 115-126.

to legislate doctrine but in order to affirm a mystery. As Torrance insists, there is both an exclusiveness and an open range in Trinitarian faith.[88] The "incarnate mystery of the union of divine and human nature in Jesus Christ the Mediator" is an "ineffable inexplicable mystery hidden in God himself."[89]

Flannery O'Connor wrote that "dogma is the guardian of mystery."[90] She explains:

> "In the greatest fiction, the writer's moral sense coincides with his dramatic sense, and I see no way for it to do this unless his moral judgment is part of the very act of seeing, and he is free to use it. I have heard it said that belief in Christian dogma is a hindrance to the writer, but I myself have found nothing further from the truth. Actually, it frees the storyteller to observe. It is not a set of rules which fixes what he sees in the world. It affects his writing primarily by guaranteeing his respect for mystery."[91]

What O'Connor describes for her Christian vision in literature applies to science. Her "very act of seeing" is akin to what we mean by theological instinct. Her rejection of "dogma" as a "set of rules," but rather as a means of opening up the world, awakening keener vision, observation, and respect for mystery – this is what we envision as the result of a Trinitarian model of reality.

The broad Nicene tradition guards the mystery of the Incarnation and Trinity. Terms like *hypostatic union*, or phrases like "one person, two natures," are used in the creeds and the theology of the creeds, but the creeds do not specify the details. The terms themselves are not the reality, but pointers to the mystery. The mesa is a large area, and the whole mesa top has ample room for conversation and diversity, for theological inquiry and analytical reflection. The edges of the mesa, delineated by the creeds, are boundary markers beyond which the church has found, through painful experience, that one descends away from the mystery revealed in Christ of the Incarnation and Trinity. Off the mesa, one loses the reality.

In works of theology like *The Trinitarian Faith* or *Mere Christianity*, we may explore the Nicene understanding of the Incarnation and Trinity. We are then exploring the mesa top. In this

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88. "Faith that arises in cognitive commitment to the compelling claims of God in Jesus Christ and is linked to the absolute priority of God over all our conceiving and speaking of him, is bound to manifest a two-fold character. On the one hand, faith appears determinate and bounded, under the control of the precise form God's truth has taken in the incarnation of his Word, but on the other hand, faith appears indeterminate and unbounded, through its correlation to the unbounded and immeasurable reality of God which transcends all finite comprehension. On the one hand, then, faith is characterised by a certainty of conviction which derives its force from the truth of God himself thrust upon it, but on the other hand, faith is characterised by an open, ever-expanding semantic focus which answers to the unfathomable mystery and inexhaustible nature of God. That is evidently the double force of the We believe (πιστεύομεν) of the Nicene confession of faith in God, the Father, the Son and the Holy Spirit, which governs the way in which all its clauses are to be understood, namely, the exclusiveness and open range of belief." T. F. Torrance, *The Trinitarian Faith*, ch. 1, p. 22.

89. Torrance, *Mediation of Christ*, p. 114.

90. Flannery O'Connor, *The Habit of Being: Letters*, ed. Sally Fitzgerald (New York: Vintage Books, 1979), p. 365.

91. Flannery O'Connor, Mystery and Manners, ed. Sally and Robert Fitzgerald (New York: Farrar, Straus & Giroux, 1961), p. 31. Tolkien's fiction, cited in these sections, exemplifies what O'Connor is saying.

book, we take the Trinitarian faith as our starting point, and explore what implications the broad Nicene tradition might have for the relations between science and theology. Our question, then, is this: *how do we understand science from on top of the mesa?*

Attractions	True to ultimate reality
	Offers further perspectives
Weakness	Need the binoculars! (Christ-centered vision)
Scientific	Nicene theology a paradigm scientific achievement
In practice	Trinitarian theological instinct for science

Table 40*: Theist model Summary*

In summary, the Trinitarian model is attractive because it is true to ultimate reality and offers further perspectives for a Christian understanding of Creation that are not obvious from the other models.

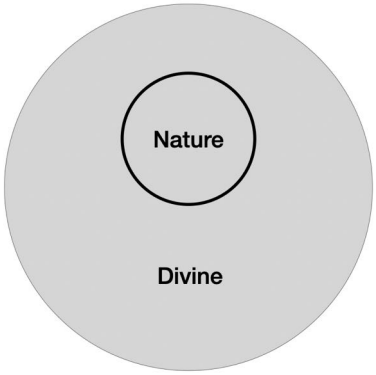
Its weakness is that we need the binoculars, a Christ-centered vision, in order to see them. We hold fast to Christ, for the foolishness of God is more powerful than the wisdom of the world, though it may seem a stone of stumbling, and a rock of offense (1 Cor 1:18-24; 1 Pet 2:8; Rom 9:32-33).

A Scientific Trinitarian model sees the articulation of the doctrine of the Trinity in the Nicene theological tradition as a paradigm scientific achievement, a methodological exemplar for the sciences. We are not adopting a methodological Deism, nor attempting to find some other model representing the lowest common denominator. In other words, we are thinking theologically about Creation in light of all we know in Christ. We are engaging in conversations that are anchored in Church Dogmatics but for the sake of the entire world.

In practice, we are seeking to develop a Trinitarian theological instinct with respect to the sciences.

2.7. The Panentheist Model

Figure 106: Diagram of the Panentheist Model



Nature is not all of the Divine

Finally, let's note that the six models do not exhaust the possibilities. Hybrids, and hybrids of hybrids, may complicate their application to any case study. For an example, let's consider "Panentheism," a hybrid between the Pantheism and Theism models.

In Panentheism, nature is not all of the divine. This is the inverse of the Pagan model. Compared with the diagram for the Pagan Model (Figure 93 on p. 244), the diagram for the Panentheist Model (Figure 106) switches the labels so that nature is within the divine rather than vice versa.

Theism	Panentheism	Pantheism
The divine transcends nature	The divine extends continuously beyond nature	The divine and nature are co-extensive
The divine and nature do not overlap in being	The divine and nature overlap in being	The divine and nature are continuous in being
Nature and the divine are distinct	Nature is part of the divine	Nature is divine (and vice versa)
Creatures have their own integrity as not divine	Nature is not distinct from the divine	
Cannot project creaturely change onto the divine	Change in nature = Change in the divine	
Union with the divine is personal	Union with the divine is impersonal	

Table 41*: Theism, Panentheism, and Pantheism compared*

Table 41 compares Panentheism with several aspects of Theism and Pantheism. Unlike Theism, in Panentheism, nature and the divine are continuous in being; the divine is not transcendent, even though it is larger. Unlike Pantheism, nature and the divine are not co-extensive; all of nature is divine, but the divine extends beyond what is nature.

Pantheism and Panentheism may arise as a protest against the separation of nature and the divine in Deism. They promise a way of recovering the intimacy and relation of nature with the divine, which Deism sorely lacks.

But just as in Pantheism, in Panentheism nature is part of the divine. This draws a line between Pantheism and Panentheism, on one side, in contrast to the Theist and Trinitarian models, on the other. If we are recovering the Theist or Trinitarian model, we can expect Panentheism to come up as a by-product, as in some forms of so-called "social

Trinitarianism" or some strands of 20th-century Celtic Christianity. Panentheism can be a sign that someone is actually thinking in a new, non-Deist way.

Yet, in the Theist and Trinitarian models, while God is present everywhere, He is not everything. The burning bush serves as an emblem of Theist perspectives, because in contrast to both Pantheism and Panentheism, God and the bush are distinct. The bush retains its identity as non-divine.

In Panentheism, nature is identified with the divine, as in Pantheism. Unlike Pantheism, Panentheism affirms something like a weakened form of God's transcendence beyond nature.

Theists affirm the reality of the creature as not divine in contrast to both Pantheism and Panentheism. Creaturely integrity is important in order not to project everything about creaturely change into the godhead, as if all creaturely changes change God himself. For instance, just because I learn something does not mean God has gotten smarter.

Panentheism differs from pantheism in that the divine is not only co-extensive with nature, but also more extensive, exceeding the realm of nature in some way. This is a step in the direction of Deism/Theism/Trinitarian models, but without the emphasis on creaturely integrity and distinction from God. In Theism, we are redeemed and reconciled to the divine, but our union with the divine is personal. Whereas, for Panentheism, union with the divine is impersonal, an assimilation into God or a loss of our creaturely identity as distinct from God.

2.8. The Models in Review

We refer to Atheist, Pagan, Pantheist, Panentheist, Deist, Theist, and Trinitarian models of reality throughout this book. They are not terms of denigration or used in a pejorative sense, but philosophical models, with the definitions just provided, to serve as analytical tools.

In each of these models, our understanding of nature and the divine are defined in relationship, like Escher's drawing hands, rather than as wholly irrevelevant one to another. The models of reality disclose how attempts to utterly exclude consideration of the divine from consideration of nature are ultimately arbitrary, because in every model *something* is divine, understood as "that on which all else depends." Nature and the divine, reason and faith, and science and religion, cannot help but be related on profound philosophical, historical, and cultural levels.

We use upper case to distinguish the models of reality, as described here, from broader religious or historical traditions which may go by the same name but may not align consistently with the models. Members of religious or intellectual traditions may hold views attributed to the different models in various combinations. For example, a Jewish or Muslim theist (lower case) may hold to perspectives here labeled Trinitarian, or a Christian theist may hold to perspectives here labeled Deist, Pagan, or Pantheist, or even be a functional Atheist, while an avowed atheist in a secular humanist tradition may share much in common with the Pantheist or Pagan models. The models provide a heuristic set of conceptions and terms not to sidestep but to clarify the complexities found in every religious and non-religious tradition.

These aren't the only possible models; we could multiply them, or tweak them, or merge them in several combinations. Even with respect to these seven models, some people define the models differently and that's ok. They're not intended as rigid categories, but as heuristics. They offer us some analytical terms in common, for the sake of starting conversations. In those conversations, remember that these are abstract models; which means they are tools for thinking, not the realities themselves. With each particular person or case study we encounter, we must be careful not to blithely apply a philosophical model, but rather seek to adapt our thinking to the concrete reality before us in that conversation.

Our aim in this book is to flesh out the Theist and Trinitarian models for their significance for science. With frequent reference to Table 42 (next page, bookmark it now), practice trying to identify which model of God and nature is evident in any case study we're discussing, implicit in any movie you're watching, conveyed in any sci-fi book you're reading, or expressed by friends in conversations over coffee.

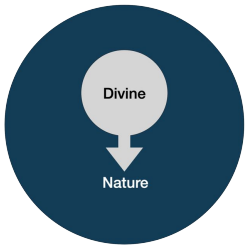
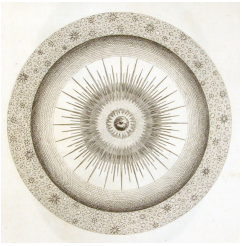
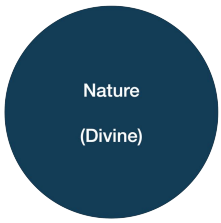
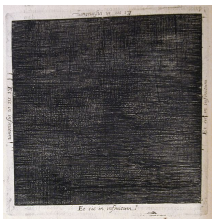
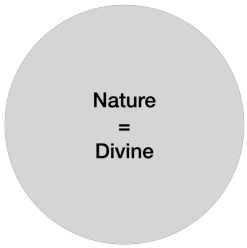
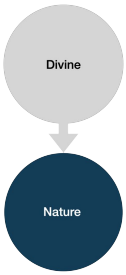
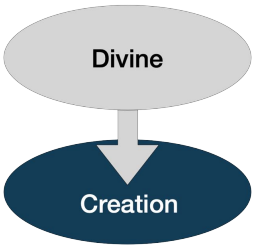
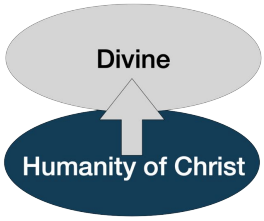
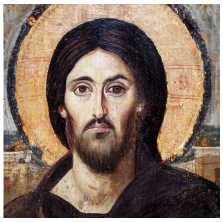
Model	Motto	Diagram	Emblem
Pagan	The divine is within nature		
Atheist	Nature is all		
Pantheist	Nature is divine		
Deist	No overlap between nature and the divine		
Theist	The divine and nature are closely related		
Trinitarian	New Creation in Christ		

Table 42*: Models of God and nature – diagrams, mottos, emblems*.

3. Discuss the Models

On the following pages are several examples to test your understanding and to assess the models themselves. With each example, consider this question:

- Which model or models best describe the relation between God and nature at play?

However, an important caveat applies: when it comes to art or science or human persons, interpretation is complex. There is no clear right or wrong answer. The point of the models is not merely to apply a label, but to help start a conversation.

So, more importantly than which model an example represents, consider these questions:

- Does analyzing the example by means of the models prompt meaningful conversation in each case about the relations between God and nature?
- Are the models helpful as analytical tools for discerning the interplay between faith and reason?
- If so, do they reinforce the discussion of faith and reason in the first section of this chapter?

3.1. NAZI FITNESS POSTERS

Figure 107: Nazi fitness posters

First are some Nazi fitness posters. Given the role of health and fitness in their doctrine of the Aryan race, which model of God and nature might best describe these?

3.2. JOHN LENNON, YOKO ONO, "IMAGINE"

John Lennon and Yoko Ono wrote one of the most popular songs of the 20th century, "Imagine":

> Imagine there's no heaven
> It's easy if you try
> No hell below us
> Above us, only sky
> Imagine all the people living for today
>
> Imagine there's no countries
> It isn't hard to do
> Nothing to kill or die for
> And no religion too
> Imagine all the people living life in peace
>
> You may say I'm a dreamer
> But I'm not the only one
> I hope some day you'll join us
> And the world will live as one
>
> Imagine no possessions
> I wonder if you can
> No need for greed or hunger
> A brotherhood of man
> Imagine all the people sharing all the world.

Which model of God and nature best describes its lyrics?

3.3. PAUL KLEE, "DIE ZWITSCHER-MASCHINE," 1922

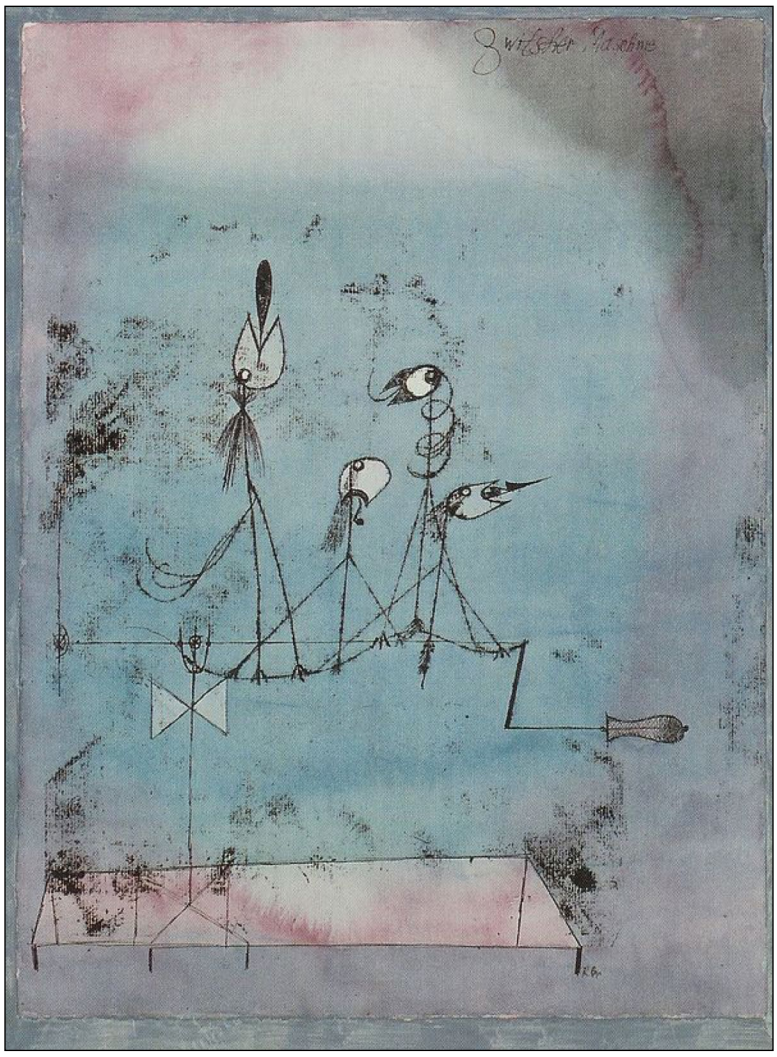


Figure 108: Paul Klee, "Die Zwitscher-Maschine," 1922`

Paul Klee painted "The Twittering Machine," which was denounced by Adolf Hitler as degenerate art.

How do you interpret its blending of biological and mechanical motifs?

Which model of God and nature might be most at play here?

3.4. John Milton, Gender Roles

John Milton's *Paradise Lost* (1667) was one of C. S. Lewis' favorite poems.[92] In the setting of the Garden of Eden, Milton summarized the gender roles of Adam and Eve as follows:

> "For contemplation he and valour formed;
> For softness she and sweet attractive grace;
> He for God only, she for God in him."
> John Milton, *Paradise Lost*, Bk IV, lines 297-299

Following a literal reading of these lines, let's imagine that Adam is telling himself to live for God transcendent; while at the same time telling Eve to live for God in him (Adam), not for God transcendent.

Which model describes the way Adam is to live?

Which model describes the way Adam is telling Eve to live?

92. C. S. Lewis, *A Preface to Paradise Lost*, is a classic study of Milton's work.

3.5. William Butler Yeats, "The Indian Upon God"

William Butler Yeats is one of my favorite early 20th-century Irish poets, and I've loved his poem, "The Indian Upon God," practically all my adult life:

> I passed along the water's edge below the humid trees,
> My spirit rocked in evening light, the rushes round my knees,
> My spirit rocked in sleep and sighs; and saw the moor-fowl pace
> All dripping on a grassy slope, and saw them cease to chase
> Each other round in circles, and heard the eldest speak:
> Who holds the world between His bill and made us strong or weak
> Is an undying moorfowl, and He lives beyond the sky.
> The rains are from His dripping wing, the moonbeams from His eye.
>
> I passed a little further on and heard a lotus talk:
> Who made the world and ruleth it, He hangeth on a stalk,
> For I am in His image made, and all this tinkling tide
> Is but a sliding drop of rain between His petals wide.
>
> A little way within the gloom a roebuck raised his eyes
> Brimful of starlight, and he said: The Stamper of the Skies,
> He is a gentle roebuck; for how else, I pray, could He
> Conceive a thing so sad and soft, a gentle thing like me?
>
> I passed a little further on and heard a peacock say:
> Who made the grass and made the worms and made my feathers gay,
> He is a monstrous peacock, and He waveth all the night
> His languid tail above us, lit with myriad spots of light.

What model of God and nature does it best illustrate?

3.6. LEONARDO DA VINCI, "VITRUVIAN MAN"

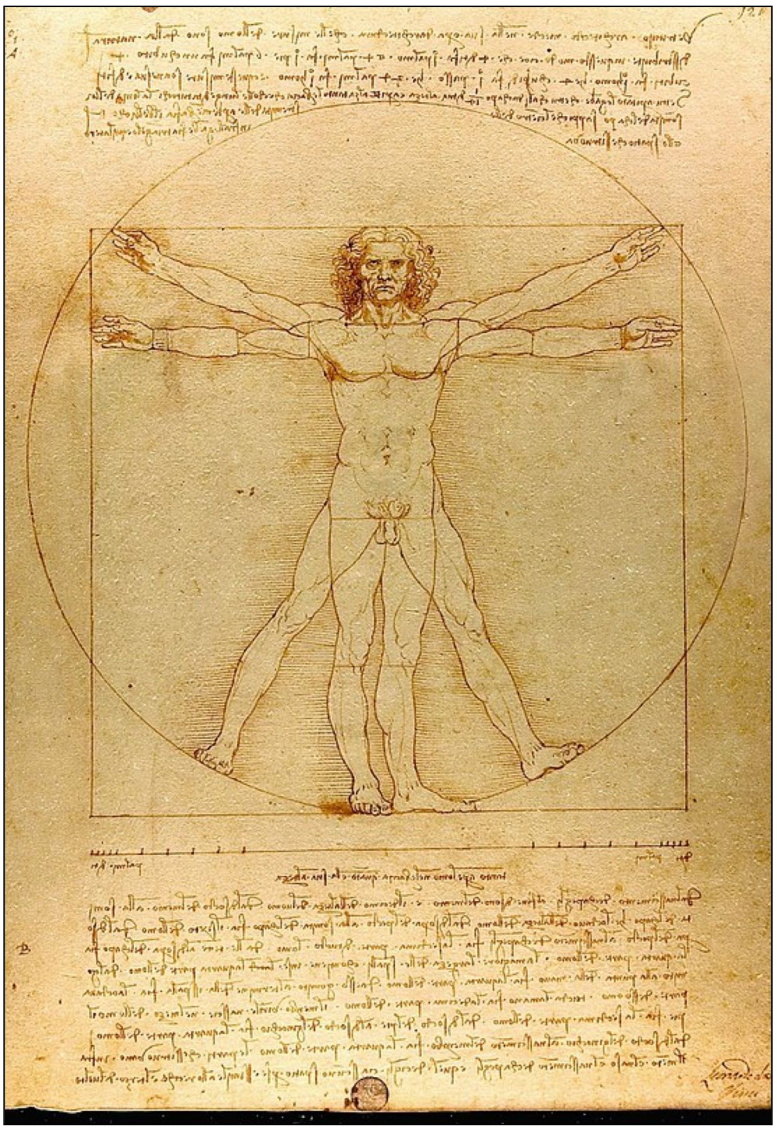


Figure 109: Leonardo da Vinci, "Vitruvian Man"

One art critic described Leonardo's life quest as an attempt to paint the soul. Perhaps the most famous example is his "Vitruvian Man."

Which model of God and nature might be at play underlying this drawing?

3.7. GEORGE HARRISON, "MY SWEET LORD"

"My Sweet Lord" by George Harrison was the first number one single by an ex-Beatle.

> George Harrison, "My Sweet Lord"
>
> My sweet Lord
> Mmm, my Lord
> Mmm, my Lord
>
> I really wanna see you
> Really wanna be with you
> Really wanna see you, Lord
> But it takes so long, my Lord
>
> I really wanna know you
> I'd really wanna go with you
> I really wanna show you, Lord
> That it won't take long, my Lord
>
> (Hallelujah)
> My sweet Lord (Hare Krishna)
> Mmm, my Lord (Hallelujah)
> My sweet Lord (Hare Krishna)

Which model of God and nature might fit it best?

3.8. Alberto Giacometti, "Chariot"

Figure 110: Alberto Giacometti, "Chariot"
Image credit: Sotheby's sale, 2014[93]

My copy of the classic book, *Irrational Man: A Study in Existential Philosophy* (1962), by William Barrett, displays a Giacometti sculpture on its front cover.

How do you interpret Giacometti's art with respect to the models of God and nature?

93. Image: https://www.newyorker.com/business/currency/the-hundred-million-dollar-giacometti

3.9. Gerard Manley Hopkins, "God's Grandeur," 1877

The world is charged with the grandeur of God.
It will flame out, like shining from shook foil;
It gathers to a greatness, like the ooze of oil
Crushed. Why do men then now not reck his rod?

Generations have trod, have trod, have trod;
And all is seared with trade; bleared, smeared with toil;
And wears man's smudge and shares man's smell: the soil
Is bare now, nor can foot feel, being shod.

And for all this, nature is never spent;
There lives the dearest freshness deep down things;
And though the last lights off the black West went

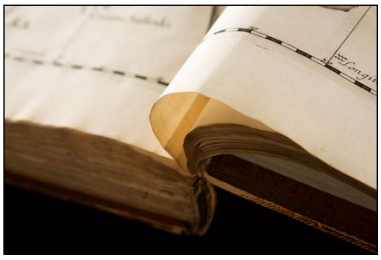
Oh, morning, at the brown brink eastward, springs –
Because the Holy Ghost over the bent
World broods with warm breast and with ah! bright wings.

Gerard Manley Hopkins, 1877

Gerard Manley Hopkins was an English poet who influenced T. S. Eliot, C. S. Lewis, and other 20th-century poets. How do you interpret this poem with respect to the models of God and nature?

4. After Words

— Classic Texts —



> "It is a good rule, after reading a new book, never to allow yourself another new one until you have read an old one in between…"[94]

- Blaise Pascal, *Pensées,* trans. and ed. A. J. Krailsheimer (Penguin), #449, #199, and #110.[95]
- Anselm, *Proslogium*, 1.

— Further Reading —

- Roy Clouser, *The Myth of Religious Neutrality: An Essay on the Hidden Role of Religious Belief in Theories*, Revised Edition (Notre Dame University Press, 2005), chs. 2-3. See also Roy Clouser, *Knowing with the Heart: Religious Experience and Belief in God* (Eugene, Oregon: Wipf and Stock, 2007).
- Karl Barth, *Anselm: Fides Quarens Intellectum* (SCM Press, Ltd., 1960).

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94. C. S. Lewis, *God in the Dock: Essays on Theology and Ethics* (Grand Rapids, Michigan: William B. Eerdmans Publishing Company, 1970), pp. 201-202.

95. Pascal is usually cited by the Krailsheimer numbers in the Penguin edition; make sure that the edition you read indicates these numbers.

— Reflect and Discuss —

It's now time to put on our thinking caps and interpret the significance of what we've been exploring! If this chapter has been successful, then you are now doing some real thinking.

1. Are the wheels spinning? Did you discover anything new, surprising, or unexpected? What was most meaningful to you?
2. What prayer would you write to introduce this chapter?
3. What scripture passage would you select to introduce this chapter?
4. How do you interpret Escher's drawing of the two hands in light of these things? Would you choose a different work of art to represent this chapter?
5. What is your definition of natural science? How does it compare with the grid of related terms in Table 30 on p. 222?
6. Compare and contrast "natural philosophy" and "natural theology." How do they both pertain to the questions of the unity and relations of the sciences?
7. Compare and contrast the foundationalist and relational senses of natural theology. What does it mean to say that relational natural theology is an integrating endeavor rather than a traditional argument for the existence of God?
8. Sometimes Christian apologetics is framed according to two opposing sides: Fideists or presuppositionalists on one side, vs rationalists or evidentialists on the other. But what if neither faith nor reason are "first," but interrelated, working together at every step on the ladder? Does Escher's drawing of the two hands offer any category improvements here?
9. Which of the models of reality describe ways you have heard people talk about science, God and nature? Are such models of reality helpful?
10. Do the models of reality described in the second section of this chapter illustrate or reinforce any of the analytical terms and categories introduced in the first section? (natural science, theology, philosophy, natural philosophy, natural theology, faith, reason, etc.)
11. Are models of reality always present in theoretical endeavors? Is it possible for natural science, for example, to proceed without assuming a model of reality? Is something always divine, even in the case of Atheism?
12. What is the role of the models in actual scientific practice? Is it appropriate ever to broach the question of models of reality, or even to affirm a model of reality in a scientific setting? If so, how could that be done in an appropriate manner? Consider the opening line of *Cosmos*, by Carl Sagan, as an example. Was it appropriate for that book? Would one guideline be that discussion of models of reality would be inappropriate in scientific discourse if a scientist fails to distinguish between that discussion (which properly pertains to philosophy and theology) and discussion of results arising from within the natural science itself? That is, a scientist should avoid implying that the model itself is the result, rather than an underlying assumption, of scientific inquiry? Scientific discourse opens

outward toward big questions that reach beyond the domains of the natural sciences themselves, but there is a need for humility in respecting other domains which also have expertise relevant to those big questions (e.g., theology and philosophy). Both hands are present in Escher's drawing, not just one. To act as if science alone can speak about the models is to put an eraser in one of the hands, which is scientism, not science.

13. How can we come to recognize when we slip into ways of thinking according to models of reality that are alien to the gospel? How can we then instead begin to shift toward "Theist" and "Trinitarian" modes of understanding?

14. In the case studies offered for discussion of the models of reality, there is not necessarily a single right answer for each example. Different people might give different answers. What matters more than just giving them a label is whether the models help us begin to think through concrete examples with attention to the sometimes hidden interplay between faith and reason. Do the models seem helpful as a way of thinking or talking about these examples?

15. Nevertheless, what are your answers for the examples presented?

    My own responses are as follows: The Nazi fitness posters illustrate Pagan attitudes toward health and fitness. "Imagine," by John Lennon and Yoko Ono, is Atheist. Paul Klee's Twittering Machine is a protest against the clockwork mechanism of the deist model. Milton's famous lines would set up Adam as a pagan lord over Eve. Yeats' "The Indian Upon God," illustrates a Pantheist view. For Leonardo's "Vitruvian Man," I would say in one sense, striving to find the soul could be the Pagan model; or, being caught in the clockwork mechanism of Deism. With respect to "My Sweet Lord," the fusion of religious traditions, making them all the same, is characteristic of both Paganism and Pantheism. I would tilt toward Pantheism in this case. For Giacometti's "The Chariot," I see it as an existential cry of angst in the loneliness of Atheism. And finally, Gerard Manley Hopkin's poem, "God's Grandeur," represents Theism, like the burning bush; and it is also Trinitarian, with its allusions to the Holy Spirit at work in the world.

16. Does this chapter add anything significant for you to previous perspectives? Does it offer any insights that extend, apply, or clarify the chapters so far? Does it help us in our quest to develop a Trinitarian theological instinct?

17. Ideas lack power to change us until we relate them to our particular stories. What stories would you tell to embody these ideas?

18. Imagine yourself in conversation with a friend who enjoys theology: How do the case studies introduced in this chapter relate to Christian belief in the Trinity?

19. Imagine yourself in conversation with a friend who cares about science: How do the case studies introduced in this chapter relate to natural science?

20. What are the implications of these things for "Love and the Cosmos"?

— Doxology —

Let's pray and sing in worship of Father, Son and Holy Spirit.

Psalm 148

"Praise the Lord! Praise the Lord from the heavens; praise him in the heights!
Praise him, all his angels; praise him, all his host!

Praise him, Sun and Moon; praise him, all you shining stars!
Praise him, you highest heavens, and you waters above the heavens!

Let them praise the name of the Lord, for he commanded and they were created.
He established them forever and ever; he fixed their bounds, which cannot be passed.

Praise the Lord from the Earth, you sea monsters and all deeps,
fire and hail, snow and frost, stormy wind fulfilling his command!

Mountains and all hills, fruit trees and all cedars!
Wild animals and all cattle, creeping things and flying birds!

Kings of the earth and all peoples, princes and all rulers of the earth!
Young men and women alike, old and young together!

Let them praise the name of the Lord, for his name alone is exalted;
his glory is above earth and heaven.
He has raised up a horn for his people, praise for all his faithful,
for the people of Israel who are close to him.

Praise the Lord!"

Amen.