The Emergence of a Scientific Culture: Science and the Shaping of Modernity 1210-1685

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CHAPTER

3 Renaissance Natural Philosophies

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Abstract

There were three competing movements in 16th-century natural philosophy. Platonism was revived in the 15th century and Ficino and Patrizi attempted, unsuccessfully, to provide an alternative to Aristotelianism. The renaissance naturalism of the 16th century aimed to secure autonomy for natural philosophy by presenting an increasingly radicalized naturalistic picture of the natural realm. Late scholastic textbook writers, from the late 16th to the early 17th centuries, attempted, unsuccessfully, to reform and systematize Christianized Aristotelianism to meet the new demands placed on it by developments in natural philosophy.

Keywords: Christianized Aristotelianism, Marsilio Ficino, late scholastic textbook, Francesco Patrizi, Platonism, renaissance naturalism

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The revival of Averroism was not an exclusively sixteenth-century matter. Petrarch, the fourteenth-century founder of what became the humanist movement, saw his project explicitly as an alternative to Averroism,[1] and the Italian Neoplatonist movement associated Aristotelianism with Averroism from its beginnings in the mid-fifteenth century. Indeed, it was Ficino's questioning of the ability of Aristotelianism to provide a philosophical basis for Christian doctrine that led to the focus on the dogma of personal immortality, which, he argued, could be accounted for straightforwardly in Neoplatonist terms but not at all in Aristotelian ones. By contrast, the Averroist strain in Renaissance natural philosophy, also predominantly an Italian phenomenon, offers a variety of forms of naturalism, even though some of its sources derive from Neoplatonism. In fact it draws on both Aristotle and Neoplatonism in some respects, but also on Stoic, Epicurean, and Presocratic sources, generally eschewing forms of any kind but in compensation, as it were, endowing matter directly with inherent active principles that shape the behaviour of the natural realm. Against both of these, there is a revival of Aristotelian orthodoxy, captured in the late scholastic textbooks of the mid-sixteenth to the early seventeenth centuries. Of the participants in these disputes, the Neoplatonists are exceptional in denying that natural philosophy is the point of entry into philosophical enquiry generally. Both scholastics and naturalists, and the corpuscularians who had little impact in the sixteenth century but quickly became dominant in the seventeenth, all took this as given, and this has the

consequence of making philosophical disputes turn on natural-philosophical questions, further propelling natural philosophy into the centre of controversy.

None of these three dominant Renaissance natural philosophies survives unscathed into the seventeenth century. The reasons why, while they differ in each case, as we shall see, nevertheless have to do primarily with their inability to reconcile natural-philosophical and orthodox Christian thinking, and this is crucial for understanding the success of the natural-philosophical systems that replace them.

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Platonism as an Alternative to Scholasticism

In Neoplatonic thought, metaphysics and natural philosophy had always been part of the same enterprise. This had traditionally been much to the cost of natural philosophy and, with the exception of the work of the sixth-century Platonist natural philosopher Johannes Philoponus,[2] the subordination had been sealed with Augustine's appropriation of Neoplatonism as the philosophy of Christianity. The introduction of Aristotelianism had changed this, but the critical use of Platonic ideas never entirely died out in medieval natural philosophy. In the thirteenth century, Grosseteste invoked a Neoplatonist metaphysics in setting out a theory of light, as we shall see below. A good example in the fourteenth century is Oresme, who uses a number of traditional Platonist objections to Aristotle, as well as a number of Platonically inspired new ideas, to criticize details of Aristotelian natural philosophy, while remaining firmly within an Aristotelian natural-philosophical framework.[3] In the fifteenth century, Nicholas of Cusa used resources derived from Platonism to break out of Aristotelian natural philosophy at certain crucial points.[4] In the sixteenth century, a number of natural philosophers used Philoponus to make critical points against Aristotelianism.[5] If reconciliation between a Neoplatonically conceived Christian theology and an Aristotelian natural philosophy was a central constraint, then it is not surprising that it would be considered that deficiencies in the latter should be made good by the former.

Genuine Platonist and Neoplatonist ideas were not transmitted through the Augustinian tradition, however, any more than they were through the writings of Cicero, even though he was the other key traditional source for Plato. Islamic philosophy in the tenth and eleventh centuries had witnessed a revival of interest in Neoplatonism, which dealt in an encyclopedic way with a wide range of issues, including natural-philosophical questions,[6] but this tradition was marginal in Islamic culture—testified to by the fact that whereas almost everything of Aristotle's was translated into Arabic, only a few of Plato's works were
p. 89 available in translation[7]—and ↳ was never transmitted to the West. Albertus Magnus' knowledge of Plato was such that he classified his predecessors into Epicureans, Stoics, and Peripatetics, with Socrates and Plato being put in the category of Stoics, along with Pythagoras and Hermes Trismegistus, as well more recognizable candidates for this nomenclature.[8] Plato's texts began to appear in Latin translation only in the fifteenth century, beginning with the *Republic* in 1420, and it was from the Eastern Orthodox Church that the Christian West, in the mid-fifteenth century, encountered a fully fledged Platonist system in which Aristotle was accommodated to Plato, rather than the other way around.[9]

There had always been a presumption in favour of Platonism in the Orthodox Churches, and in the eleventh century Michael Psellus had set out to form a comprehensive philosophico-theological system by combining Neoplatonism with the *Chaldaic Oracles* and the *Corpus Hermeticum*. Towards the end of the fourteenth century, Plethon began to combine Psellus and Proclus (who had actually been Psellus' main source), seeking to reconstruct the ancient theology of which he believed Pythagoras and Plato to be representatives. Arriving in 1438 as philosophical adviser to the Greek Orthodox delegation to the Council of Florence (1439–40), Plethon offered a comprehensive Platonist system that seemed to some in the West to have the potential to rival the dominant Christianized Aristotelian system. The northern Italian states were more susceptible to this influence than elsewhere. The Venetian Republic had extensive trade with a huge region

covering Anatolia, the Steppes, and the Black Sea, and acted as a mediator between East and West in the fifteenth century; moreover within its orbit was Padua, where humanism had gained a foothold early in the fifteenth century (albeit not in the rigidly Aristotelian Arts Faculty). There had been a wave of new translations of Plato beginning with the rough draft of the *Republic* completed in 1402 by Chrysoloras, a Byzantine scholar who arrived in Florence to teach in 1397, and Uberto Decembrio, whose son was to revise and publish the translation in 1420, and Bruni had started producing his influential translations of the dialogues in the early decades of the century.[10] But translations were not the only way in which the ground was prepared. Petrarch believed that Plato's work was very close to revelation, and, following Augustine's lead, he found close parallels between the *Timeaus* and the Gospel of St John. Plato's works were not considered alien interlopers like those of Aristotle, which had to be accommodated to Christian doctrine: they were taken to be the philosophical key to Christian doctrine, part and parcel of the same enterprise, an
p. 90 enterprise in which the aim was the *de facto* obliteration of the divide between ↳ natural and revealed theology.[11] This project began to look realizable with the textual and intellectual resources that Plethon introduced and, mainly through his disciple Bessarion, Platonism became a formative influence on later fifteenth-century Italian thought.[12]

Although concerned to some extent with reconciling Christianity and Platonism, Plethon was not a Christian but a Platonist, and he could with some plausibility be seen as advocating a return to Greek paganism.[13] The point was not lost either on his critics, such as George of Trebizond, or his followers such as Bessarian. Bessarian, who converted to the Roman church and was made a cardinal in 1439, put a more orthodox Christian gloss on Plato's writings than had his master.[14] The question was how much this was a mere gloss and how much it revealed a real union between Plato and Christianity. The issues at stake here were fundamental and had been problematic since the overtly allegorical readings of the Old Testament of Origen and Augustine, which had the effect of stripping it of historical meaning, and raised the general question whether the past had value only to the extent that it prefigured Christianity.[15] The Old Testament had been transformed into a Christian book, and there was now danger of works such as the *Timeaus* being given a virtually similar standing.[16]

George of Trebizond, who saw himself, as Hankins puts it, as a prophet sent to warn the West against a revival of paganism orchestrated by a conspiracy of Platonists,[17] had no doubt that the union between Plato and Christianity was a sham. In his *Comparatio philosophorum Platonis et Aristotelis* (1458) he sets out a stinging attack on Plato and Platonism, distinctive not so much for the fervour of its invective (not uncommon in humanist circles) but for the extent of his knowledge of Plato, which far outstripped that of earlier defenders of Aristotle, and indeed he translated more Plato into Latin than anyone before Ficino. George sees a line of descent from the first Plato, through the second (Mohammed), to the third, Plethon, who he believed was trying to incorporate a Byzantine philosophy into the Roman Church, in the process undermining its chief intellectual bulwark, Aristotelian scholasticism, precluding the union of the Eastern and Western churches and thereby preventing the salvation of the Eastern Church from the Turk. On George's account, it was Platonism, not Aristotelianism, that was the source of schisms, heresies, and the like, and the Roman church had escaped destruction only by protecting itself with the armour of Aristotelian scholasticism.

p. 91 Bessarion responds to the *Comparatio* in *In calumniatorem Platonis* (1469), and takes George to task on a number of fronts, not least his translations of Plato, in an attempt to show that he knows nothing of philosophy in general and of Plato in particular, and on his knowledge of Aristotle, where he uses Albertus Magnus, Aquinas, Scotus, and others to show that George's version of Aristotelianism is idiosyncratic and unreliable. But there is a distinctive approach in the text which was to be influential in the subsequent development of a specifically Latin Platonism. This is the contrast he draws between the kind of discursive reasoning we find in scholastic authors, which is appropriate to the temporal and material world, the world of politics and of constant flux, and the superior form of divine intuition that an intellectual elite can have of

the divine. The latter is knowledge of the cause, whereas the former is knowledge only of effects, and he urges that we do not try to use language and argument appropriate to sensible things to capture divine things. As Hankins points out, there are two crucial and influential moves in Bessarion's approach.[18] First, he uses a Neoplatonic understanding of biblical and Patristic exegesis to undercut the possibility of a science of theology based on Aristotelian dialectic. This denies any legitimacy to the scholastic enterprise. Second, what he is in effect advocating is the replacement of scholastic theology with a kind of intuitive knowledge or wisdom which is a form of contemplative understanding. This undercuts an indirect approach based on analogy. In one respect, this idea of interpretation for contemplation is reminiscent of the pre-scholastic monastic tradition in the West, which was close to what had been advocated at the turn of the century by theologians such as Gerson, who were trying to find a way to counter the disputatious character that theology had taken on under the influence of scholasticism. In the monastic tradition, reading had provoked not question, answer, and disputation, but prayer and contemplation.

But Bessarion's Platonist successors were not advocating a return to monasticism, and their idea of contemplation of the divine was an intellectual not a spiritual form of contemplation, whatever their protestations to the contrary. What drove them was the combination of philology, as opposed to dialectic, and direct contemplation of the divine, rather than an indirect analogical grasp whose success could in any case not be guaranteed. The precocious Giovanni Pico Della Mirandola planned the definitive work of Platonic synthesis[19] but completed little more than a preface—'on being and the one'—to his encyclopedic project, and it did not replace Ficino's *Theologia Platonica*, which appeared between 1469 and 1474, and remains the high point of the metaphysical stream of Renaissance Platonism. From the point of view of natural philosophy, this stream culminated in a distinctively Platonic natural philosophy in Patrizi's *Nova de universis philosophia* of 1591. In what follows, I shall take these two to represent the scope and limits of Platonism's attempt to replace scholastic Aristotelianism as the system that unites theology, metaphysics, and natural philosophy.

p. 92 In the Preface to his translation of and commentary on Plotinus (1492), Ficino writes: ↳

> Almost the entire world is occupied and divided between two sects of Peripatetics, the Alexandrians and the Averroists. The first think our intellect is mortal, the second that it is one in number. Both schools are equally destructive of religion, especially as they seem to deny that men are subject to divine providence, and in both cases they seem to have been failed by their Aristotle. Today few men except our sublime fellow-Platonist Pico seem to understand Aristotle's mind with that sense of piety with which formerly Theophrastus, Themistius, Porphyry, Simplicius, Avicenna, and recently Plethon interpreted him.[20]

The point about approaching these questions with a sense of piety is crucial.[21] Ficino is opposed to the scholastic procedure, which he associates particularly with the Averroists, who formed the dominant schools in the Padua and Bologna Faculties, of identifying the best exegetes of a text—those who give the best arguments for an opinion—without regard to whether they provided interpretations that were edifying of Christian faith and morals. The issue is that which bedevilled thirteenth-century disputes over Averroism, under the guise of the misleadingly named doctrine of 'double truth', whereby the theological mode, which interprets sacred texts so as to reveal the underlying truth, is opposed to the philosophical mode, which seeks to be free of all dogmas and concentrates solely on which opinions are best supported by the arguments. What Ficino wants to do is to shift philosophy into a theological mode, since the theological mode is the only one that directs itself to truth, and to do this requires a move from an Aristotelian to a Platonic model. Indeed, in a sense, Platonic philosophy will replace traditional theology, virtually becoming a special esoteric form of Christianity for an intellect elite,[22] just as it had in effect for Bessarion.

Platonism and Christianity are not the only ingredients in Ficino's project however. Ficino was employed by Cosimo de' Medici to translate Plato's works. He began learning Greek in 1456, and received his first

manuscript from Cosimo in 1462, but in that year Cosimo also managed to procure the Greek text of the first fourteen books of the *Corpus Hermeticum*, and Ficino completed the translation of this a year later under the title of *Pimander*, actually the name of the first of the books of the *Corpus*.[23] Although in fact dating from the late second century CE, the *Corpus* was believed to be the work of a Hermes Trismegistus, supposed to have lived just after the time of Moses, and it was taken to represent a tradition of ancient pagan theology which mirrored and complemented the revealed truth of scripture, with its Egyptian provenance throwing light on stories of Plato's travels in Egypt.[24] As I have indicated, Psellus had incorporated parts of the *Chaldaic Oracles* and the *Hermetica*, which were known to Byzantine writers in the eleventh century, into his original
p. 93 Neoplatonic ↳ synthesis, and no one before the seventeenth century doubted their great antiquity. Lactantius and Augustine had both considered Trismegistus as a writer from remote antiquity, and although Augustine had condemned the idolatry in the Hermetic texts, Lactantius had used Trismegistus as an ally, as a pagan source in support of the truth of Christianity, noting in particular that he spoke of 'God and Father'. The Hermetic texts were considered to offer a *prisca theologia*, an ancient or original theology, supplementing the revelations given to Moses on Mount Sinai.

In his *Theologia Platonica*,[25] Ficino welded together Christian, Hermetic, and Neoplatonic sources into a syncretic treatise on philosophical theology which offered the first developed alternative to the Aristotelian system. The seemingly marvellous anticipations of Christianity evident in the Hermetic corpus, all the more remarkable in the light of its supposed great antiquity, and the marvellous and natural coherence between Platonism and both the Hermetic doctrines and Christian revelation, seemed to Ficino, as they had seemed to earlier thinkers in the Eastern Church, to suggest the key to the understanding of the link between God and his creation. What put Ficino ahead of his predecessors is the fact that his account drew not just on these sources but also on a whole body of Patristic and scholastic argument, and he deployed Augustine and Aquinas almost as readily as he did Plato, Plotinus, and Proclus. The aim was not to use Platonism to take pot-shots at Aristotelianism, as some scholastic writers had done, nor was it just setting out a Platonic system without regard to the kinds of questions that Aristotelianism had engaged, as Eastern Platonists had done. It was the setting out of a new synthesis which was presented as the answer to problems that Christian Platonists and Aristotelians shared, and it forced to the centre a question that the scholastic tradition had certainly taken seriously, but only as one of a number of issues. Ficino made the doctrine of the personal immortality of the soul the question on which the whole enterprise stood or fell.

The theme is set out in the first Book of the *Theologia*, where Ficino argues that the yearning for immortality which is characteristic of human beings would violate our understanding of God's behaviour if we were not allowed that immortality that we seek: for God not to allow immortality would frustrate the very nature of his most illustrious creation. Much of Ficino's account of the faculties of the soul and the attributes of God follows traditional scholastic accounts, but his argument for the soul's indissolubility is a resolutely Neoplatonic one and follows from its place in the ontological order. Perhaps the most distinctive feature of Neoplatonic conceptions is the hierarchical structure of the universe. Ficino's universe is typical in this regard, but his structuring goes beyond the traditional Neoplatonic hierarchy in two respects.[26] First the
p. 94 categories of being are determined by the five basic kinds of substance: God, ↳ the angelic mind, the rational soul, quality, and body. God has the highest degree of being and the highest degree of goodness: body, by contrast, is simply a negation of this, having no being or goodness in its own right. This is a revision of Plotinus' scheme, replacing his vegetative and sensitive souls, and a development of that of Proclus, introducing the single category of quality and putting the human mind at the centre of a symmetrical classification. Second, Ficino conceives the hierarchy to be dynamic rather than static, the various parts and degrees being held together by active forces, the central one of which, following Plato's *Symposium*, he identifies with love. To provide some medium for the active forces he resurrects the Neoplatonic world soul, and gives astrology a central role in a natural system of mutual influences.[27] Having established this tightly structured hierarchy, Ficino then goes on to establish the soul's indissolubility on the basis of its central place in the ontological order: it plays a key role in holding the hierarchy together.

Ficino puts the earth at the physical centre of the universe and the rational soul at the ontological centre, so that the human being is doubly at the centre of things, and the focus of creation. As Copenhaver and Schmitt note, in this schema, 'macrocosm and microcosm, world-soul and human soul, affect one another through symmetries of psychic correspondence and mutually sustain an optimistic view of man's ability to fulfill an immortal destiny in a cosmos divinely ordered for human ends'.[28] One charge that this approach faced, a charge that George of Trebizond had laid against Bessarion, was that of introducing a host of redundant middle deities between God and his creation. Whatever the merits of the hierarchical scheme as a complete picture of the ways in which the various degrees of being interact, just how those who took an independent interest in natural philosophy might articulate their results in terms of the Neoplatonic scheme is not easy to conceive. Deriving physical principles from the metaphysical hierarchy would seem an impossible task, and it is certainly one that Ficino does not attempt. On the other hand, nor is it clear how one might incorporate physical principles into the system, because it is completely obscure how the system works at a physical level. The reliance on active principles connecting various parts of being, for example, is very problematic. In the sixteenth century, there will be a number of philosophers who will use 'active principles' to explain phenomena such as magnetism, which appears to act without a physical intermediary between the magnet and the magnetically attracted body. But when such claims come to be examined in early seventeenth-century writers such as Mersenne and Descartes, it turns out that the purported 'explanations' are little more than an exercise in labelling. One can invoke active principles to account for anything, but in
p. 95 invoking them it is far from clear that one has understood something that one did not understand before ↳ invoking the active principle. The question therefore arises whether they can perform any genuine explanatory work. If they cannot, then Ficino's metaphysical system loses its attachment to any substantive natural-philosophical content.

After the era of Ficino and Pico, Platonism became a more eclectic discipline, as authors such as Steuco and Mazzoni attempted to reconcile Aristotelianism and Platonism into a 'perennial' system, as Steuco termed it.[29] Patrizi, by contrast, who converted to Platonism on reading Ficino's *Theologia Platonica*, was very hostile to Aristotelianism, marking him out from Steuco and the more syncretic tradition of sixteenth-century Platonism.[30] Nevertheless, his attempt to ground a natural philosophy in Neoplatonic metaphysics was such that the nature of the task required that his system was a hybrid one even by the rather eclectic standards of Renaissance Platonism. *Nova de universis philosophia*, which first appeared in 1591, was intended by Patrizi not merely as a summation of the Platonic system,[31] but as an explicit alternative to Aristotle. In the Dedication, he explains to Pope Gregory XIV that there have been only four pious philosophers—Zoroaster, Hermes, Plato, and Patrizi himself—and he asks the Pope to abandon the Aristotelian system taught in the schools and colleges and to replace it with his.[32] The full title of the book gives an good indication of its structure. It rises to the first cause, we are told, not by the standard natural-philosophical route of motion or change, but by means of *lux* (light) and *lumen* (brightness).[33] Second, by a 'new and special method' all divinity comes into view. Third, the universe is derived by the Platonic method from God. We shall look at these in turn, but first we need to understand the role that theories of light play, for it is through an intimate attachment to optics that sixteenth-century Neoplatonism takes the form of a natural philosophy.

It is in the Arab optical tradition, in the *De Prospectibus* of al-Kindi in the ninth century, that we find the first statement of the principle that luminous rays issue in all directions from every point on the surface of a luminous body. Al-Kindi does not restrict this principle to light, however, but considers that 'everything that has actual existence emits rays in every direction, which fill the whole world'.[34] This applies as much to fire,
p. 96 magnets, and words as it does light. The special significance of optics ↳ derives from the fact that it is concerned with the radiation of power, which al-Kindi considered the most fundamental natural phenomenon.[35] Al-Kindi offered an extramission theory of light, following Euclid and Ptolemy, whereby vision is effected by means of a 'power' proceeding from the eye to the sensible thing.[36] His successor in optics, Alhazen, offered an intromission theory, whereby vision is effected by the eye being struck by light

rays which are emitted from or reflected off the object seen.[37] Alhazen was the first to integrate anatomical, physical, and geometrical considerations into a unified theory of vision, and he presented the first plausible solution to the problem of how large images can enter the pupil of the eye, which was one of the most serious problems for intromission theory. On Alhazen's physico-physiological theory, an external agent—*lumen*—is posited which is capable of stimulating the sense of vision. The luminous quality or brightness of a body is *lux*, and it is by means of *lumen* that *lux* is able to act on vision. The *lux*/*lumen* distinction became the staple of subsequent Arab and Western optics, undergoing a number of revisions and refinements, and the origins of the distinction in a consideration of the transmission of powers is important.

When Arab optics reached the West in the thirteenth century, in the work of Robert Grosseteste—who, though not a Franciscan himself, was closely associated with the English Franciscans—we find it immediately being given a very explicit metaphysical gloss, as part of the theology of creation.[38] Grosseteste incorporated optics into an account which had three other ingredients. The first is the Augustinian doctrine of divine illumination. In the *Soliloquia*, Augustine had argued that just as objects must be made visible by being illuminated before they can be seen, so too must truths be made intelligible by a kind of light before they can be known, and just as the sun is the source of physical light, so God is the source of spiritual light or truth. In his *De veritate* and in the commentary on the *Posterior Analytics*, Grosseteste explicitly took up this doctrine, drawing intimate parallels between optics and the power of God. These parallels were able to be so close because of the second ingredient in his account, a light cosmogony deriving from the Neoplatonic
p. 97 doctrine of emanation, known in the Middle Ages primarily through a compendium ↳ of passages from Plotinus and Proclus, misleadingly entitled *Theologia Aristotelia*. Here light was construed as the 'first corporeal form', with the material universe itself evolving from a primordial point of light.[39] Hence the study of 'physical' light was a prerequisite to the understanding of the origins and structure of the material universe. Finally, the third ingredient in his account was the Neoplatonic idea that all causation in the material universe operates on the analogy of the radiation of light. A crucial source here was pseudo-Dionysius the Aeropagite,[40] who was wrongly identified (by some right up to the nineteenth century) with the first-century Dionysius whom Paul converted in Athens.[41] His writings, which date from some time between the second half of the second century and the beginning of the sixth, had an immense authority because of his assumed closeness to the origins of Christianity, and to its founder, Paul, and Dionysius played the same role in Franciscan philosophy, from Bonaventure onwards, that Aristotle played in that of the Dominicans.[42] Dionysius was the author of *Coelistis Hierarchia* and *Ecclesiastica Hierarchia*, in which an extremely elaborate hierarchy of heavenly and terrestrial beings was set out. The hierarchy worked via degrees of illumination deriving from God himself—the creation of the world was explicitly identified with the appearance of light in the darkness, with the emergence of a spatial universe from a purely spiritual one[43]—and physical illumination and spiritual enlightenment were effectively identified. The basic distinction was between the intelligible realm and the visible realm, and one of Dionysius' aims was to show how the intelligible is veiled in the visible and how it can be unveiled through illumination.[44] To study light on this view, was to study the emanations of God.[45]

Grosseteste's Dionysian 'metaphysics of light', in which light was the substance underlying all physical change in the cosmos, provided a rationale for the study of optics, a rationale supplemented with a new element in the attempt of the Franciscan Roger Bacon to elucidate theological truths in terms of light metaphors. His *Opus Maius* (1267) takes its starting point from the phrase 'Guard us, O Lord, as the pupil of thine eye.' This phrase, he argued, like many others in the Bible, cannot properly be understood without a knowledge of how the mechanism of 'corporeal' vision corresponds to physical enlightenment, and he
p. 98 proceeded to construct an analogical ↳ account of epistemology in which God has direct spiritual vision, angels have refracted spiritual vision, and human beings have reflected spiritual vision, that is, the ability to see spiritual truths as they are mirrored in earthly creation.[46] The theme was developed further in the Platonic revival, with Ficino devoting a short treatise, *De sole et lumine* (1493),[47] to the question of the relation between corporeal and incorporeal light. This is the context in which we need to examine Patrizi's

use of light metaphors, for, eccentric as it might first seem, these are not unprecedented, and in fact have a substantial Neoplatonic tradition behind them.

The first part of *Nova de universis philosophia*, entitled *Panaugia* ('all-splendour'), treats an incorporeal correlate of light as an intermediary between the spiritual and the material levels of being, and is devoted to exploring the physical and metaphysical properties of light, and by extension, its incorporeal analogue. Knowledge of the properties and behaviour of physical light is the key to knowledge of the properties and behaviour of its incorporeal analogue, and this incorporeal analogue is what links God to his creation. Corporeal light is taken in a very broad sense here, and Patrizi's discussion is as concerned with its life-giving qualities as much as with optics. It also has a cosmological aspect, for outside the visible universe lies the empyrean (the place of the saints in the Christian cosmos), which is an infinite region of pure light. This light is corporeal but derives from incorporeal, divine things—namely souls, intellects, angels, and God, although God is the ultimate source of incorporeal and, by extension, corporeal light. At this point (Book 10), the *lux*/*lumen* distinction is given an explicitly incorporeal reading, as we are told that God, as the *lux prima*, is the source of incorporeal light—a view that goes back to one of the earliest Christian cosmologies, that of Basil in the fourth century[48]—and from him proceeds *lumen*, diffused light, which is found first in his Son, and then in incorporeal creatures. Light, in its incorporeal version, serves not simply to unify the cosmos throughout each level of being, but to secure the immediacy of divine action at each level. This unity prepares the way for the metaphysics set out in the second part, *Panarchia* (all the principles), in which we are given a detailed account of the hierarchy of being, drawing on Plotinus, Proclus, and Ficino, and adding an extra level of being—form—between Ficino's qualities and matter. One of the more novel innovations of Patrizi's treatment here is his rejection of Plotinus' transcendent God and a move to an immanent God who includes all things and is not separate from his creation. As we shall see, this kind of immanent view, which comes close to pantheism, will be singled out by Mersenne as indicative of the dangers of this whole programme. The dangers are especially apparent in one of the linchpins of Patrizi's approach, indeed one of the linchpins of his view of the integrated structure of the universe, namely the world soul, which takes on a number of roles that might traditionally have been reserved for the supernatural, and Part 3 is devoted to an account of how the relation of the ↳ world soul to the cosmos as a whole is analogous to that of the relation between the individual soul and the body.

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In the final part of *Nova de universis philosophia*, suitably named *Pancosmia* (all the cosmos), Patrizi introduces the four fundamental principles of the physical world: space, light, heat, and fluidity or humid air.[49] His treatment of space mirrors the analogies between the corporeal and the incorporeal that dominated Part 1. In Books 1 to 3, he sets out how incorporeal space gives rise to corporeal space. The former is the space of geometry, and contains points rather than bodies, the distinctive feature of which is that they exhibit resistance. How exactly incorporeal space can 'give rise' to corporeal space is not spelled out, but the process seems like one of creation rather than straightforward causation. The first thing to fill corporeal space, however, is, in deference to Genesis, not matter but light (Book 4). Indeed it is light that initially gives rise to the corporeal world, for a formal and active principle, namely heat, derives from light, and in combination with a passive and material principle, fluidity, material bodies are formed with different degrees of density, depending on the combination of heat and fluidity. Having established this theory of the constitution of matter, Patrizi can move finally to the large-scale structure of the cosmos in terms of the kinds of corporeal and incorporeal constituents that make up the three layers: the empyrean, the region that lies beyond the stars and is filled with light (Book 9), the ether, which fills the region between the stars and the moon and through which they move (Book 10), and the sublunary realm. Patrizi's treatment of the ethereal realm was of some influence because he rejected the idea that the celestial bodies were carried around on crystalline orbs and instead postulated a fluid medium, the ether, in which they moved[50]—they 'fly within a liquid sky'—and he explained the diurnal motion of the earth in terms of its movement from west to east, rather than in terms of the motion of the celestial orb from east to west. It is worth noting, however, that the rejection of the crystalline orbs was not based on optical or astronomical evidence. Jean

Péna had argued in 1557 that crystalline orbs would produce anomalous refractions of the light from celestial bodies and that the orbs must therefore be treated as abstractions,[51] and Tycho Brahe had rejected their existence as being incompatible with the path of the comet observed in 1577, as well as with the appearance of a new star in 1572. Patrizi, however, was oblivious to such considerations. In Patrizi's system,
p. 100 it is the nature of matter that determines cosmological structure, and if the basic ↳ building blocks of our universe at the superlunary level are light, heat, and space, then there is simply no material from which crystalline orbs can be formed.[52]

Patrizi's cosmological ideas were not without influence with his contemporaries and immediate successors. Gassendi explicitly acknowledged his indebtedness to Patrizi on the question of the nature of space, for example,[53] and Bacon's cosmology was very much in the tradition of speculative cosmology and derived celestial motions from matter theory,[54] and the scheme he set out owed a good deal to Patrizi.[55] Kepler, by contrast, although he considered Patrizi as the founder of a cosmological system—while at the same time implicitly accusing him of seeking novelty for its own sake[56]—singled him out for criticism in the *Apologia pro Tychone contra Ursum* for his rejection of astronomical hypotheses, something that was consonant with Patrizi's reliance on a general theory of matter to provide the groundwork for an investigation of the structure of the cosmos. Kepler's approach was manifestly very different from this, as his criticism of Patrizi made clear. Patrizi, he tells us,

> is infuriated with astronomers for attempting to construct the apparent motions of the planets from the various circles and solid orbs and to impute to the nature of things those circles, those hypotheses, figments of their own minds. He himself asserts this about the planets. They move amongst the fixed stars in the liquid ether exactly as they appear to, free from the fetters of solid orbs, which do not exist. And exactly as appears to our eyes they truly describe with non-uniform motions spirals and lines variously contorted back and forth, never exactly repeating themselves. Nor ought we to be surprised by this diversity, because the planets are in truth animals with the faculty of reason—a view he supports with the authority of pagan philosophy—and it would not have been impossible for the divine omnipotence to create creatures with enough wisdom to perform those ordained motions until the end of the world.[57]

As we shall see below, there are Platonic elements in Kepler's systematic astronomy, but they function in a very different way from anything we find in Patrizi. Rather than astronomy and cosmology being shaped around the matter theory that issues from a Neoplatonic metaphysics, for Kepler it is the former that do the work: any metaphysics must be accommodated to them. For Patrizi, who does not hide his contempt for astronomers in *Nova de universis philosophia*, this is to get things completely the wrong way around. Instead
p. 101 of asking how the cosmos is structured and what it is ↳ made from, and then proceeding to investigate how and why its constituents move in the way that they do, they carry out observations and calculations and devise ridiculous hypotheses to account for them. He accuses Copernicus and (unaccountably) Tycho, for example, of thinking of the stars as being fixed to the heavens like knots or nails in a plank,[58] whereas, he believes, it is clear from reflection on the ultimate constituents of the material from which the region between the stars and the moon is constructed that they must be moving through a fluid. If scholasticism, by comparison with Patrizi's system, could only come up with a piecemeal account of cosmology, the astronomers are even worse, giving priority to observational minutiae and devising geometrically motivated hypotheses which are oblivious to any understanding of the large-scale physical structure of the cosmos.

In 1592, Pope Clement VIII called Patrizi to Rome as Professor of Platonic Philosophy at La Sapienza University, where he lectured on the *Timaeus*. But his call for his system to replace the Christianized Aristotelianism of the scholastics came to nothing, as it met the fate awaiting any novel comprehensive

system. The Inquisition found it contained a number of doctrinal errors, and it was placed on the *Index expurgatorius*, along with many of the texts whose orthodoxy it had questioned.[59]

Naturalism and the Scope of Natural Philosophy

Heterodoxy was not by any means the preserve of Neoplatonism in the sixteenth century. A far more significant generator of heterodoxy was a form of Aristotelianism, associated principally with the University of Padua, in which Pomponazzi was a leading figure. In the late fifteenth and early sixteenth centuries there was a revival of interest in Averroes in the northern Italian Universities, accompanied by a spate of translations of his Aristotle commentaries.[60] The term 'Averroism' is generally used to pick out two distinct doctrines held by Averroes. One is a doctrine about the autonomy of natural philosophy, the other a distinctive natural-philosophical doctrine about the fate of the soul when it leaves the body at death, namely the doctrine of the unity of the intellect. The doctrines are connected indirectly, but crucially. That of the unity of the intellect is clearly contrary to orthodox Christian teaching, and hence was held to be untrue, yet because it is a natural-philosophical doctrine, and not a theological one, its natural-philosophical credentials were not necessarily undermined by this. Its natural-philosophical inadequacy could be demonstrated only in natural-philosophical terms, and the real dilemmas arise when no natural-
p. 102 philosophical inadequacy can be shown. These problems come to a ↳ head in Pomponazzi, and it is clear from the beginning that there are really two connected basic determinants. One is the purview of natural philosophy, the other is its autonomy. Pomponazzi pushes natural-philosophical explanation into areas where it would traditionally have been thought inappropriate: in particular, into areas in which effects seem to be produced via divine or supernatural activity, rather than natural processes. This exacerbates the problems significantly, and forces the question of the autonomy of natural philosophy to the fore.

There was a measure of eclecticism in Pomponazzi's thinking, and he was certainly not free of Stoic and Neoplatonic influences, but his aim was to uncover Aristotle's doctrines, compare them with Church teaching, and try to draw conclusions as to what it was reasonable to hold. He opens the Preface to *De immortalitate* with a request to him from a friend, couched in these terms:

> Beloved teacher, in former days when you were expounding the first book of *De caelo* to us and had come to that place in which Aristotle tries to show by many arguments that the ungenerated and the incorruptible are convertible, you set forth the position of St Thomas Aquinas on the immortality of the soul. Although you were in no doubt that it was true and certain in itself, yet you judged that it is in complete disagreement with what Aristotle says. Therefore, unless it is too much trouble for you, I should very much like to know two things from you. First, leaving aside revelation and miracles, and remaining entirely within natural limits, what do you yourself think in this matter? And, second, what do you judge was Aristotle's opinion on the same question?[61]

Two years later, in 1518, Pomponazzi defended his philosophical conclusions on the grounds that it was his duty to interpret Aristotle and therefore not to deviate from what Aristotle thought.[62] This conservative gloss on his project should not mask the radicalness of what he is proposing: what Pomponazzi does is to open up the whole question of whether Aristotelian natural philosophy—accepted, in its Christianized version, as orthodoxy in the scholastic tradition—can in fact serve in the role of a philosophical foundation for a systematic theology. The credentials of Aristotelian natural philosophy had been secured in the thirteenth century, as we have seen, in its treatment of the Trinity, the nature of Christ, and transubstantiation, but less attention had been devoted to the question of the personal immortality of the soul. If, as Aristotelian natural philosophy required, the soul was the substantial form of the body, how could it survive the death and corruption of the body? Aquinas had dealt with several issues, including Averroist conceptions of the disembodied soul as one in number, but there was little doubt that this was one

area in which the original Platonist conception of the soul as an intermediary between sense perception and the realm of Forms, and having no essential relation to the body, fitted rather more easily with Christian teaching. This had, of course, been the thrust of the attack on Aristotle by Ficino.

What had now happened was that Pomponazzi had unravelled a little of the careful work done by Aquinas,
p. 103 and in the course of opposing both Neoplatonist and ↳ Averroist accounts of the soul he had treated them purely in philosophical terms, only to find that, in purely philosophical terms, the conclusion drawn was at variance with Aquinas' Aristotelian defence of Christian teaching on the issue. Aquinas had separated lower functions of the soul, such as growth and sense perception, which he considered do indeed end with the death and corruption of the body, from higher cognitive and intellective functions, which do not. But it is crucial on his Aristotelian account that, for human beings, the activities characteristic of the higher functions, in particular the grasp of universals, must start from sense perception, that is, from something intrinsically corporeal. In particular, all knowledge works from sensory images. In advocating this doctrine, however, Aquinas distinguished between the kind of intuitive grasp of truth characteristic of the intellect, and the reasoning processes that underlie and accompany sensation. All knowledge starts from sensation, but once the intellect is engaged and has done the work of abstraction, sensory images are no longer needed.[63] This is where Pomponazzi's difficulties with the Thomist account began, for the idea of a form of cognition that does not involve a representation of the object cognized is just not cognition for Pomponazzi, and the representation can hardly be pure form for no Aristotelian account of cognition could countenance pure forms. Consequently, the mind cannot act in cognition without corporeal representations, that is, without the body. As Pomponazzi realised, this left the question of immortality wide open:

> keeping the saner view, we must say that the question of the immortality of the soul is a neutral problem, like that of the eternity of the world. For it seems to me that no natural reasons can be brought forth proving that the soul is immortal, and still less any proving that the soul is mortal, as very many scholars who hold it immortal declare.[64]

Philosophically, Pomponazzi advocated the view that the soul is the 'highest form'—and it is interesting how even Pomponazzi had to resort to Neoplatonic notions at this point—but philosophy cannot establish its immortality.

The implications of this failure of Aristotelian natural philosophy to supply appropriate philosophical support for a core doctrine go beyond the issue of personal immortality. At the most fundamental level, what is at stake is the failure of Aristotelian natural philosophy to provide a philosophical basis for a systematic theology. By the early to middle decades of the sixteenth century, such a failure had become deeply problematic, because the need for a philosophical basis was greater than ever, and the need for it to take the form of Aristotelian natural philosophy was also greater than ever. The magnitude and ramifications of the failure are evident on the issue of transubstantiation, and the radical nature of the responses to the failure is evident in the rise of naturalism.

In Anselm's elaboration of a systematic theology, particularly in his *Cur Deus Homo*, the eucharist had been
p. 104 raised to the primary sacrament: it was the only ↳ occasion in which one was in the real presence of the crucified Christ. This view became central to the Western church (as opposed to the Eastern church, for which the crucifixion had no significance apart from the resurrection).[65] This understanding of the eucharist turned on the question of transubstantiation, which became the issue on which everything hinged in the theological disputes of the 1520s onwards. On it rested the whole question of an ecclesiastical hierarchy, the central issue at stake in the Protestant break with Catholicism. While the Catholics insisted on the need for a priesthood and a clerical hierarchy, Luther rejected the notion that the spiritual estate was superior to the temporal estates, the aristocracy and the laity, regarding the clerical office as one calling among others: all vocations, on this view, were equally spiritual (something crucial for the development of physico-theology, as we shall see in the next chapter). Levi has noted that Catholic theologians in the 1520s

were well aware that baptism could be conferred by anyone, that sins could be forgiven in the case of genuine contrition without priestly forgiveness, and that marriage partners conferred the sacrament on one another. Consequently, as he points out, without transubstantiation,

> there was no need for a hierarchical priesthood validly empowered to celebrate the mass, and without the church's need for a hierarchical priesthood, it would have been difficult to establish the need for any hierarchy consisting of more than administrative officers. . . . In the west, after the nation states had assumed responsibility for civil administration, only the unbroken apostolic continuity of a sacramental priesthood, founded by Jesus in his lifetime and essential for the valid transformation of the eucharistic elements in the central act of worship, made the hierarchical church necessary.[66]

Transubstantiation was a doctrine that had traditionally been formulated and defended in Aristotelian terms,[67] and it would seem that it is impossible to capture the doctrine in a satisfactory way in any other philosophical terms.[68] Never was the defence of Aristotelianism, both in its own right and in terms of its credentials as a foundation for a systematic theology, so necessary, yet it no longer seemed that these roles were reconcilable. More generally, the questions now had to be raised, first, whether it was at all viable to think one could provide philosophical foundations for theology at all, something fideists were to deny; second, if it were viable, whether a philosophy completely different from Aristotle's might fit the bill, as Gassendi, for example, will suggest in his efforts to revive ancient atomism; or, third, whether, instead of trying to shape one's natural-philosophical foundations to a pre-given theology, one might explore the
p. 105 consequences of one's natural philosophy and (within limits) develop a ↳ natural theology on this basis, something we begin to find in seventeenth-century English natural philosophy.

The question whether Aristotelian natural philosophy provides a satisfactory basis for Christian doctrine prompts the question whether this is an appropriate test of the adequacy of a natural philosophy. The attacks on the doctrine of ‘double truth’ had centred on the idea that natural philosophy and Christian teaching had provided different competing accounts, but there was a further question, whether particular phenomena had been mischaracterized as being supernatural and hence falling under Christian teaching, or whether they were in fact matters more appropriately explained in natural-philosophical terms.[69] We can find evidence of this line of reasoning in two posthumously published treatises by Pomponazzi, *De incantationibus* and *De fato*, both written around 1520.[70] *De incantationibus* deals with a range of phenomena that had traditionally been construed in terms of supernatural causation, arguing that these phenomena had been mischaracterized, that they were in effect wholly explicable in natural terms. In the process he excludes not only explanations in terms of demons and spirits, but also those in terms of miracles. His natural explanations depend on two distinctive features: the importance of planetary influences and what we might describe as the psychological state of the subject of these phenomena. The former, as the first two books of *De fato* make clear, is part of a thoroughgoing form of physical determinism of a Stoic kind, and indeed the traditional arguments against astrology had focused on its perceived determinism. The latter suggests that any devotional and miraculous phenomena can be explained naturalistically through the action of material spirits produced by or accompanying particular psychological states.

Pomponazzi is not carving out completely new ground here, for Ficino had paved the way in his holistic spiritual magic, in which astrological and psychological explanations are employed to provide non-supernatural accounts of questions that had traditionally been thought to be outside the realm of natural explanation.[71] Ficino's motivation and that of Pomponazzi differ radically, however. Ficino's aim was the construction of a transcendental Platonic system, Pomponazzi's is the elaboration of a naturalist Aristotelian one. What Pomponazzi effectively does is to begin to reformulate and expand the domain of natural philosophy by questioning the extent to which it is ever in need of supplementation by supernatural explanations, even in cases of miraculous apparitions and prayer. In the case of prayer, for example, he

distinguishes two aims: obtaining some external benefit and making oneself more pious. Because God's will
p. 106 has been immutably fixed from eternity and ↳ guides the movement of the heavens, prayer is unable to alter these. However, prayer does indeed make us more pious, and can be effective if the prayers

> come from the depths of the heart and be fervent; for thus are the spirits more strongly affected and more powerful in their effect on matter—not in order that they may prevail upon the intelligences [viz. the powers that move the celestial spheres] (for these are entirely immutable), but in order that they may be more moved.[72]

What we have here is a combination of the psychological reduction of prayer, plus a theory of the material effects of psychological states whereby psychological states of sufficient intensity make the subject of the state more receptive to various kinds of spiritual influence. Even more radical, his psychological reduction of prayer is matched by an implicit astrological account of the success of Christianity, whereby the stars were favourable to the growth of Christianity at the time it developed by giving power to its symbols (such as the name of Jesus and the sign of the cross) to produce miracles so that Christianity might spread,[73] but this is something distinctive of the era, and an era that produced other planetary conjunctions might not be one in which Christianity would have flourished. Of course, it is God who, in His providential wisdom, produces the sequence of planetary conjunctions in the first place, so it is He who makes these conducive to the spread of Christianity through the efficacy of its symbols, but the efficacy of the Christian symbols is something natural, not supernatural, and is to be understood in terms of a combination of psychological states producing material effects through their release or rearrangement of spirits, and particular conjunctions of celestial bodies producing the material medium in which these spirits act.

The philosophical resources that Pomponazzi employed were eclectic, but his motivation derived from a particular naturalistic construal of Aristotle, and he sought to ground his project in Aristotelianism. There were more thoroughgoing forms of naturalism than that of Aristotle, however, and the kind of naturalist project that Pomponazzi advocated was subsequently pursued with more tailored resources. From among the host of naturalist writings that appeared from the mid- to the late sixteenth century—whose authors included figures such as Cardano, Paracelsus, Fracastro, Servetus, Stellato, Porzio, and Campanella—I shall take the work of Telesio and Bruno as representative. Both followed the programme of pushing natural philosophy in a naturalistic direction and both undermined the boundary between the natural and the supernatural. Rejecting the kind of commitment to Aristotle that we find in Pomponazzi, however, they made free use of Presocratic and Hellenistic natural philosophy, mixing it with elements taken from Neoplatonism and Aristotelianism as they saw fit.

The natural philosophy of antiquity was concerned with the problem of change. Parmenides had denied that knowledge of something that was changing was possible, and since nature is constantly changing, this
p. 107 meant that knowledge of nature is ↳ impossible. Plato responded to this problem by positing a world of unchanging Forms beyond the sensible realm of nature. Accepting Parmenides' dictum, he argued that the real objects of knowledge are the Forms, of which nature is merely an imperfect copy. What one must aim to know is the unchanging prototype, not the changing copy. Aristotle countered with the argument that the Forms did not constitute a realm separate from that of the sensible world, but rather underlay the sensible world. The form of something was actually part of it, just like its matter. Indeed, it was even more a part of it, since it constituted its essence. But, as Aristotle's Hellenistic successors realized, he never completely shook off his Platonic and Parmenidean legacy.[74] His thought still had room for a transcendental God who was linked in its activity with the system's only other transcendental being, the human intellect. Although in the first two books of *De anima* Aristotle had defined, described, and analysed the human soul in terms of its functioning in a natural relationship with the body, elsewhere he hinted that it might be immortal and separable from the body. This ambivalence did not survive Aristotle long, however. At about the time that

Plato's successors in the Academy were discarding the Forms, their contemporaries in the Lyceum were purging Aristotelianism of any supernatural elements.

The cosmos of Zeno of Citium, the founder of Stoicism, was essentially that of Aristotle cleansed of its last traces of transcendentalism, and pushed even further back towards the dynamism of the pre-Parmenidean philosophers. Despite the fact that Aristotle had relocated the Platonic forms within material beings, they were still forms, principles of structure. By contrast, all vestiges of forms are gone from Zeno. He saw both being in general and the universe of individual beings as an immense physical organism and so was led by the analogy with living beings to an internal principle that had already been discussed in fifth-century medical circles, the *pneuma* or vital spirit. For both Plato and Aristotle the human soul was one of the transcendentals, in whole or in part capable of escaping the body and so enjoying immortality. The Stoics conceded that people were different from animals, but only in degree, not in kind. The human soul was like that in animals in that it was nothing more than a certain tension in the pneumatic system of the organism, and death was in effect simply a dissolution of the system. More generally, the Stoics offered a biological model of the universe which suggested that the cosmic system was controlled, that the control was rational, as in human beings, and that there was a close connection between corporeal, psychic, and ethical functions in both human beings and the universe. In other words, their naturalism is a decidedly holistic naturalism.

The other great natural philosophy of the Hellenistic era, Epicurean atomism, was similarly naturalistic. For Plato, unchanging reality lay beyond the sensible changing world, whereas for Aristotle it lay behind this sensible world. Epicurus takes the view that unchanging reality lies in the world, at the microscopic level.
p. 108 There is a level of the sensible world itself which provides a reference point for understanding ↳ its changes. Moreover, although not overtly holist in the way that Stoicism is, Epicureanism fostered a view of the cosmos as an interconnected whole, in which ethics, logic, and natural philosophy have interrelated places.

Stoicism and Epicureanism were assimilated to some extent in the sixteenth century,[75] and if we think of their characteristic features not in terms of whether they see the world at the most fundamental level as compromising atoms and empty space, or a continuum, but in terms of their relation to Platonism and the more transcendent readings of Aristotle, then we can perhaps see how the typically naturalistic Hellenistic philosophies might be contrasted with the more typically dualist philosophies of classical antiquity.[76] But if the contrast is that between transcendence and naturalism, then we must not only include those Aristotelians who offered a naturalistic reading of Aristotle, such as Pomponazzi, but also recognize that the Neoplatonic doctrine of the world soul might be, and was, assimilated to the naturalist cause, despite the fact that its origins lay in the idea that such a soul was needed to unite a wholly transcendent God with the natural world.[77]

While both Stoics and Epicureans were naturalists in a broad sense, their positions differ in a way that is significant for sixteenth- and seventeenth-century natural philosophy, in that the Epicureans conceived of the fundamental constituents of the world as being inert corpuscles, whereas Stoic holism and the tendency to model the cosmos on analogy with a living organism precludes any constituents being called inert. There is an important division for our purposes between a programme of reduction of the natural world to inert atoms, and a programme that sees the ultimate constituents of the natural world in terms of immanent powers or principles. I propose to reserve the term ‘corpuscularianism’ for the former and ‘naturalism’ for the latter.[78] Corpuscularianism, which plays very little role in the sixteenth century but a dominant one in the seventeenth, takes a variety of forms, depending on whether those properties of the corpuscles that do
p. 109 the explanatory work are restricted ↳ to mechanical properties such as speed/velocity and size/weight (as in Beeckman), or whether they have macroscopically modelled properties such as shape, which are invoked in explaining macroscopic effects such as taste, as in traditional Epicureanism (a tradition Gassendi follows to some extent). There is also the question of whether such corpuscularian conceptions subsume the mental and the supernatural under the natural realm, that is, whether a fully reductionist corpuscularianism is

being advocated. Hobbes, for example, was accused of this, and some of his followers, such as Margaret Cavendish[79], as well as the Leveller Richard Overton[80] and John Milton,[81] may have advocated a particularly strong form of reductionism, but this kind of reductionism was very rare, if it really existed at all, before the eighteenth century.[82]

In the case of naturalism properly speaking, we find parallel considerations, although the situation is more complicated. There are varieties of naturalism depending on whether the primary motivation is naturalistic Aristotelianism, Stoicism, or some form of Epicureanism, but whereas Pomponazzi and Nifo, for example, were explicitly taking their bearings from an Aristotelian understanding of natural processes,[83] the distinctions are often difficult to make, and natural philosophers such as Telesio and Bruno are far harder to characterize. Moreover, whereas a reductionist programme is rarely pressed beyond physical phenomena by corpuscularians (Descartes' account of *bêtes machines* being the most famous exception), naturalism can offer a far more plausible reductionist programme in this regard: the problem of the nature of soul being a case in point, as naturalized Aristotelianism has the resources to provide a sophisticated account of this in purely natural-philosophical terms. But the problems are compounded by the assimilation of what had been traditionally considered to be supernatural phenomena to the natural realm. The driving force behind such
p. 110 assimilation was the postulation of immanent ↳ powers or principles. Such powers and principles came in a range of strengths, as it were, starting from Aristotelian potentialities and being gradually reinforced by Stoic and Neoplatonic additions. The doctrine of the world soul was of great significance in the latter. Although there was nothing heterodox in the doctrine itself—it was a traditional doctrine, ascribed to by Augustine, for example—as an immanent principle it could be credited with a great deal of responsibility for the regulation of terrestrial events, and given the extreme transcendence of the Neoplatonic God (compared to the Christian God), it had been given a great deal to do in the regulation of natural events in writers such as Plotinus. The danger it posed to orthodoxy was that, in the hands of natural philosophers such as Telesio and Bruno, it both contracted the realm of those phenomena requiring supernatural explanation, and at the same time blurred the distinction between the natural and the supernatural.

Telesio provided the first significant version of the naturalist project with tailored resources, thereby moving from the question whether Neoplatonism or Aristotelianism can provide the resources for a thoroughgoing naturalism, to that of how we might build up the resources for a thoroughgoing naturalism from scratch.[84] The natural philosophy on which Telesio chose to ground his project proved to be influential in the late sixteenth century, not least for Bacon, but even more important was the general approach of setting one's natural-philosophical aims and then seeking the natural philosophy that best realized those aims, for it is in this way that various corpuscularian natural philosophies would be established in the seventeenth century.

Telesio offered a natural philosophy based on Presocratic and Stoic sources, stripped down to its bare essentials. In his *De rerum natura*, the first two books of which appeared in 1565,[85] he begins by eschewing any natural-philosophical assumptions, starting from sense experience. The reader is warned not to expect any philosophical subtlety from his account, for the work follows nothing, he tells us, but our observations, sense experience, and natural powers.[86] This is not a statement of empiricism in any modern sense: Telesio's account is as speculative as that of any of his Aristotelian or Platonist contemporaries. Rather, although he accuses Aristotle's system of being at variance with sensation and with scripture, I suggest we take the claim as indicating that he is not concerned to reconcile natural philosophy with Christian doctrine, via metaphysical or any other means, but will rather pursue it as an autonomous discipline—'from its own principles' (*iuxta propria principia*) as the full title of the work tells us—just as it was pursued in antiquity. Moreover, he construes natural philosophy as having a very wide purview: Telesio's default position is, in effect, that something needs a supernatural explanation only when it has been established that it cannot be explained naturally.

p. 111 Telesio's naturalism does away not only with Platonic dualism, but even with the residual dualism of Aristotle,[87] offering a single pair of principles, hot and cold. Just as philosophy began in the West with speculation on the basic elements or 'principles' (*archai*) of the physical world—water (Thales), air (Anaximenes), fire (Heraclitus)—so we find a return to basic elements or principles in those sixteenth-century thinkers seeking to lay new foundations for natural philosophy. Some reduce the number of fundamental elements or principles—Cardano dispenses with the element of fire for example—and some add to them—the alchemical tradition, followed by Paracelsus for example, added sulphur and mercury. What is at issue here are basic 'principles', designated by the names of common substances it is true, but it is not a matter of simply choosing common substances and designating them as elementary. Nevertheless there is some obscurity in Telesio's account as to the standing of these basic principles of hot and cold. On the one hand, they are imposed on a 'receptive nature', which is in effect a propertyless substratum, much like Aristotle's prime matter or the 'receptacle' of Plato's *Timeaus*, and so are analogous to the imposition of form on matter, but on the other hand he describes the action of heat and cold as dilating and contracting matter, which suggests that the principles vary the properties of matter rather than providing them with properties in the first place. Still, what Telesio is rejecting is clear: Aristotelian forms are supposedly already always there in matter in a potential form, but Telesio finds this incompatible with the generation and corruption of properties in matter. Whatever the exact way in which heat and cold act on matter, the principal effect is to determine their state of motion or rest, and this plays a crucial role in his cosmology, in the theory that the coldness of the earth is the cause of its immobility, whereas the great heat of the sun causes its rapid motion through the heavens.[88]

Everything is explained in terms of the contrast between hot and cold, not least sentience, which Telesio ascribes to everything in one degree or another. This is because everything strives to conserve itself and in order to do this it must be able to distinguish those things that help preserve it from those that threaten it (Book 7). The ability of things to make such distinctions is due to the fact that they possess *spiritus*, a subtle fluid with Hellenistic precedents in the Epicurean *anima* and the Stoic *pneuma*, as well as in the spirits postulated by physicians,[89] which is enclosed within the body: it is akin to Aristotelian forms except that it is a separate material substance rather than an immaterial principle. *Spiritus* is acted upon by external things
p. 112 and undergoes a physical change as a result, and this is how Telesio accounts for sensation, ↳ although the only change possible in *spiritus* is expansion or contraction. At this point (Book 8), Telesio extends his discussion to the vexed question of universals and abstractive knowledge. In sensation, he maintains, *spiritus* is able to perceive things as being either the same or different, and it is able to compare these things with what is stored in the memory: similarity as perceived by the senses is, in this way, the basis of all knowledge, even geometry, and this is something we share with animals.

Telesio recognizes only one limit or exception to the explanatory power of the principles of hot and cold. Were these the only principles, he tells us (Book 5, ch. 2), we would expect human beings, like everything else in the universe, to strive only for self-preservation. But human beings are always anxiously, restlessly, looking for something beyond mere self-preservation and pleasure: they look for useless knowledge, for God, for eternity, and for this we must introduce a higher soul, which is transcendent and immortal.

There are striking parallels with Pomponazzi here. There is nothing in Pomponazzi or Telesio to suggest that their commitment to the immortality of the soul was disingenuous, advocated only because of worries about orthodoxy. The consideration of human aspirations that Telesio appeals to, and which he finds to be incompatible with a purely corporeal *spiritus*, is one that Pomponazzi would certainly have shared. And their concerns are perfectly reasonable and acceptable, so long as one thinks that an account of the nature of the mind is the relevant domain of explanation in accounting for these phenomena. It is on this last point that I think they are profoundly mistaken, and the project a doomed one. A hundred years later Spinoza will spell out a form of naturalism highly reminiscent of Telesio's, but in which a radically different kind of monism is offered, one that is able to raise questions of moral, aesthetic, religious, and other forms of intellectual

aspiration in a way that does not construe the relevant question as being whether these are to be explained by something material or whether they require the postulation of an immaterial soul. But for Pomponazzi and Telesio this is precisely the question, and it is irresolvable: just as Pomponazzi, at the end of *De immortalitate*, advocates the view, reminiscent of Platonism, that the soul is the 'highest form', so Telesio finds himself obliged to go beyond *spiritus* to account for certain aspects of human behaviour.

But just as Pomponazzi, whatever his qualms about what Aristotelian natural philosophy can tell us about the human soul, pushes the claims of naturalistic explanation into realms which had previously been the preserve of religion, so Telesio, whatever his qualms about what his own monist natural philosophy can tell us about the human soul, pushes his naturalism into very contentious areas. In Book 8 of *De rerum natura*, for example, he applies his basic principles of hot and cold to moral psychology, maintaining that differences in moral character arise from differences in people's *spiritus* with respect to warmth, purity, and subtlety (chs. 35–6). In spite of Telesio's commitment to free will, he makes it clear that our passions and emotions simply reflect the changes to which our *spiritus* is exposed: moderate emotions constitute virtue because they are conducive to the conservation of *spiritus*, whereas immoderate ones correspond to harmful impulses (Book 9, ch. 3).

p. 113 Pomponazzi and Telesio, in different ways, pursue the theme of the autonomy of natural philosophy, and this is in part what drives the naturalist programme, but the thinker who really brings out how radical the naturalist programme is, and how radical the claim of the autonomy of natural philosophy can be, is Bruno. Although Bruno attacks Patrizi ('pedant scum') for substituting one useless system for another and praises Telesio in his *De una causa*,[90] his programme is, in its sheer ambition, more a development of Patrizi than Telesio, taking over Patrizi's Neoplatonist holism and transforming it into a thoroughgoing pantheism. The move is the archetypical naturalist one in which the domain of natural-philosophical explanation is extended into areas traditionally thought to require divine or supernatural explanation. The distinctive feature of Bruno's account is that his extension of the scope of natural philosophy effectively means there is nothing that natural-philosophical reflection cannot explain. The charges against him laid by the Venetian and Roman Inquisitors included: heterodox views on the Trinity, the divinity of Christ and the Incarnation, on Jesus' life and death, on transubstantiation and the mass, on the virginity of Mary, on hell, on Cain and Abel, on prayer to the saints, on holy relics, and on metempsychosis; and that he asserted the eternity of the universe and the existence of a plurality of worlds similar to our own, that he asserted that the earth is animate and possesses a rational soul, that the Holy Spirit can be identified with the world soul, that human beings existed prior to Adam, that he depicted the pope as a pig in his *Cantus Ciraeus*; and that he questioned the doctrine of the immortality of the soul, and asserted that the earth moves.[91] Bruno rejected many of these charges (that of denying Mary's virginity for example) as false, and maintained that others (such as the doctrine of the Trinity) were private worries that he had not espoused publicly, but many others had a textual basis in his writings. And although Bruno had studied theology,[92] much of the basis for his arguments seems to depend on natural-philosophical questions, although his Neoplatonically inspired synthesis meshes natural-philosophical, metaphysical, and theological questions in a way that makes separation difficult, and there can be no doubt that he regarded Christianity as a corruption of an earlier undefiled religion, which he associated with Hermes Trismegistus.[93] Nevertheless, Bruno makes it clear at the beginning of his *De triplici minimo* that all philosophical questions—and this is very much an all-inclusive category—must be decided by the light of reason.[94]

p. 114 Bruno had a great interest in Lull, and it was for his development of Lull's 'art of memory' that he initially gained fame.[95] His interest in the causes of religious wars led him to investigate the origin of theological disputes, and like Lull before him, to offer something that would put an end to them. Whereas Lull offered something that was designed to secure Christian orthodoxy, however, Bruno's holistic, animistic, magical, and pantheist metaphysics effectively lost contact with Christianity from an early stage. Bruno's holism

derived from a core thesis of his metaphysics, namely that substance is both unitary and divine. He set out the essentials of this doctrine in *De la causa* in these terms:

> Have we not seen that the Peripatetics, like the Platonists, divide substance by the specific difference of corporeal and incorporeal? Just as these specific differences are reduced to the potency of a single genus, so the forms must be of two kinds: some are transcendent, that is, higher than genus, and are called principles, such as 'entity', 'unity', 'one', 'thing', 'something', and their like; other forms belong to a given insofar as it is distinct from another genus, such as 'substantiality' and 'accidentality'. The forms of the first sort do not distinguish matter or make matter here one thing, there another, but, as absolutely universal terms embracing corporeal as well as incorporeal substances, they signify the absolutely universal, absolutely common and undivided matter of both. . . . Again, if everything that exists (beginning with the supreme and sovereign being) possesses a certain order and constitutes a hierarchy, a ladder where one climbs from the composite to the simple things, and from those to the most simple and absolute things, by means of proportional and copulative middle terms which participate in the nature of the one and the other extreme, yet possess their own, independent value, there is no order which does not involve a certain participation, nor participation which does not involve a certain union, nor union which does not involve a certain participation. It is therefore necessary that there be a single principle of subsistence for all existing things.[96]

Bruno draws both metaphysical and cosmological conclusions from his conception of substance. Metaphysically, he conceives of God as being included in the infinite unitary substance that makes up the totality of things—'the universe is in none and all of its parts, which occasions an excellent contemplation of divinity'[97]—and an internal world soul drives changes in this substance so that we have something more like an internally generated unfolding of events rather than a universe in which independent things interact. Indeed, the world soul is best thought of as an underlying active principle in accord with which things in the universe act, and here it is part of Bruno's polemic against Aristotle that we have to distinguish real changes, which occur as a result of this action, from merely superficial changes in the forms of individual things.

God does not transcend his creation on this picture, if indeed one can speak of creation at all, since he does not create *ex nihilo*—matter is simply absolute possibility or potency, and is coeternal with God, who has to
p. 115 realize himself through his action in ↳ the world. One of the issues that was made clear in Bruno's trial for heresy was that he believed that God needs the material world just as much as it needs him.[98] No mediation, and hence no Christology, was necessary in Bruno's theology. Indeed, in his *Eroici furori*, contemplation of the divine explicitly takes place through the medium of contemplation of nature. This is a view reinforced in his cosmology,[99] which does away with any residual notion of the empyrean, and thus any physical location where God and the blessed might exist. In *La cena de le Ceneri*, the philosopher is led on a journey across the heavens only to discover not only that there are no such things as the crystalline orbs, but that there is no end to the journey as we begin to traverse infinite space. Not only are there other universes or worlds, but each of them is infused with divinity, just as ours is.

After Bruno, the naturalist tradition collapsed in natural philosophy, not so much because of the dreadful death inflicted upon him by the Roman Inquisition in 1600, but because he cut natural philosophy loose from virtually all its traditional bearings, while offering little more than promissory notes, especially when compared to the newly developing 'physico-mathematical' and corpuscularian movements. His defence of the earth's diurnal motion, for example, was simply that it rotates on its axis in order to partake of the sun's light and heat, and it revolves around the sun so that it can partake in the seasons.[100] This hardly engaged the natural-philosophical or astronomical issues seriously, and could not possibly have furthered the cause of Copernicanism. The threat that Bruno posed lay not in his Copernicanism but the way in which his

naturalism was able to generate or support just about every conceivable heterodoxy. In his 800-page attack on naturalists and others, *L'Impiété des Déistes, Athées et Libertins de ce Temps*, Mersenne considered Bruno to be 'the most dangerous thinker of deists, atheists or free-thinkers', and singled him out for attack, along with Cardano and Charron.[101] The core error of naturalism, on Mersenne's view, is that it blurs the
p. 116 distinction between the natural and the supernatural.[102] ↳ This can result either in a tendency to deny the very existence of the supernatural, as in naturalism proper, or to mistake the natural for the supernatural, as in theories of natural magic. In both cases, the root problem derives from a tendency to see nature as being full of all kinds of powers, and in both cases it results in the truly supernatural being effectively left out of the picture. Naturalism, broadly defined, is the doctrine that the truly supernatural (God alone) does not need to be invoked to explain a whole range of events in which it was traditionally thought to be required. Whether the explanations offered in place of traditional ones are naturalistic or quasi-supernatural was not the key issue for Mersenne: the key issue was the exclusion of the (genuinely) supernatural. This was the characteristic feature of naturalism for him, and it was this that made it a threat to established religion, and hence something to be opposed as strongly as possible.

Late Scholasticism

One of the effects of the failure to reconcile the Eastern and Western Churches in the mid-fifteenth century was a revival of Thomism, which quickly became established as the official philosophy of the Western Church. In this climate, the Neoplatonic revival, which had taken its initial inspiration from thinkers of the Greek Orthodox Church, was not the default position, despite its greater closeness to the Augustinian philosophy that lay at the core of Christian theology. Neoplatonism did raise a number of difficulties for Thomism, however. One particularly pressing difficulty, as we have seen, was the doctrine of personal immortality. Ficino had offered an account of this designed to show how it followed from the fundamental principles of his Neoplatonic metaphysics. Aristotle, by contrast, had offered a naturalistic account of the 'soul' in the first two books of *De anima*, and one more (but not wholly) consonant with Christian teaching in the *Metaphysics* and the third book of *De anima*, and there was dispute among Aristotelians on what the philosophically defensible and consistent position is on what happens to the soul upon the death and corruption of the body. One view, associated with Alexander of Aphrodisias, was that since the soul is defined by Aristotle functionally, as the organizing principle of the body, without the body there can be no soul, so the soul cannot enjoy immortality. Another was the view associated with Averroes, that the soul is not subject to corruption so cannot perish, but it cannot be individuated in separation from the body—it no longer has the sensations, memories, affective states, etc. that make it *my* soul—so, in a disembodied state, we can only talk of one soul or one mind, and this is identical with God, in so far as we conceive of God to be a purely spiritual entity. In other words, we have immortality, but not personal immortality. In contrast with both of these, we have what was by this stage—that is, from the middle of the fifteenth century onwards—the orthodox Thomist position, that the soul is the form of the body and that it enjoys personal immortality.

p. 117 In other words, Aristotelian natural philosophy gave no decisive guidance on this question, which is why the Thomist project of devising a metaphysics that could resolve and unify the differing considerations was needed. And this was indeed the thrust of the Fifth Lateran Council's instruction to philosophers and theologians, as we have seen. But for the opponents of scholasticism, the metaphysics was needed only because of an inherent fragmentation in Christianized Aristotelianism, a fragmentation which they believed reflected a deep flaw in the whole project of Christianized Aristotelianism. It must be remembered that competing philosophies—which by the sixteenth century included not just Neoplatonism but also philosophies based upon Stoicism and Epicureanism—each constituted a total world-view, however philosophically impoverished these world-views might have been by the standards of Aristotelianism. In the case where world-views were at stake, a clear internal consistency, constrained by a clear internal hierarchy,

was of very great significance. Fragmentation was a high price to pay for the great philosophical subtlety and depth that was characteristic of scholastic Aristotelianism in comparison with its competitors.

Late scholasticism offered a concerted response to this problem. The late scholastic textbooks are a bastion of orthodoxy, and we can identify three phases in the movement. The 'first wave' of this textbook tradition, beginning in the work of Francisco Toletus in the 1560s and culminating in the Coimbra commentaries later in the century,[103] was by and large Thomist, at least on the issues that bore crucially on the relation between theology, metaphysics, and natural philosophy, although there are significant elements of Scotism in key commentators such as Suárez. It comprises primarily the textbooks of the Jesuit commentators based at Coimbra, the Jesuit commentators based at the Collegio Romano, and Antonio Rubius, who compiled textbooks both during his twenty-five years in Mexico and then at the Jesuit College at Alcalá. These were the three main sources of Jesuit textbooks in the late sixteenth and early seventeenth centuries, and it is from these that Descartes, for example, learned his philosophy.[104] The second wave of textbooks—such as the *Corps de Philosophie* (1603–10) of Scipion Dupleix, the *Summa philosophiae* (1610) of Eustachius a Sancto Paulo, and the *Totius philosophiae* (1629) of Abra de Raconis—while following the Coimbra commentaries, often to the point of *verbatim* repetition, nevertheless differ from them in a number of crucial respects, and by 1630 had displaced them. They are no longer commentaries on Aristotle but condensations of his thought, which is quite a radical shift of genre.[105] Moreover these condensations laid a far greater emphasis
p. 118 on natural philosophy than the older ↳ commentaries had done.[106] It is also of interest that they are less orthodox, and on the crucial question of our knowledge of God all follow the transcendentalist doctrine of Scotus.[107] Finally, there was a third wave of textbooks, which took the form of a conservative reaction to the Jesuit textbooks, but it was a retreat into dogmatism and, philosophically speaking, an admission of failure, and it never had any impact outside Catholic clerical circles.[108]

The explicit aim of the first wave textbooks was the systematic reconstruction of Aristotle's metaphysics and natural philosophy from first principles, rearranging material in Aristotle as necessary.[109] It should be noted that, despite their general advocacy of Thomism, not only did these commentaries set out to supplant Aquinas but in many ways they were meant to supplant Aristotle as well.[110] They recast the whole Aristotelian tradition with two main aims: to show how the truths of a Christianized Aristotelianism could be derived from first principles, and to show how this was a single, coherent, comprehensive system. The project traded on a traditional feature of Aristotelianism, whereby understanding ultimately took the form of *scientia*. Research or discovery was not part of *scientia* as such, as we have already seen, but rather a prerequisite for *scientia*, which was constituted by the derivation of true and certain conclusions from first principles that were both evident and indemonstrable: that is, neither in need of, nor capable of, further demonstration. *Scientia* is built up and consolidated as more and more conclusions are drawn from the basic principles, and the ultimate aim is a wholly exhaustive and encyclopedic account of theoretical knowledge, that is, knowledge concerned with understanding how things are and why they are as they are.[111]

p. 119 The encyclopedic *scientia* approach set out to meet the requirements of a unified system, something lacking in later scholasticism when compared with Neoplatonism. But in attempting to do this, it failed in a different respect, a respect in which it had previously manifested great strengths. For with systematization came a closing-off of scholasticism to new developments within natural philosophy. The Neoplatonist systems had willingly sacrificed innovation in natural philosophy for an overall hierarchical coherence, above all because, with Ficino, such a coherence had secured and, indeed, guaranteed personal immortality for the soul, an area where Aristotelian natural philosophy had failed to deliver. Neoplatonists had denied any legitimacy to independent natural-philosophical investigation: natural philosophy was ultimately an outcome of the metaphysics that generated an understanding of every aspect of the cosmos, and it was at best a matter of detail. Sixteenth- and early seventeenth-century scholastics were not quite so ambitious, or reckless: for them, the point of the exercise was to show how Aristotelian natural philosophy and a Christian philosophical theology could be reconciled, in the process throwing new light on both domains. What the

controversies over natural philosophy, and particularly over the immortality of the soul, had shown them was that they needed a tighter, more systematic framework within which to achieve these.

Among the problems they encountered in attempting to realize this project, there are two to which I want to draw attention. The first is that the natural philosophy that they were trying to reconcile was no longer something generated internally within scholasticism but increasingly from outside. The second is that the project of reconciliation depended on a Thomist understanding of metaphysics as a bridge between natural philosophy and a Christian philosophical theology, but the Thomist conception was intrinsically problematic, and the late scholastic textbooks in fact move closer and closer to a Scotist conception of metaphysics, which made it completely inappropriate as an instrument of reconciliation.

Up to the sixteenth century, natural philosophy, no matter how unorthodox, had been pursued largely within the confines of scholasticism by scholastics who, whatever qualms they may have had about the details, or even some of the basic assumptions, of Aristotle's natural philosophy, pursued their project within the broadly Aristotelian framework of the kind developed in the thirteenth century. This changed in the course of the sixteenth century, as natural-philosophical developments increasingly fell outside its own control. It was these developments that scholasticism had to reconcile with its Christian philosophical theology, but they were increasingly unable to do this. It is true that not all questions were of this kind, and indeed the most pressing questions identified by the Fifth Lateran Council—the immortality of the soul, the unity of the intellect, and free will—were dealt with in a way that integrated the different kinds of consideration into an amalgam of some philosophical sophistication.[112] But these were areas where the issues were settled in the sense that there was agreement on what exactly had to be established and why it mattered. Once one moved outside this area of consensus, severe problems arose.

The most problematic such area was cosmology, and a particularly pressing question was that of the cause of the rotation of the heavens: were celestial bodies attached to crystalline orbs, or did they move through some kind of fluid matter, an ether? The question turned out to be far from straightforward, however, raising the complex issue of just what had to be reconciled with what in dealing with these kinds of issue. Three potential areas of relevance were: astronomical observations of the motions of celestial bodies, a physical or cosmological theory of the nature of the celestial regions, and revelation. Each of these was problematic. Indeed, even the question of whether reconciliation was needed in the first place was contentious.

The immediate upshot of the defences of heliocentrism by Copernicus and Rheticus was not an upsurge of interest in the natural-philosophical consequences of astronomical systems but a move in the opposite direction, a stress on the autonomy of mathematical models in saving the phenomena.[113] This was reinforced by a view developed in the early sixteenth century by Jacopo Zabarella and Archangelus Mercenarius. In itself the view—that celestial matter and form were completely unlike their terrestrial counter parts—might seem innocuous enough, having been held by Aquinas for example, but Zabarella and Mercanarius were from the Averroist stronghold of Padua, and the distinction between terrestrial and celestial matter in effect rules out any understanding of the cosmos based on natural philosophy, which depends on, and derives from, observation of terrestrial events.[114] The view was developed further by Benito Pereira, a colleague of Clavius at the Collegio Romano. Pereira's most influential and popular work was a commentary on Genesis,[115] which exemplifies the kind of theological cosmogony that concerned him most. Because we have no knowledge of the nature of celestial matter, he argues, astronomers are obliged to employ what he considers to be physical absurdities, such as epicycles and eccentrics. Here mathematical astronomy becomes something like an especially impoverished form of natural philosophy, something not concerned with truth, except that instead of assessing opinions on the strength of arguments, as natural philosophy does, the astronomer is engaged simply in the exercise of how best to save the appearances.[116]

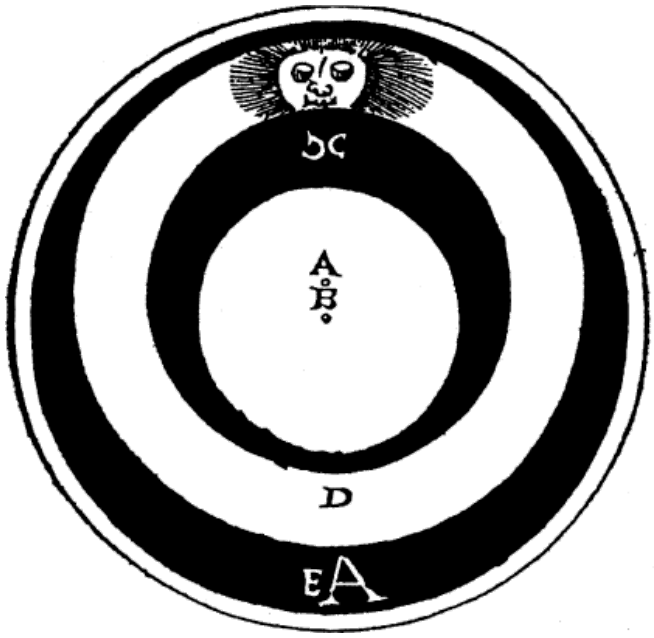
This approach was consonant with Aristotle's view of the relation between physical and mathematical
p. 121 enquiry, even if he would not have drawn exactly the same ↳ conclusions from it. The traditional rationale of astronomy was the construction of tables for the purpose of calculating the positions of celestial objects. It was a mathematical discipline and on the dominant Aristotelian way of thinking about mathematical disciplines, it allowed deduction of the positions of the planets from purely mathematical considerations, rather than from the physical constitution of the planets or the nature of the orb or fluid or internal motive force by which they moved. On such a conception, there is a stark contrast between a mathematical understanding of motion and a physical understanding, and the one cannot be used to elucidate the other. The clearest presentation of this issue is given in Pereira, who sets out six differences between natural philosophy and mathematical astronomy.[117] The first two identify areas central to natural philosophy which are of no concern to astronomers. Natural philosophy attempts to discover the nature of the substance of celestial bodies—whether it comprises some combination of the four elements, for example, or whether celestial bodies are made up from a fifth kind of matter—and it seeks the various kinds of causes of their motion, the function of the celestial realm, and so on. The third area of difference concerns the 'accidents' of the celestial realm. Astronomers confine their attention to size, shape, and motion, whereas the natural philosopher deals with the full range of accidents, and understands them in terms of the nature of the heavens, in terms of its substance, what role the motions of celestial bodies play, and how they are related to sensation. Fourth, the astronomer, unlike the natural philosopher, is not concerned to establish the true causes of things, which derive from the natures of those things, but with causes that are merely sufficient for saving the phenomena. Fifth, in natural philosophy one will generally demonstrate celestial phenomena a priori, whereas the astronomer will only demonstrate them a posteriori. Finally, the natural philosopher will explain a property of the cosmos by deriving it from its nature, whereas the astronomer will simply provide a mathematical characterization. The natural philosopher will explain the spherical shape of the cosmos, for example, by saying that it is neither heavy nor light but is designed to be moved in an orb, whereas the astronomer will say that it is round because every part of it is equidistant from its centre, the earth.

Because, on this conception, astronomical hypotheses are designed to reconcile sets of observations, not to reveal the structure of the cosmos, there is no impediment to using such hypotheses even in cases where one believes that the literal physical interpretation of the hypothesis is false. So, for example, tables based on Copernicus' *De revolutionibus* came into general use from 1551 with the appearance of the *Prutenic Tables*, but the attraction of *De revolutionibus* was that it was believed to offer a simpler and more accurate means of calculation in many respects, not because it was thought to provide a physically accurate account of the motions of celestial bodies: Rheticus was the only astronomer we know of, other than Copernicus himself,
p. 122 who ↳ believed that the Copernican system actually represented the physical structure of the cosmos before the 1580s.[118]

The trouble was that physical questions could not be divorced from astronomical ones so easily, because the latter always contain some assumptions about physical structure. For example, Copernicus was a staunch advocate of the rigidity and impenetrability of celestial orbs, which was the default position throughout the first two-thirds of the sixteenth century.[119] The attempt to make physical sense out of the Ptolemaic model had begun with Alhazen in the eleventh century, who set out a system of concentric orbs and shells, and attempted to assign a single spherical motion to each of Ptolemy's simple motions, ultimately concluding that Ptolemy's equants failed to satisfy the requirement of uniform circular motion.[120] His treatise 'on the configuration of the world', the only one of his works that reached the West, appeared in a Latin version in the early fourteenth century, and it was a major influence on the most important fifteenth-century textbook on astronomy, Peurbach's *Theoricae novae planetarum*, first printed in 1475. Peurbach followed Alhazen in trying to offer a separate celestial orb for each component of Ptolemy's planetary motions, and by contrast with Ptolemy's *Almagest*, his illustrations are not geometrical diagrams but representations of three-dimensional solid orbs with concentric inner and outer surfaces, but whose thickness varies from point to

point representing the epicycles and eccentric orbits of the sun and the planets around the earth (see Fig. 3.1). The compromise offered in the *Theoricae* between the mathematical requirements of Ptolemaic observational astronomy and the physical requirements of Aristotelian cosmology quickly became the standard physical interpretation of Ptolemaic astronomy, and it was from Peurbach's textbook, not from Ptolemy's *Almagest*, that Copernicus first learned his astronomy. Peurbach's solid illustrations made it clear to Copernicus that Ptolemy's equants required rotation around an off-centre axis, and he considered this to be something that was physically impossible if the orbs were indeed rigid.[121] Eliminating equants meant he
p. 123 had to look for an ↳ alternative mechanism, and substituting epicycles for equants pointed him in the direction of a system in which the sun, rather than the earth, was at the centre.[122]

Figure 3.1



Copernicus was certainly not the only person to reject Ptolemaic astronomy on physical grounds. A rather different—and, for most of the sixteenth century, much more prominent—approach followed that which had been pursued four centuries earlier by Averroes, who had offered a very influential rebuttal of the Ptolemaic system in his commentary on the *Metaphysics*:

> The astronomer must, therefore, construct an astronomical system such that the celestial motions are yielded by it and that nothing that is from the standpoint of physics impossible is implied. . . . Ptolemy was unable to see astronomy on its true foundations. . . . The epicycle and the eccentric are impossible. We must, therefore, apply ourselves to a new investigation concerning that genuine astronomy whose foundations are principles of physics. . . . Actually, in our time astronomy is nonexistent; what we have is something that fits calculation but does not agree with what is.[123]

p. 124 Averroes had hoped to complete this study himself,[124] but it was left to his contemporary Alpetragius, with whom he had shared a teacher (Ibn-Tofail), to carry it out. The cosmology Alpetragius took up is one in which the earth lies in the middle of a system of orbs all of whose orbits are centred upon the earth. In this homocentric system, all the planets have regular circular orbits in the same direction. It was realized at an early stage in the development of astronomy that such an account did not fit the observational data: at the most elementary level, for example, the nearer planets varied in brightness in a continuous and systematic way, indicating that they were approaching or receding from the earth during at least part of their motion.[125] Ptolemy tried to resolve the complexities of the observational data, while reconciling these with a

geocentric universe, by abandoning concentric orbs and introducing epicycles and movable eccentrics. This approach allowed the data to be accounted for, but had no obvious natural-philosophical rationale: it had an air of merely 'saving the appearances', accounting for the different lengths of the seasons, for example, by making the sun's orbit eccentric, so that it now revolved not around the earth but around a point at some mathematically convenient distance from the earth.[126]

It was largely in response to such considerations that Alpetragius revived the homocentric theory, rejecting the independent movement of planets from east to west that had characterized Ptolemy's account. He realized that the theory had to be modified—for example to account for the fact that the poles of the ecliptic differed from the celestial poles, and for the fact of the variable velocities of the planets in longitude—and to do this he suggested that the poles of each planet describe small circles around their mean positions in each period of the planet, and he altered the accepted positions of the planets, putting Venus between Mars and the sun. The theory proved inadequate to account for the observational data: it could offer no convincing account of retrograde arcs, for example. But despite its inadequacies, it had an obvious natural-philosophical rationale: the earth was at the centre of the cosmos and the planets, stars, and the firmament revolved around it. This firmament consisted of nine concentric orbs placed around the earth at the centre, all moving in the same direction, and carrying the moon, the planets, and the sun, the fixed stars, with the outermost orb, which was the single 'prime mover', completing its own motion from east to west in just under one sidereal day. Although it carries the other orbs around with it, there is a lag in the motion of each orb, increased as one moves inwards from the prime mover, and there is also an increased deviation from a
p. 125 circular orbit as one moves inwards, with inner planets moving in what are effectively spirals. A number of ↳ medieval Christian thinkers, such as Albertus Magnus and Aquinas, who were either non-committal or rejected concentric orbs,[127] considered it seriously at one time or another, if only subsequently to reject it. There seems to have been a widespread sense that there was something artificial about the Ptolemaic system, and Alpetragius came closest to providing a physically satisfying geocentric model. The homocentric model underwent a revival in the early sixteenth century in the works of the Paduan natural philosophers Fracastoro and Amico, who, following Averroes, regarded the Ptolemaic system as unnatural.[128]

Copernicanism received similar treatment. Although many responses, from Peucer's *Elementa doctrinae de circulis coelestibus* (1551) to the 1633 condemnation of Galileo by the Roman Inquisition, offer a combination of biblical and natural-philosophical reasons for the unacceptability of the Copernican model as a physically true representation,[129] there were responses that focused on whether or not Copernicanism might be reconciled with Christianized Aristotelian natural philosophy. In the wake of the Inquisition's condemnation of Galileo in 1633 for example, one of the standard responses to Copernicanism in Iberian countries was to attempt to reformulate Copernicanism in terms of an Aristotelian natural philosophy, that
p. 126 is, within the confines of an Aristotelian theory of matter, thereby ↳ establishing its legitimacy as a physical theory in an orthodox way.[130] One of the earliest investigations along these lines had been that of the Spanish Augustinian friar Diego de Zúñiga, but it had been unsuccessful.[131] In his *Commentary on Job* of 1584, Zúñiga had argued the theological credentials of Copernicanism, namely that Holy Writ, if correctly interpreted, did not deny the assertion of Solomon in the *Ecclesiastics* that 'the earth is fixed forever'. What this means, he argued, is that the earth is always the same, and not that it does not move at all, and he adds that Copernicus' hypothesis gives a better account of planetary motions than any of its competitors. But thirteen years later, in his *Philosophiae prima pars*, Zúñiga offered a purely natural-philosophical examination of Copernicanism, failing to reconcile it with Aristotelian natural philosophy and concluding that Copernicus' system was physically impossible: as indeed it proved to be, in the context of Aristotelian natural philosophy.

Rejecting Ptolemaic and Copernican systems on physical grounds was of course quite a different matter from devising something more satisfactory. Here was the greatest weakness of the late scholastic

movement. The systematization that is crucial to its project takes up all its resources, so to speak, so that the kind of innovation that we find in natural philosophy in the fourteenth century, for example, is wholly missing from the sixteenth and early seventeenth centuries. Reconciliation of doctrines is paramount, or where this is not possible, gathering of arguments for competing opinions: the Coimbra Commentators had difficulty reconciling the biblical view that the empyrean consisted of water with the Aristotelian view that it was a fifth element, for example, and in true scholastic style found themselves 'compelled by an ambiguity of opinion to accommodate themselves to both points of view'.[132] This approach would not have been so bad if it were a way of accommodating new developments, registering them as problems that future scholars might deal with. But this was not at all what happened: quite the contrary, the way in which the systematization was pursued closed off receptivity to new developments. Yet there can be little doubt that the time had come for scholasticism to redeem the promissory notes of three centuries, and systematization
p. 127 was the only way in which it could do this. Lohr gives a sense of what was at issue in his discussion of ↳ Pereira's programme at the Collegio Romano, the Jesuit powerhouse of late scholastic systematization:

> Aristotle himself had regarded the opinions of his predecessors as stuttering attempts to express his own ideas and sought by the use of dialectics to discover among their theories the true principles of a question under discussion. In the same way the professors of the Collegio Romano were to seek the true principles of Aristotelian philosophy, not only the first principles of being, but also the axioms on which Aristotle's conception of science was founded. With these epistemological first principles in hand Aristotle could be reinterpreted or even rewritten to agree with the true principles of philosophy, that is, those which lead to Catholic doctrine. It was in accordance with this hermeneutic that Pereira defined 'first philosophy' not only as the science of being, but also as the science of science itself. Conscious of the fact that the basic problem with which scholasticism was confronted was that of maintaining the fundamental principles of its worldview, he held that metaphysics as the first philosophy also had the task of expounding and defending its *principia generali naturali lumine manifesta* in the face of the doubts and uncertainty which secular Aristotelianism had called forth.[133]

On the original Thomist conception of metaphysics, it acts as a bridge between Aristotelian natural philosophy and Christian theology, and it was such bridging that the systematization and synthesis were designed to achieve. But the kind of systematization and synthesis that Pereira envisages closes off any avenue for an independent natural philosophy, with the result that metaphysics acts not as a bridge but as a foundation. This is in keeping with Pereira's own conception of how cosmology should be pursued, which, as we saw above, leaves little scope for any natural-philosophical treatment of this subject. The approach he takes may have Paduan precedents, but what drives the sharp division he draws between the terrestrial and the celestial is reminiscent of the sharp division that Scotus drew between the natural and the supernatural, as is the way in which he conceives of metaphysics as a science of being. Pereira's approach is one that was to become standard. The first generation of scholastic textbooks had been of mixed orthodoxy, those issuing from Coimbra being Thomist on basic metaphysical issues, but the textbooks of Suárez,[134] as well as the influential works of otherwise Thomist philosophers such as Cajetan, take up a Scotist position on the nature of metaphysics, treating it as a general science of being. For Suárez, as for Scotus, there must be some unified notion of being, provided by metaphysics, and through this metaphysics we have access to some understanding of divine being: metaphysics does not unify knowledge from disparate sources, it stands over and regulates knowledge. The drift to Scotism is consolidated in the second wave of textbooks, those of Eustachius, Abra de Raconis, and Dupleix, who assume Scotism as a matter of course. This undermines the very finely balanced notion of metaphysics that is so crucial to the Thomist programme,
p. 128 and its upshot is ↳ to lock scholasticism out of any new developments in natural philosophy. One can only agree with Alan Gabbey, when he points out that 'the scholastics believed their explanatory schemes and ontological categories coped adequately with the universal range of natural phenomena, and one gets the

impression in reading their treatises that no empirical discovery or philosophical upheaval, present or future (or indeed from their recent past) could lead to a revision or displacement of that scheme.'[135]

Notes

1 Petrarch to Boccaccio, 28 August 1364: *Opera* (Basle, 1554), 880; trans. in Cassirer *et al*., *The Renaissance Philosophy of Man*, 140–1. Nevertheless, this did not prevent Averroist strains in some Aristotelian humanists of the sixteenth century: see Charles B. Schmitt, *Aristotle in the Renaissance* (Cambridge, Mass., 1983).

2 See Richard Sorabji, 'John Philoponus', Michael Wolff, 'Philoponus and the Rise of Pre-Classical Dynamics', and David Sedley, 'Philoponus' Conception of Space', all in Richard Sorabji, ed., *Philoponus and the Rejection of Aristotelian Science* (London, 1987).

3 Note also Oresme's comment at the end of Book 1 of *Le Livre du ciel et du monde*: 'Although Aristotle was an excellent philosopher, nevertheless it is clear from what Eustrathios says concerning the First Book of the *Nicomachean Ethics* that Aristotle was sometimes unduly harsh in his criticisms of Plato, whose opinion he hated unreasonably. As we have said many times, he was here arguing against Plato, who St. Augustine prefers and recommends above all others, along with Plato's followers in philosophy, in the eighth and ninth books of *The City of God*, and he holds that their teachings are more congruous and more in harmony with Catholic faith than those of other philosophers' (fo. 62d; 260–2 [text]/261–3 [trans.]).

4 See Ernst Cassirer, *The Individual and the Cosmos in Renaissance Philosophy* (Philadelphia, 1963); and Blumenberg, *The Legitimacy of the Modern Age*, 483–547.

5 See Charles Schmitt, 'Philoponus' Commentary on Aristotle's Physics in the Sixteenth Century', in Richard Sorabji, ed., *Philoponus and the Rejection of Aristotelian Science* (London, 1987).

6 See Ian Richard Netton, *Muslim Neoplatonists: An Introduction to the Thought of the Brethren of Purity* (London, 1982).

7 Plato's works were known primarily through Galen's summaries.

8 Albertus Magnus, *De causis et processu universitatis* 1. 1. 1. *Opera omnia*, ed. Augustus Borgnet (38 vols., Paris, 1890–9), x. 361b. The classification presumably derives in part from the prologue to Diogenes Laertius' *Lives of Eminent Philosophers* 1.13–16.

9 See Raymond Klibansky, *The Continuity of the Platonic Tradition During the Middle Ages* (London, 1950), and Paul Shorey, *Platonism Ancient and Modern* (Berkeley, 1938).

10 On Latin translations of Plato between 1400 and 1600, in both manuscript and printed editions, see the lists in Hankins, *Plato*, 669–796.

11 Note in this respect the later sanctification of Socrates and Plato, begun by Bessarion: see Raymond Marcel, ' "Saint" Socrate, patron de l'humanisme', *Revue internationale de philosophie* 5 (1951), 135–43.

12 On Plethon and Bessarion, see Hankins, *Plato*, 161–263, and on the question of Plethon's influence, 436–40.

13 Plethon, who was born around 1355, began as a Zoroastrian, and was expelled from Constantinople for heresy. By 1409 he was based at Mistra, which he proposed turning into a state modelled on Plato's *Republic* and *Laws*.

14 See Hankins, *Plato*, 255–61

15 See Ozment, *The Age of Reform*, 64–72.

16 This kind of reading of the *Timaeus* goes back to Philo of Alexandria, and can be found explicitly, e.g. in Kepler: Johannes Kepler, *The Harmony of the World*, trans. with introd. and notes by E. J. Aiton, A. M. Duncan, and J. V. Field (Philadelphia, 1997), 301 (Book 6, ch. 1).

17 Hankins, *Plato*, 167.

18 Ibid. 225.

19 As the 1491 proemium to *De ente et uno* makes clear, however, his was a synthesis in which Aristotle plays a role at least equal to that of Plato, by contrast with Ficino's approach.

20 Ficino, *Opera Omnia* (2 vols, Basle, 1576), 1438, cited in Hankins, *Plato*, 274.

21 See ibid. 275–6.

22 Ibid. 287.

23 See Brian Copenhaver and Charles B. Schmitt, *Renaissance Philosophy* (Oxford, 1992), 146–9, to which my account here is indebted.

24 On the *Corpus Hermeticum* see the Introduction to Brian Copenhaver, *Hermetica: The Greek Corpus Hermeticum and the Latin Asclepius in a New English Translation, with Notes and Introduction* (Cambridge, 1992). Frances A. Yates, *Giordano Bruno and the Hermetic Tradition* (Chicago, 1964), while a mine of information on many points, is curiously evasive on the

dating of the Hermetic texts, apparently assuming that whatever the dates of the particular texts that have come down to us, they reflect material from remote antiquity. Such a reading is not consistent with the evidence.

25 A new edition of the Latin text of the *Theologia* with full English translation is gradually appearing: Marsilio Ficino, *Platonic Theology*, ed. James Hankins and William Bowen, trans. Michael J. B. Allen and John Warden (6 vols, Cambridge, Mass., 2001–).

26 See the discussion in Paul Oscar Kristeller, *Eight Philosophers of the Renaissance* (Stanford, 1964), 43–7. For a full exposition of the doctrines and a detailed discussion see Kristeller, *The Philosophy of Marsilio Ficino* (New York, 1943), who deals with Ficino's metaphysics at 35–200, and with his account of the spiritual or contemplative life at 206–401.

27 Astrology, which had been widely condemned by the Church in the thirteenth and early fourteenth centuries, witnessed a revival in the wake of the Black Death, in the middle of the fourteenth century, after which time it was the norm to find astrologers attached to royal courts. It is noteworthy that the members of the Paris Medical Faculty explained to the king that the cause of the plague had been astrological, and hence beyond their power: Roger French, *Medicine Before Science: The Rational and Learned Doctor from the Middle Ages to the Enlightenment* (Cambridge, 2003), 130.

28 Copenhaver and Schmitt, *Renaissance Philosophy*, 151.

29 On this movement see Charles B. Schmitt, 'Perennial Philosophy: From Agostino Steuco to Leibniz', *Journal of the History of Ideas* 27 (1966), 505–32 10.2307/2708338 .

30 Patrizzi had argued in his translation of the work known as 'Aristotle's Theology' that this was a genuine work, and he used it to discredit other (genuine) doctrines of Aristotle's in an attempt to bring Aristotle into the Platonist camp. This was disingenuous in the extreme, as he had already argued that the work was spurious in his *Discussiones peripateticae* of 1571: it was in fact an apocryphal Arabic work based on Plotinus.

31 The work subsequently appeared in a revised version in 1593, and it incorporated revised versions of a number of his earlier natural-philosophical writings. On Patrizi see Kristeller, *Eight Philosophers*, 111–126, and the literature cited in Copenhaver and Schmitt, *Renaissance Philosophy*, 187 n. 65.

32 Copenhaver and Schmitt, *Renaissance Philosophy*, 190.

33 Cf. James 1: 17: 'Every best gift and every perfect present is from above, coming down from the Father of lights'; and Paul to the Ephesians 5: 13: 'All that is made manifest is light'.

34 Al-Kindi, *De Prospectibus*, prop. 7, cited in David C. Lindberg, *Theories of Vision from al-Kindi to Kepler* (Chicago, 1976), 19.

35 On al-Kindi's metaphysics, which is a mixture of (primarily) Neoplatonism and Aristotelianism, see Thorndike, *A History of Magic and Experimental Science*, i. 642–7; and Alfred L. Ivry, 'Al-Kindi as Philosopher: The Aristotelian and Neoplatonic Dimensions', in S. M. Stern, Albert Hourani, and Vivian Brown, eds, *Islamic Philosophy and the Classical Tradition* (Columbia, SC, 1972), 117–40.

36 See Lindberg, *Theories of Vision*, 18–32, on al-Kindi's optics. Al-Kindi defended the extramission theory on anatomical grounds—were the eye a receptacle we would expect it to be shaped like the ear, which is a receptacle and so is hollow, whereas the eye is spherical—and on optical grounds—above all why acuity depends on position in the visual field. There are also epistemological considerations: we see objects out there in the world not in the head, which is where vision takes place on the intromission theory.

37 See Lindberg, *Theories of Vision*, 58–86, on Alhazen's optics.

38 See A. C. Crombie, *Robert Grosseteste and the Origins of Experimental Science, 1100–1700* (Oxford, 1971), ch. 6; McEvoy, *The Philosophy of Robert Grosseteste*, part III; and Steven P. Marrone, *William of Auvergne and Robert Grosseteste: New Ideas of Truth in the Early Thirteenth Century* (Princeton, 1983), pt II.

39 On the history of this light cosmogony prior to Grosseteste, see Schmidt-Biggemann, *Philosophia Perennis*, 138–42, 273–83.

40 See Roger French and Andrew Cunningham, *'Before Science: The Invention of the Friars' Natural Philosophy* (London, 1996), chs. 9 and 10.

41 See Joseph Stiglmyr, *Das Aufkommen der pseudo-dionysischen Schriften und ihr Eindringen in die christliche Literature* (Bonn, 1895).

42 See French and Cunningham, *Before Science*, 218–24. Dionysius also exercised a considerable influence on the Dominicans: see J. Durantel, *Saint Thomas et le Pseudo-Denis* (Paris, 1919).

43 See Schmidt-Biggemann, *Philosophia Perennis*, 275.

44 See René Roques, *L'Univers dionysien: structure hiérarchique du monde selon le Pseudo-Denys* (Paris, 1983).

45 See French and Cunningham, *Before Science*, ch. 10, and, more generally on the importance of a light metaphysics, Klaus Hedwig, *Sphaera Lucis: Studien zur Intelligibilität des Seienden im Kontext der mittelalterlichen Lichtspekulation* (Münster, 1980).

46 See the discussion in Carolly Erickson, *The Medieval Vision: Essays in History and Perception* (New York, 1976), 42–4.

47 Ficino, *Opera*, i. 965–86.

48 See W. G. L. Randles, *The Unmaking of the Medieval Christian Cosmos, 1500–1760: From Solid Heavens to Boundless Æther*

(Aldershot, 1999), 3–5.

49 The term is *fluor*, lit. flow. The idea that the firmament consists of a fluid or humid air had been advocated in Francesco Giorgio, *De harmonia mundi totius cantica tria* (Venice, 1525), a work of Neoplatonic and Hermetic inspiration, although it ultimately goes back to Basil in the fourth century. See Randles, *The Unmaking of the Medieval Christian Cosmos*, 32–4.

50 The idea was not without precedent: some advocates of the Ptolemaic system had construed the planetary orbs not as crystalline shells but as different regions of a fluid heavens which have differential rates of rotation around a terrestrial centre. Robertus Anglicus had offered an account of fluid shells in the thirteenth century, Andalo di Negro had done so in the fourteenth, and Giovanni Pontano in the fifteenth. See James M. Lattis, *Between Copernicus and Galileo: Christoph Clavius and the Collapse of Ptolemaic Cosmology* (Chicago, 1994), 94–6.

51 Jean Péna, *Euclidis optica et catoptrica* (Paris, 1557), Preface. See Peter Barker, 'The Optical Theory of Comets from Apian to Kepler', *Physis* 30 (1993), 1–25.

52 See Edward Grant, *Planets, Stars, and Orbs: The Medieval Cosmos, 1200–1687* (Cambridge, 1996), 349.

53 Pierre Gassendi, *Opera Omnia* (6 vols, Lyon, 1658), i. 246.

54 See ch. 5.

55 See Francis Bacon, *The Oxford Francis Bacon*, vi. *Philosophical Studies c.1611-c.1619*, ed., introd., notes, and comm. by Graham Rees (Oxford, 1996), pp. xlii–xliv and 158–60.

56 *Epitome Astronomiae Copernicanae*, in *Johannis Kepler Astronomi Opera Omnia*, ed. C. Frisch (8 vols, Frankfurt, 1858–71), vi. 306; 'Epitome of Copernican Astronomy, Books 4 and 5', trans. C. G. Wallis, in *Britannica Great Books* 16 (Chicago, 1952), 843–1004: 850. Compare Kepler's *New Astronomy*, trans. William H. Donahue (Cambridge, 1992), 117, where a similar complaint is made against Patrizi.

57 Translation quoted from Nicholas Jardine, *The Birth of History and Philosophy of Science: Kepler's 'A Defence of Tycho against Ursus' with Essays on Its Provenance and Significance* (Cambridge, 1988), 154. As Jardine points out in his discussion of the significance of the *Apologia*, Kepler misrepresents Patrizi on the question of real and apparent motion: 234–5.

58 *Nova de universis philosophia*: *Pancosmia*, fo. 106r col. 2 and fo. 92v col. 1. See Jardine, *Birth*, 155.

59 The Indices had begun to appear in 1561, but the first Roman Index was not issued until 1590. For details of how the Index system worked, see George H. Putnam, *The Censorship of the Church of Rome and its Influence on the Production and Distribution of Literature* (2 vols., New York, 1906–7).

60 See Schmitt, *Aristotle in the Renaissance*, 22–3. A key figure was Johannes Argyropulos, whose 1460 lectures on the *De anima* resurrected the question of the Averroist doctrine of one mind, introducing it to a new generation.

61 Translated in Cassirer *et al*., *Renaissance Philosophy of Man*, 281.

62 Pietro Pomponazzi, *Tractatus acutissimi utillimi et mere peripatetici* (Venice, 1525), 104r–v.

63 See Stephen Gaukroger, *Cartesian Logic: An Essay on Descartes's Conception of Inference* (Oxford, 1989), 38–47; and Julien Peghaire, *Intellectus et ratio selon S. Thomas d'Aquin* (Paris and Ottowa, 1936), *passim*.

64 Translated in Cassirer *et al*., *Renaissance Philosophy of Man*, 377.

65 See Miri Rubin, *Corpus Christi: The Eucharist in Late Medieval Culture* (Cambridge, 1991) and Sarah Beckwirth, *Christ's Body: Identity, Culture and Society in Late Medieval Writings* (London, 1993).

66 Levi, *Renaissance and Reformation*, 353. See Gary Macy, 'The Doctrine of Transubstantiation in the Middle Ages', *Journal of Ecclesiastical History* 45 (1994), 11–44 10.1017/S0022046900016419 .

67 It became the official doctrine of the Church with the Fourth Lateran Council of 1215, and in the third quarter of the century Aquinas provided its Aristotelian formulation.

68 This is evident in the problems inherent in Descartes' attempt to think through transubstantiation in mechanist terms. See Jean-Robert Armogathe, *Theologia cartesiana: l'explication physique de l'Eucharistie chez Descartes et Dom Desgabets* (The Hague, 1977).

69 The question is not restricted to natural-philosophical explanation. We can also find a naturalistic approach to sexual activity, which is treated in the Italian Galenic tradition as being one of the passions of the soul and as a result something not encumbered by theological edicts: see Ian Maclean, *Logic, Signs and Nature in the Renaissance: The Case of Learned Medicine* (Cambridge, 2002), 88–9, 252–3.

70 Pietro Pomponazzi, *De naturalium effectuum causis sive de incantationibus* (Basle, 1556), and *De fato* (Basle, 1567).

71 The classic treatment of these questions, to which I am indebted here, is Daniel P. Walker, *Spiritual and Demonic Magic from Ficino to Campanella* (London, 1969).

72 *De incantationibus*, 255. Translation quoted from Walker, *Spiritual and Demonic Magic*, 108: see the discussion at 107–111.

73 *De incantationibus*, 302–10.

74 On Hellenistic philosophy, see the texts and commentaries in A. A. Long and D. N. Sedley, *The Hellenistic Philosophers* (2 vols, Cambridge, 1987).

75 See Louise Fothergill-Payne, 'Seneca's Role in Popularizing Epicurus in the Sixteenth Century', in Margaret J. Osler, ed.,

Atoms, Pneuma, and Tranquillity: Epicurean and Stoic Themes in European Thought (Cambridge, 1991), 115–34. On the Epicurean tradition from the Hellenistic era to the seventeenth century, see Howard Jones, *The Epicurean Tradition* (London, 1989). There is no similarly compact treatment of the history of Stoicism. On Stoicism in antiquity see J. M. Rist, *Stoic Philosophy* (Cambridge, 1969); on its pre-early-modern development see Marcia Colish, *The Stoic Tradition from Antiquity to the Early Middle Ages* (2 vols, Leiden, 1985); on its importance for sixteenth-and seventeenth-century moral and political thought see Oestreich, *Neostoicism and the Early Modern State*; and on its role in early modern natural philosophy, see Peter Barker, 'Stoic Contributions to Early Modern Science', in Osler, ed., *Atoms, Pneuma, and Tranquillity*, 135–54.

76 We are not concerned with dualism in the Cartesian sense here, a doctrine not to be found before Plotinus at the earliest. See the succinct and conclusive discussion of the issues in Eyjólfur Kjalar Emilsson, *Plotinus on Sense-Perception: A Philosophical Study* (Cambridge, 1988), 145–8.

77 The most perceptive discussion of naturalism remains Robert Lenoble, *Mersenne ou la naissance de la mécanique* (2nd edn, Paris, 1971), 83–167.

78 My distinction between naturalism and corpuscularianism corresponds at least in outline to what Ralph Cudworth refers to as hylozoic atheism and atomistic atheism respectively: see *The True Intellectual System of the Universe* (2nd edn, 2 vols, London, 1743), i. 144.

79 Margaret Cavendish, Duchess of Newcastle, *Observations upon Experimental Philosophy to which is added The Description of a New Blazing World* (London, 1666). However, Emma Wilkins has pointed out to me that although Cavendish believed the 'corporeal soul' was material, she also believed that we have supernatural souls: she explicitly did not discuss supernatural souls in her natural philosophy on the grounds that religion and natural philosophy did not mix.

80 Richard Overton, *Man's Mortallitie* (Amsterdam, 1643). Despite the fact that 'Amsterdam' is given as the place of publication, the work was in fact printed in London on a secret private press.

81 See Christopher Hill, *Milton and the English Revolution* (London, 1977), chs. 25 and 26 on Milton's mortalism and materialism respectively.

82 See John W. Yolton, *Thinking Matter: Materialism in Eighteenth-Century Britain* (Oxford, 1983). Reductionism generally implies mortalism, but not vice versa. While reductionism was a rare doctrine, mortalism of one kind of another seems to have been not uncommon in England in the sixteenth and seventeenth centuries: see Norman T. Burns, *Christian Mortalism from Tyndale to Milton* (Cambridge, Mass., 1972).

83 The complexity of the varieties of the eclecticism among the Paduans is illustrated by the fact that, in rejecting Pomponazzi's naturalism on the soul in his *De immortalitate animae libellum* of 1518, Nifo will defend a view based on the Neoplatonist commentary on Aristotle's *De anima* traditionally ascribed to Simplicius: see Simplicius, *On Aristotle On the Soul 1.1–2.4*, trans. J. O. Urmson, notes by Peter Lautner (London, 1995).

84 Telesio's natural philosophy is discussed in detail in Martin Muslow, *Frühneuzeitliche Selbsterhaltung: Telesio und die Naturphilosophie der Renaissance* (Tübingen, 1998).

85 *De rerum natura* was underwent constant revision through Telesio's life and appeared in three significantly different editions. The most convenient edition, and one I shall cite, is the third and final one: Bernardinus Telesio, *De Rerum Natura Iuxta Propria Principia Libri IX* (Naples, 1586: repr. with introd. by Cesare Vasoli, Hildersheim, 1971).

86 *De rerum natura*, Prooemium.

87 Just how residual is this dualism is a matter of dispute. For a very naturalistic reading of Aristotle's account of the soul, in which heat plays a central role, see Gad Freudenthal, *Aristotle's Theory of Material Substance: Heat and Pneuma, Form and Soul* (Oxford, 1995).

88 *De rerum natura*, Book 1 chs. 1–5.

89 The three authors that Telesio quotes at length are Aristotle, Hippocrates, and Galen, and Walker points out that Telesio 'uses medical spirits, which were traditionally hot and rarefied, and therefore, according to his own principles, especially sentient and active' (*Spiritual and Demonic Magic*, 190). See also his 'Medical Spirits in Philosophy and Theology from Ficino to Newton', in D. P. Walker, *Music, Spirit and Language in the Renaissance*, ed. Penelope Gouk (London, 1985), ch. 11.

90 Giordano Bruno, *Cause, Principle and Unity*, trans. Richard J. Blackwell and Robert de Lucca (Cambridge, 1998), 54.

91 See Luigi Firpi, *Il processo di Giordano Bruno* (Rome, 1993) and Maurice A. Finocchiaro, 'Philosophy versus Religion and Science versus Religion: The Trials of Bruno and Galileo', in Hilary Gatti, ed., *Giordano Bruno: Philosopher of the Renaissance* (Aldershot, 2002), 51–96. The case of Campanella has many parallels to that of Bruno: see John M. Headley, *Tommaso Campanella and the Transformation of the World* (Princeton, 1997).

92 On Bruno's education see Ingrid Rowland, 'Giordano Bruno and Neapolitan Neoplatonism', in Hilary Gatti, ed., *Giordano Bruno: Philosopher of the Renaissance* (Aldershot, 2002), 97–119.

93 These aspects of Bruno's thought are dealt with in Yates, *Giordano Bruno and the Hermetic Tradition*.

94 Giordano Bruno, *De triplici minimo* (Frankfurt, 1591), Book 1, ch. 1.

95 On Bruno's art of memory see Frances A. Yates, *The Art of Memory* (London, 1978), chs. 9–14; and Stephen Clucas,

'*Simulacra et Signacula*: Memory, Magic and Metaphysics in Brunian Mnemonics', in Hilary Gatti, ed., *Giordano Bruno: Philosophy of the Renaissance* (Aldershot, 2002), 273–97. Bruno's publications on this question came later in his career.

96 Giordano Bruno, *De la causa, principio et uno* (London, 1584) translated in Bruno, *Cause, Principle and Unity*, 74–5.

97 *Cause, Principle and Unity*, 8.

98 See Angelo Mercati, *Il Sommario de processo di G. Bruno* (Vatican City, 1942), 79.

99 Bruno's cosmology is developed primarily in his *La cena de le Ceneri* (London, 1584)—translated as *The Ash Wednesday Supper*, trans. S. Jaki (The Hague, 1975)—and *De l'infinito universo et mondi* (London, 1585)—translated in Dorothea Waley Singer, *Giordano Bruno, His Life and Thought: With Annotated Translation of his Work, On Infinite Universe and Worlds* (New York, 1968). *La cena* presents a critical account of Ptolemaic and Aristotelian cosmology, presenting Copernicanism as an alternative and then revising the Copernican account to establish the infinity of the world, while *De l'infinito* pursues much the same ends by means of a detailed refutation of Aristotle's *De caelo*.

100 See Finocchiaro, 'Philosophy versus Religion', 80.

101 Marin Mersenne, *L'Impiete des Deistes, Athees et Libertins de ce temps, combatuë, & renuersee de point en point par raisons tirees de la Philosophie, & de la Theologie* (Paris, 1624). See Lenoble, *Mersenne*, 259–64; and more generally Keith Hutchison, 'Supernaturalism and the Mechanical Philosophy', *History of Science* 21 (1983), 297–333.

102 These questions are dealt with in his *Quaestiones celeberrimae in Genesim* (Paris, 1623) as well as in *L'Impiete des Deistes*. They are also pursued in François Garasse, *La Doctrine curieuse des beaux esprits de ce temps, ou prétendus tels* (2 vols., Paris, 1623), i. 1–98. An earlier criticism of naturalism along the lines that it ascribes to nature qualities that can only be divine can be found in Laurent Pollot, *Dialogues contre la pluralité des religions et l'athéism* (La Rochelle, 1595), 104v-118v. Later in the seventeenth century, Henry More will offer the same kind of diagnosis of 'enthusiasm', as being caused by the failure of Aristotelians to distinguish between material and immaterial substances: *Observations on Anthroposophia Theomagica and Anima Magica Abscondita* ([London], 1650), 7–8, and *Enthusiasmus Triumphatus* (London, 1656), 48–9.

103 Confining our attention to commentaries on natural-philosophical texts, the *Parva naturalia*, the *Meteorology*, the *De anima*, the *Physics*, and the *De caelo* commentaries appeared between 1692 and 1698. On these commentaries see Dennis Des Chene, *Physiologia: Natural Philosophy in Late Aristotelian and Cartesian Thought* (Ithaca, NY, 1996). Note that these commentaries occasionally took an independent route, without offering a systematic interpretation of the text of Aristotle.

104 See Gaukroger, *Descartes, An Intellectual Biography*, ch. 2.

105 See Laurence W. B. Brockliss, 'Rapports de structure et de contenu entre les *Principia* et les cours de philosophie des collèges', in Jean-Robert Armogathe and Giulia Belgioiso, eds, *Descartes: Principia Philosophiae, 1644–1994* (Naples, 1996), 491–516.

106 See Charles B. Schmitt, 'The Rise of the Philosophical Textbook', in Charles B. Schmitt, Quentin Skinner, and Eckhard Kessler, eds, *The Cambridge History of Renaissance Philosophy* (Cambridge, 1988), 792–804: 803.

107 See Roger Ariew, *Descartes and the Last Scholastics* (Ithaca, NY, 1999), ch. 2.

108 This third wave comprises the ultra-Thomist commentaries of the Complutenses, based at the Philosophical College of the Discalced Carmelites at Alcalá (Lat. *complutum*), and Salmanticenses, based at the Theological College at Salamanca. The Complutenses commentaries began with the logic commentary of Diego de Jesus, which was first published in 1608, and they appeared in a definitive five-volume version in 1670. Although they dealt with natural-philosophical questions, they seem to have had no influence on natural-philosophical disputes outside Catholic clerical circles. The Salamancan commentaries, which began to appear in 1630, were primarily concerned with theology rather than natural philosophy, and similarly had no impact outside Catholic clerical circles, where they formed the epitome of orthodoxy.

109 See the discussion in Charles H. Lohr, 'The Sixteenth Century Transformation of the Aristotelian Division of the Speculative Sciences', in D. Kelley and R. Popkin, eds, *The Shapes of Knowledge from the Renaissance to the Enlightenment* (Dordrecht, 1991), 49–58; and idem, 'Jesuit Aristotelianism and Sixteenth-Century Metaphysics', in G. Fletcher and M. B. Scheute, eds, *Paradosis* (New York, 1976), 203–20. See also Thorndike, *A History of Magic*, vii. 372–425.

110 See Joaquim F. Gomez, 'Pedro da Fonseca: Sixteenth Century Portuguese Philosopher', *International Philosophical Quarterly* 6 (1966), 632–44: 633–4. The later Carmelite Complutenses commentaries set out to reverse this trend.

111 There is a good account of these questions in Lohr, 'Metaphysics and Natural Philosophy'. See also L. W. B. Brockliss, 'The Scientific Revolution in France', in Roy Porter and Mikulas Teich, eds, *The Scientific Revolution in National Context* (Cambridge, 1992), 55–89: 56–7.

112 See Dennis Des Chene, *Life's Form: Late Aristotelian Conceptions of the Soul* (Ithaca, NY, 2000).

113 See Nicholas Jardine, 'The Significance of the Celestial Orbs,' *Journal of the History of Astronomy* 13 (1982), 168–94.

114 Cf. Giovanni Pontano: 'If we seek in heaven things which relate to our eyes and ears, why should we not then seek what relates to our noses'. *De rebus coelestibus libri XIIII* (Basle, 1556), 2113. Cited in Jardine, *The Birth of History and Philosophy of Science*, 233: see the discussion there.

115 Benedictus Pereira, *Prior tomus Commentariorum et Disputationem in Genesim* (Lyon, 1590).

116 Peter Barker and Bernard Goldstein, in their 'Realism and Instrumentalism in Sixteenth-Century Astronomy: A

Reappraisal', *Perspectives on Science* 6 (1998), 232–58, argue that no sixteenth-century writers on astronomy have a fictionalist reading of astronomy: they simply hold that causal knowledge is an ideal which is unattainable. If for 'writers on astronomy' we substitute 'astronomers', Barker and Goldstein are right. But scholastic critics of astronomy, such as Pereira, *do* seem to think that astronomy is simply not in the game of providing causal explanations.

117 Pereira, *De communibus omnium rerum naturalium principiis et affectionibus* (Rome, 1576), 47D–48B. Note that Pereira refers to 'astrologers', but in fact he is concerned with mathematical astronomy. See also William H. Donahue, *The Dissolution of the Celestial Spheres* (New York, 1981), 28–30.

118 Robert S. Westman, 'The Astronomer's Role in the Sixteenth Century: A Preliminary Study', *History of Science* 18 (1980), 105–47, finds only ten natural philosophers in the whole of Europe prepared to accept the physical reality of the heliocentric model in 1600: Digges and Harriot in England, Bruno and Galileo in Italy, Zúñiga in Spain, Stevin in the Netherlands, and Maestlin, Rothmann, and Kepler in Germany. Zúñiga, as we shall see below, should not in fact be included in this list. See also Robert S. Westman, 'The Melanchthon Circle, Rheticus, and the Wittenberg Interpretation of the Copernican Theory', *Isis* 66 (1975), 165–93; idem, 'The Comet and the Cosmos: Kepler, Mästlin and the Copernican Hypothesis', *Studia Copernicana* 5 (1972), 7–30; Jardine, 'The Significance of the Celestial Orbs'; and Thorndike, *History of Magic*, vi. ch. 31.

119 The situation changed as the century progressed and by the end of the sixteenth century there was a strong view in favour of fluid heavens: see William H. Donahue, 'The Solid Planetary Spheres in Post-Copernican Natural Philosophy', in Robert S. Westman, ed., *The Copernican Achievement* (Berkeley, 1975), 244–75.

120 See Owen Gingerich, 'Islamic Astronomy', in idem, *The Great Copernicus Chase and Other Adventures in Astronomical History* (Cambridge, 1992), 43–56.

121 See Noel M. Swerdlow, '*Pseudodoxia Copernicana*: Or, Enquiries into Very Many Received Tenets and Commonly Presumed Truths, Mostly Concerning Spheres', *Archives internationales d'histoire des sciences* 26 (1976), 108–58.

122 See Noel M. Swerdlow, 'The Derivation and First Draft of Copernicus' Planetary Theory: A Translation of the *Commentariolus* with Commentary,' *Proceedings of the American Philosophical Society* 117 (1973), 423–512.

123 Averroes, *Metaphysics*, Bv. 12, summae secundae ch. 4, comm. 45. Quoted in Pierre Duhem, *To Save the Phenomena* (Chicago, 1969), 31.

124 See F. J. Carmody, 'The Planetary Theory of Ibn-Rushd', *Osiris* 10 (1952), 556–86 10.1086/368564.

125 See D. Hargreave, 'Reconstructing the Planetary Motions of the Eudoxian System,' *Scripta Mathematica* 28 (1970), 335–45.

126 Note that Ptolemy's arguments 'that the earth is in the middle of the heavens' at 1. 5 of the *Almagest*, are distinctive in that, in contrast to those of Aristotle and others, they offer no physical grounds for the centrality of the earth but exclusively astronomical arguments. Indeed, whereas for Aristotle it is crucial that the earth be literally at the physical centre of the cosmos, for Ptolemy all that matters is that the earth be at the centre 'with regard to the senses': its position can be approximate. See Liba Chaia Taub, *Ptolemy's Universe: The Natural Philosophical and Ethical Foundations of Ptolemy's Astronomy* (Chicago, 1993), 71–9.

127 Aquinas, for example, was non-committal in *De trinitate* and rejected concentric orbs in his *Commentary on the Metaphysics*: see Grant, *Planets*, 281.

128 Girolamo Fracastoro, *Homocentrica: Sive de Stellis* (Venice, 1538); Giovanni Battista Amico, *De Motibus corporum coelestium iuxta principia peripatetica sine eccentris et epicyclis* (Venice, 1536). On the sixteenth-century revival of the homocentric thesis, see Lattis, *Between Copernicus and Galileo*, 87–94.

129 On the nature of the disputes over Copernicanism as they bore on Galileo's condemnation, see Robert S. Westman, 'The Copernicans and the Churches', and William R. Shea, 'Galileo and the Church', both in David C. Lindberg and Ronald L. Numbers, eds., *God and Nature: Historical Essays on the Encounter between Christianity and Science* (Berkeley, 1986), 76–113 and 114–35 respectively; and Olaf Pedersen, 'Galileo and the Council of Trent: The Galileo Affair Revisited', *Journal for the History of Astronomy* 14 (1983), 1–29. Although things changed very significantly in the course of the seventeenth century, it is worth noting that complete acceptance of Copernicanism took much longer, usually (but not always due) to religious factors. This reluctance to accept heliocentrism was prevalent in, but not restricted to, Catholic countries such as Spain, where resistance to Copernicanism continued at least up to the end of the eighteenth century (see David Goodman, 'Iberian Science: Navigation, Empire and Counter-Reformation', in David Goodman and Colin A. Russell, eds, *The Rise of Scientific Europe, 1500–1800* (London, 1991), 117–44: 143). As regards Protestant countries, there are late seventeenth- and early eighteenth-century English works that treat Copernicanism as a passing fad: John Edwards, *Brief Remarks upon Mr. Whiston's New Theory of the Earth* (London, 1697), 23–6, and Edward Howard, *Remarks on the New Philosophy of Descartes* (London, 1700), 207. Moreover, Blumenberg points out that Copernicanism was not accepted as being beyond dispute in Germany until 1760 (*The Genesis of the Copernican World* (Cambridge, Mass., 1987), 357). And as far as Orthodox countries were concerned, 'modern' natural philosophy replaced Aristotelianism only in the 1870s in Kiev; and in Greece we find a teacher being condemned for teaching the heliocentric theory in 1804 (Colin Chant, 'Science in Orthodox Europe', in David Goodman and Colin A. Russell, eds, *The Rise of Scientific Europe, 1500–1800* (London, 1991), 333–60: 355). For documents

relating the conflict between astronomical theories generally and Scripture, there is a comprehensive collection in Pierre-Noël Mayaud, *Le Conflit entre l'Astronomie Nouvelle et l'Écriture Sainte aux XVI^e^ et XVII^e^ siècles* (5 vols, Paris, 2005).

130 See Beatriz Helena Domingues, *Tradição na Modernidade e Modernidade na Tradição: A Modernidade Ibérica e a Revolução Copernicana* (Rio de Janeiro, 1996), and her summary in 'Spain and the Dawn of Modern Science', *Metascience* 7 (1998), 298–312 10.1007/BF02912809 . More generally, on attempts to accommodate Aristotelianism to the new natural philosophies, see Christia Mercer, 'The Vitality and Importance of Early Modern Aristotelianism', in Tom Sorell, ed., *The Rise of Modern Philosophy* (Oxford, 1993), 33–67: 57–66.

131 See Víctor Navarro Brotóns, 'The Reception of Copernicus in Sixteenth-Century Spain: The Case of Diego de Zúñiga', *Isis* 86 (1995), 52–78 10.1086/357075 . More generally on the reception of Copernicanism in Spain see idem, 'Contribución a la Historia del Copernicanismo en España', *Cuadernos Hispanoamericanos* 283 (1974), 3–24; and José María López Piñero, *Ciencia y Técnica en la Sociedad Española de los Siglos XVI y XVII* (Barcelona, 1979), 178–96.

132 *In quattuor libros De coelo*, 1. 2. q. VI, a. III. The author of this commentary is Emmanuel de Goes.

133 Lohr, 'Metaphysics', 608.

134 The most important textbook is Fransisco Suárez, *Metaphysicarum disputationem, in quibus, & universa theologia ordinatè traditor, & quaestiones ad amnes duodecim Aristotelis libros pertinentes, accuratè dispuntatur* (Salamanca, 1597).

135 Alan Gabbey, 'The *Principia Philosophiae* as a Treatise in Natural Philosophy', in Jean-Robert Armogathe and Giulia Belgioiso, eds, *Descartes: Principia Philosophiae, 1644–1994* (Naples, 1996), 517–29: 524–5. Cf. Montaigne's statement that he knew in Pisa 'a good man, but such an Aristotelian that the most sweeping of his dogmas is this: that the touchstone and measure of all serious speculations and of all truth is conformity with the teaching of Aristotle, for outside these everything is chimera and inane; and that Aristotle saw everything and said everything'. Michel de Montaigne, *Essais*, ed. Rat (2 vols Paris, 1965), i. 161 (Essay I. 26).