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978-0-521-56762-6 - The Foundations of Modern Science in the Middle Ages: Their Religious, Institutional, and Intellectual Contexts

Edward Grant

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The Roman Empire and the first six centuries of Christianity

DURING the first four centuries of Christianity, the Roman Empire was a geographical colossus, extending from the Atlantic Ocean in the west to Persia in the east, and from Britain in the north to regions south of the Mediterranean Sea. Within this Greco-Roman world, Christianity was born and disseminated. Its birth and early development occurred in a period of vast religious change and economic upheaval. For the first two hundred years of its existence, Christianity was no more visible and noticeable than many other of the numerous mystery religions and cults that had proven attractive to people at all levels of society. The sense of comfort that pagans derived from their belief in the traditional Homeric and Roman gods of the state religions was disappearing. The new cults – for example, Isis, Mithras, Cybele, and Sol Invictus (Unconquered Sun), as well as Gnosticism and Christianity – that were replacing the traditional deities not only borrowed ideas and rituals from one another but also came to share a few basic beliefs. The world was evil and would eventually pass away. Humans, sinful by nature, could achieve never-ending bliss only if they turned away from the things of this world and cultivated those of the eternal spiritual realm. Along with practicing varying degrees of asceticism, many of the cults believed in a redeemer god who would die in order to bring eternal life after death to his faithful followers. Contemporary philosophical schools, such as Neoplatonism and Neopythagoreanism, were also affected by these popular currents. Some came to function as religions, as they sought to guide their adherents toward salvation and union with God, even employing magic to achieve their ends. (The philosophical schools, however, were ill-suited to the competition, because they required lengthy periods of study and training before they judged a student capable of understanding the world and its governance.) The reaction to centuries of homogenized and impersonal worship of traditional gods took the form of a desire for a single, personal god, the ruler of the world, with whom one could establish an intimate, personal relationship. Many came to believe that they could be transformed by a direct revelation from the one god, a revelation that would enable them to overcome the

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evils of the world. Numerous groups emerged, each concerned with its own private and exclusive program for salvation. Christianity was one of these.

How Christianity triumphed over the traditional gods and also over the numerous other mystery religions and cults that were its rivals cannot be discussed here. But certain features that concern Christianity's dissemination and its attitude toward the larger Roman world around it are germane to the subsequent development of science and therefore central to this volume. A notable feature of the spread of Christianity was the slowness of its dissemination. The spread of Christianity beyond the Holy Land and its surrounding region began in earnest after Saint Paul proselytized into the Gentile world, especially into Greece, during the middle of the first century. In retrospect – and by comparison with the spread of Islam – the pace of the dissemination of Christianity appears quite slow. Not until A.D. 300 was Christianity effectively represented throughout the Roman Empire. And not until 313, in the reign of Constantine, was the Edict of Milan (or Edict of Toleration) issued, which conferred on Christianity full legal equality with all other religions in the empire. In 392, the Emperor Theodosius not only ordered pagan temples closed but also proscribed pagan worship, which thereafter was classified as treason. Thus it was not until 392, or the end of the fourth century, that Christianity became the exclusive religion supported by the state. After almost four centuries, Christianity was triumphant. It had taken nearly four centuries (approximately three hundred fifty years from the beginning of Paul's serious efforts to spread Christianity wherever possible) to achieve this result. By contrast, Islam, following the death of Muhammad in 632, was carried over an enormous geographical area in a remarkably short time. In less than one hundred years, Islam was the dominant religion from the Arabian peninsula westward to the Straits of Gibraltar, northward to Spain, and eastward to Persia, Balkh, Bukhara, Samarkand, and Khwarizm. But where Islam was spread largely by conquest during its first one hundred years, Christianity spread slowly and, with the exception of certain periods of persecution, relatively peacefully. It was the slow percolation of Christianity that enabled it to adjust to the pagan world around it and thus prepare itself for a role that could not have been envisioned by its early members.

CHRISTIANITY AND PAGAN LEARNING

The momentous adjustment of Christianity to the pagan world around it is manifested by numerous learned Christians whose writings were subsequently influential. To Gregory of Nyssa, Christianity was "the sublime philosophy." Yet he, like many other eminent Christians, recognized that pagan philosophy still had a role to play, as did pagan

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tradition and learning generally. In the process of acquiring an education, Christians came to share numerous cultural traditions with their pagan neighbors and fellow citizens. Much of this came by way of *paideia*, a kind of shared civility, which “offered ancient, almost proverbial guidance, drawn from the history and literature of Greece, on serious issues, issues which no notable – Christian or polytheist, bishop or layman – could afford to ignore: on courtesy, on the prudent administration of friendship, on the control of anger, on poise and persuasive skill when faced by official violence.”¹

Because they came from varied backgrounds, the Greek fathers, who significantly shaped Christian attitudes toward pagan philosophy, were hardly of one mind on the subject. Some were hostile to science and philosophy out of concern for their potentially subversive effect on the faith. Most, however, denounced these disciplines because of their conviction that Christianity was “the sublime philosophy” and therefore the only system capable of delivering truth. For many of them, science was a confusing, contradictory body of knowledge. Church fathers like Tatian, Eusebius, Theodoret, and Saint Basil seemingly delighted in subverting Greek science by showing that its conclusions were often fatuous or contradictory. Theodoret likened science to writing on water,² and Basil declared, perhaps in imitation of Plato’s scornful description of the Presocratics, that “the wise men of the Greeks wrote many works about nature, but not one account among them remained unaltered and firmly established, for the later account always overthrew the preceding one. As a consequence there is no need for us to refute their words; they avail mutually for their own undoing.”³ Many church fathers, of whom Gregory of Nyssa was one, followed Plato and argued that science could at best give only probable knowledge, not genuine truth.

As early as the end of the second century and first half of the third century, other Christian apologists came to a quite different conclusion, arguing instead that Christianity could profitably utilize pagan Greek philosophy and learning. In a momentous move, Clement of Alexandria (ca. 150–ca. 215) and his disciple Origen of Alexandria (ca. 185–ca. 254) laid down the basic approach that others would follow. Greek philosophy was neither inherently good nor bad, but was one or the other depending on how it was used by Christians. Although the Greek poets and philosophers had not received direct revelation from God, they did receive natural reason and were thus heading toward truth. Philosophy – and secular learning in general – could thus be used to prepare the way for Christian wisdom, which was the fruit of revelation. Philosophy and science could be studied as “handmaidens to theology,” that is, as aids in understanding Holy Scripture, an attitude that had already been advocated by Philo Judaeus, a resident of the Jewish community of Alexandria, early in the first century A.D. Science was thus regarded as a

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study that was preparatory for the higher disciplines that were concerned with Scripture and theology. In the second half of the fourth century, Basil of Caesarea reinforced the handmaiden idea in a brief treatise to students titled *On How to Make Good Use of the Study of Greek Literature*. Like many of his early Christian colleagues, however, Basil was ambivalent. He warned about the dangers of some of the great works of Greek literature, but he also recognized that a Christian could profit from familiarity with pagan writings and quoted from various Greek works. Much later, Christian humanists in the Renaissance viewed Basil's treatise as providing encouragement for Christians to study pagan Greek literature. Leonardo Bruni (1370–1444) was inspired to translate Basil's treatise into Latin because he saw in it justification for his own translations of Plutarch and Plato from Greek to Latin.

The handmaiden concept of Greek learning was widely adopted and became the standard Christian attitude toward secular learning. That Christians chose to accept pagan learning within limits was a momentous decision. They might have heeded Tertullian (ca. 150–ca. 225), who asked pointedly, "What indeed has Athens to do with Jerusalem? What concord is there between the Academy and the Church?" With the total triumph of Christianity at the end of the fourth century, the Church might have reacted against Greek pagan learning in general, and Greek philosophy in particular, finding much in the latter that was unacceptable or perhaps even offensive. They might have launched a major effort to suppress pagan learning as a danger to the Church and its doctrines. But they did not. Why not?

Perhaps it was in the slow dissemination of Christianity. After four centuries as members of a distinct religion, Christians had learned to live with Greek secular learning and to utilize it for their own benefit. Their education was heavily infiltrated by Latin and Greek pagan literature and philosophy. Numerous converts to Christianity – the most notable being Saint Augustine – had been steeped in pagan learning, which formed a normal part of their societal and cultural milieu. Although Christians found certain aspects of pagan culture and learning unacceptable, they did not view them as a cancer to be cut out of the Christian body.

The handmaiden theory was obviously a compromise between rejection of traditional pagan learning and its full acceptance. By approaching secular learning with caution, Christians could utilize Greek philosophy – especially metaphysics – to better understand and explicate Holy Scripture and to cope with the difficulties generated by the assumption of the doctrine of the Trinity and other esoteric dogmas. Ordinary daily life also required use of the mundane sciences such as astronomy and mathematics. Christians realized that they could not turn their backs on Greek learning. But many were also wary of pagan Greek science and philos-

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ophy, which contained ideas and concepts that were contrary to Christian doctrine. Among these ideas were the common Greek notion that the world was eternal and had no beginning and the deterministic interpretations of the world advocated by Stoic philosophers and astrologers, who often assumed a world rigidly determined by the configurations of the planets and stars. Like Saint Basil a few years before him, Saint Augustine (354–430), who was enormously influential in the Latin Middle Ages, reflects both attitudes. He advocated the study of the liberal arts, including the sciences – geometry, arithmetic, astronomy, and music – embodied in the traditional quadrivium of the seven liberal arts. But he was suspicious of astronomy, a discipline that frequently led its practitioners to astrological determinism, which he deplored. Augustine’s ambivalence toward secular learning is reflected in his *Retractions*, written in 426, four years before his death, where he expressed regret that he had ever emphasized the study of the seven liberal arts and concluded that the theoretical sciences and mechanical arts are of no use to a Christian.

HEXAEMERAL LITERATURE: CHRISTIAN COMMENTARIES
ON THE CREATION ACCOUNT IN GENESIS

Although Christians adopted the handmaiden approach to science, science itself was not a major concern of theirs. However, their need to understand the Bible better and to explicate the creation account in Genesis made it advisable for Christians to learn something about natural philosophy and science. Following the pattern established by Philo Judaeus (d. ca. 40 A.D.), who left the first commentary on the creation account in Genesis, a number of influential church fathers – Saints Basil, Ambrose, and Augustine, for example – wrote commentaries that proved influential in the Middle Ages.

Basil (ca. 331–379), who wrote in Greek, presented his commentary in the form of nine homilies, delivered originally as lectures to audiences in a church. In this famous work, Basil sought to praise the glory and power of God and to instill in Christians a strong sense of moral purpose. To achieve these ends, he appealed to nature, as God’s handiwork. In the process, he found it necessary to convey a modicum of contemporary scientific knowledge about the basic structure and composition of the world. For example, in explaining the words “In the beginning God created the heavens and the earth,” Basil was compelled to consider a host of topics: whether creation was simultaneous, or in time; whether the heavens were created before the earth; the nature of the heavenly substance; the meaning of the firmament; the meaning of the waters above and below that firmament; clouds, vapors, and the four elements; the location and shape of the world; the production of vegetation on the

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earth; the creation of the planets and stars; and the creation of crawling creatures, birds, and sea life. Thus Basil confronted the question: how does the earth remain immobile at the center of the world? On what does it rest? Perhaps drawing on Aristotle, Basil considered a number of possible answers: the earth rests on air, or on water, or on something heavy. Rejecting these options – for example, if a heavier object supported the earth, one would then have to ask what held up the heavier object, and so on – Basil concluded that the earth has no reason to move because it lies in the middle of everything.⁴ He never tired of emphasizing the marvelous design that God embedded in nature.

Basil frequently mixed his descriptions of natural phenomena and design, especially of the behavior of animals and plants, with morality. As he put it, “Everything in existence is the work of Providence, and nothing is bereft of the care owed to it. If you observe carefully the members even of the animals, you will find that the Creator has added nothing superfluous, and that He has not omitted anything necessary.”⁵ He drew lessons from the migration of fish, the stealth of the octopus, the function of the elephant’s trunk, the behavior of dogs tracking wild animals, and the existence of both poisonous and edible plants. All play their designated role in nature, even poisonous plants, for, as Basil argued, “there is no one plant without worth, not one without use. Either it provides food for some animal, or has been sought out for us by the medical profession for the relief of certain diseases.”⁶ Thus did Basil respond to those who wondered why God would create poisonous plants capable of killing humans.

Basil’s ideas were enormously influential in the western and eastern parts of the Roman Empire. In the West, Saint Ambrose (ca. 339–397), who possessed a sufficient knowledge of Greek to make use of Basil’s homilies in his own Latin hexaemeral treatise, was instrumental in introducing Basil’s ideas into the Latin language. (Basil’s treatise was translated into Latin in the fifth century and was known directly in the Middle Ages.) It was Saint Augustine, however, who composed the most formidable and influential early Latin commentary on the creation account in Genesis. Not only was his much lengthier than those by Basil and Ambrose (he was familiar with Ambrose’s), but it was also much more informative and philosophical. It had a considerable impact in the late Middle Ages, especially on the theological students who were required to write commentaries on Peter Lombard’s *Sentences*, the second book of which was concerned with the creation and about which we shall say more later.

Basil also had an impact on Greek writers in the East, especially on John Philoponus, a Christian commentator on Aristotle of the sixth century. Philoponus’s hexaemeral treatise was incomparably more sophisticated than Basil’s. In defending the Mosaic account in Genesis against

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the traditional pagan Greek description of the physical world, Philoponus found it necessary to discuss numerous scientific claims and arguments. When his treatise became available in Western Europe in the sixteenth century, it made a significant impact.

Although these early Christian authors subordinated science and the study of nature to the needs of religion, they often indicated an interest in nature, as did Basil, that transcended the mere ancillary status that the study of nature was customarily accorded. The attitude of theologians toward natural philosophy during the late Middle Ages is eloquent testimony that invocation of the handmaiden theory eventually became little more than formulaic.

CHRISTIANITY AND GRECO-ROMAN CULTURE

Greco-Roman culture and learning was sometimes viewed with suspicion, but it was not considered an enemy and its potential utility was recognized early on. Indeed, it may have received unintended support from the Christian attitude toward the state. Because they believed that the kingdom of heaven was imminent, early Christians paid relatively little heed to the world around them. They sought generally to meet their obligations to the state insofar as these did not violate their religious scruples. Nowhere is this better exemplified than in Jesus' reply to the Pharisees who sought to trap him by asking whether they should pay taxes to the Roman emperor. Their question presented Jesus with a dilemma: if he urged them not to pay taxes, he would be guilty of treason to the state; but if he urged them to pay, he would antagonize Jewish nationalists. Jesus' reply was momentous when he urged that they "Render therefore unto Caesar the things which are Caesar's; and unto God the things that are God's" (Matt. 22.21). Thus did Jesus acknowledge the state and implicitly urge his followers to be good citizens.

From the outset, Christians recognized the state as distinct from the church, although, as the Roman Catholic Church became more centralized, various popes sought to dominate the multiplicity of states in Europe. They based their arguments on the conviction that, by the nature of things, the priesthood had to be closer to God than did secular rulers. In a letter to Anastasius, the Eastern emperor, Pope Gelasius (492–496) declared that "there are . . . two by whom principally this world is ruled: the sacred authority of the pontiffs and the royal power. Of these the importance of the priests is so much the greater, as even for Kings of men they will have to give an account in the divine judgment."⁷ The later pretensions of the papacy were based on this notion. The pope claimed supremacy over emperors and kings, as when Innocent III (1198–1216) declared that "The Lord Jesus Christ has set up one ruler over all things as his universal vicar, and as all things in heaven, earth

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and hell bow the knee to Christ, so should all obey Christ's vicar, that there be one flock and one shepherd" and again when he proclaimed that "The *sacerdotium* [priestly power] is the sun, the *regnum* [royal power] is the moon. Kings rule over their respective kingdoms, but Peter rules over the whole earth. The *sacerdotium* came by divine creation, the *regnum* by man's cunning."⁸

A counterattack by the secular power, whether the Holy Roman Emperor or one or another of the kings of Europe, when it came, usually involved an invocation of Christ's statement that one ought to give to Caesar, or to the state, what is Caesar's, and give to God what is God's; or that Christ sat on David's throne as king and not on Aaron's throne as high priest; or that Christ would eventually rule the human race as king, not priest.⁹

From the fifth century through the late Middle Ages, the struggle for supremacy between the papacy and the numerous secular rulers with which it had to contend was ongoing. The power of the papacy reached its high point during the early thirteenth century with the pontificate of Innocent III, after which it declined, largely because secular rulers became so wealthy and powerful that they could no longer be controlled from Rome.

Significant here, however, is not which of these two contending powers was dominant at any time, but rather that each acknowledged the independence of the other. They regarded themselves as two swords, although, all too often, the swords were pointed at each other. Even when the Church asserted supremacy over the state, however, it never attempted to establish a theocracy by appointing bishops and priests as secular rulers. The tradition of the Roman state within which Christianity developed and the absence of explicit biblical support for a theocratic state were powerful constraints on unbridled and grandiose papal ambitions and, above all, made the imposition of a theocratic state unlikely. Although church and state were not as rigidly separated in the Middle Ages as they are today in the United States and Western Europe, and the two often interacted, even blatantly intervening in each other's affairs, they were, nonetheless, independent entities. Pope Gelasius's words cited earlier – "there are . . . two by whom principally this world is ruled: the sacred authority of the pontiffs and the royal power" – bear witness to the separation.

Why are the relationships between early Christianity and Greek science and philosophy on the one hand, and between the Christian church and the secular state on the other hand, relevant to the history of science? Because, as we shall see, the separation of church and state, at least in principle, and, more significantly, the Christian accommodation with Greek science and philosophy, were instrumental conditions that facilitated the widespread, intensive study of natural philosophy during the

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late Middle Ages. As a consequence of the emergence of natural philosophy within the unique university system of the Latin Middle Ages, the revolutionary developments in science of the sixteenth and seventeenth centuries were made possible. We may better appreciate the force of these claims by a comparison of Western European developments with developments in two major contemporary civilizations, Islam and the Byzantine Empire. The differences are striking and will be described in the final chapter.

THE STATE OF SCIENCE AND NATURAL PHILOSOPHY
DURING THE FIRST SIX CENTURIES OF CHRISTIANITY

To comprehend the state of science that obtained by the beginning of the seventh century, it is essential to sketch the basic events that transformed the Roman Empire. During its first two centuries, from the reign of Caesar Augustus to the death of Marcus Aurelius, the Romans controlled a vast empire in which two languages were dominant. In the west, not surprisingly, the Romans succeeded in imposing a basic Roman culture in which Latin was the common means of communication, overlaying a multiplicity of native languages in the regions of Italy, Gaul, Spain, Britain, and North Africa. In the eastern part of the Roman Empire, which to a considerable extent coincided with the old Hellenistic world left in the wake of the conquests of Alexander the Great (that is, Greece, Asia Minor, Syria, Persia, Palestine, and Egypt), Greek was the common language. Beginning with the emperor Diocletian (284–305), the Roman Empire was split administratively into eastern and western parts, largely reflecting the linguistic split into Greek- and Latin-speaking regions. Diocletian chose a colleague, Maximianus, to rule in the West, while he governed in the East, establishing a new capital at Nicomedia. In 330, Constantine established yet another new capital in the East, Constantinople, locating it at the site of an old Greek colony, Byzantium, a name that would eventually stand for the empire itself. For a brief period, between 394 and 395, Theodosius the Great reunited the empire, ruling as sole emperor. Following his death in 395, however, the empire was again ruled by two independent, self-proclaimed emperors, one in the East and one in the West. The line of emperors in the West ended in 476, when Romulus Augustulus was deposed. But even with German states functioning in the Western empire after 476, the Roman Empire was still viewed as intact, and German rulers often acknowledged the empire by either taking or accepting the honored title of consul. This state of affairs continued until Charlemagne was crowned “Emperor of the Romans” by Pope Leo III on December 25, 800, thus beginning the long history of the Holy Roman Empire in Western Europe. By the time of Charlemagne’s coronation, Western Europe had long ceased to be a

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de facto part of the Roman Empire. In the East, however, Roman emperors reigned continuously from the time of Constantine's foundation of Constantinople until the city fell to the Turks in 1453, more than one thousand years later. Thus did the Roman Empire fall for the final time.

Although Latin was the language of the Romans, and Roman military might had created a vast empire, the language of learning in the Roman Empire was Greek. In this sense, Athens conquered Rome. Latin-speaking Romans with intellectual pretensions, never a large group, usually learned Greek, and some went to Greece for their education.

How did science fare within the Roman Empire? Despite much political and military turmoil, the multiplication of mystery religions, and an emphasis on the occult, some of the greatest scientific works of the ancient world were written in this period (as always in the Greek language and in the eastern half of the empire). A few of these works exerted a profound influence on the later course of medieval science and well beyond into the Renaissance.

The first century A.D. saw the significant works of Hero of Alexandria (who wrote on pneumatics, mechanics, optics, and mathematics), Nicomachus (on Pythagorean arithmetic), and Theodosius and Menelaus (who both wrote on spherical geometry; Menelaus's *Spherics* is especially important for the treatment of spherical triangles and trigonometry). The greatest works in astronomy and medicine were written in the second century. Claudius Ptolemy wrote the *Mathematical Syntaxis*, or *Almagest*, as it was called by the Arabs, the greatest treatise in the history of astronomy until the time of Copernicus in the sixteenth century. Ptolemy's scientific genius was not confined to astronomy. He also wrote technical works in optics, geography, and stereographic projection, and he even produced the greatest of all astrological works, the *Tetrabiblos* (known in Latin as the *Quadripartitum*, the four-parted work). In the medical and biological sciences, Galen of Pergamum produced about one hundred fifty works embracing both theory and practice, which formed the basis of medical theory and study until the sixteenth and seventeenth centuries. Even in the third century significant contributions were made in mathematics by Diophantus in algebra and later by Pappus, who not only wrote commentaries on the great mathematical works of Greek antiquity but also, in his *Mathematical Collection*, showed originality and understanding of a high order.

The Greek world of late antiquity also contributed powerfully to natural philosophy, largely by way of commentaries on the works of Aristotle. Because Aristotelian natural philosophy plays a central role in this study, and because the Greek commentaries on Aristotle's works in late antiquity were of particular importance for the subsequent history of science, a brief description of the late Greek commentators will be given in the next chapter.