

# The Enduring East

## Byzantine Orthodoxy

After Rome fell in 476 CE, the empire's eastern districts with their capital at Constantinople gradually metamorphosed into the Greek-speaking Byzantine Empire. (See map 6.1.) A Christian state, headed by an emperor and governed by elaborate and scheming bureaucracies (hence "byzantine"), the Byzantine Empire endured for a thousand years before being overrun by the Ottoman Turks in 1453. In possession of the Egyptian breadbasket the empire flourished and wealthy emperors continued to patronize many old institutions of higher learning.

Science in the Byzantine Empire remains to be studied by historians in greater detail. Byzantine civilization is often criticized as anti-intellectual and stifled by a mystical Christianity that was imposed as a state religion. That the emperor Justinian (r. 527–565) closed Plato's still-functioning Academy at Athens along with other schools in 529 CE is commonly seen as evidence of the state's repressive posture toward science. Yet, to dismiss Byzantium from the history of science would be to overlook continuations of Hellenistic traditions and the ways, quite typical of eastern bureaucratic civilizations, in which science and useful knowledge became institutionalized in society.

Even after the Justinian closures, state schools and church schools provided instruction in the mathematical sciences (the quadrivium: arithmetic, geometry, astronomy, and music), the physical sciences, and medicine; libraries existed as centers of learning. The true hospital, as an institution of in-patient medical treatment (and Christian mercy), was a notable Byzantine innovation. It was, like the hospital today, primarily a center of medical technology, not science. As hospitals arose throughout the Byzantine Empire through the largesse of government, church, and aristocratic patrons, in some measure they also became centers of medical research. Byzantine medicine fully assimilated the medical and physiological teachings of Galen and Hippocrates, while



some hospitals maintained libraries and teaching programs and even fostered some original investigations and innovative techniques. Learned Byzantine doctors turned out influential medical and pharmacological tracts, albeit with much repetition of Greek knowledge. Veterinary medicine was a notable aspect of scientifico-medical activity in Byzantine civilization, one heavily supported by monarchs who had an interest in the well-being of their war horses since cavalry and the cavalry charge formed the basis of the Byzantine army and military tactics. As a result, Byzantine veterinarians produced many veterinary manuals, occasionally on a high level of originality.

In the fields of the exact sciences the Greek-speaking Byzantine scholars inherited much Greek learning from antiquity. They knew their Aristotle, Euclid, and Ptolemy, and Byzantine astronomers and mathematicians themselves sometimes produced sophisticated tracts based on earlier Greek and contemporary Persian sources. In addition to calendar work, a strong element of astrology, reflecting that venerable and inextinguishable desire to know the future, characterized Byzantine astronomy. Experts likewise studied music and mathematical music theory, perhaps for liturgical purposes. And finally, Byzantine alchemy and alchemical mineralogy cannot be overlooked as areas of both considerable research activity and of perceived practical utility.

The most notable natural philosopher of the early Byzantine era was John Philoponus. Philoponus lived and worked in Alexandria under Byzantine governance during the middle years of the sixth century CE, and he launched the most sweeping attack on Aristotelian physics prior to the Scientific Revolution in Europe. In various commentaries he developed trenchant critiques of Aristotle and several aspects of Aristotelian physical theory. In his ingenious analysis of projectile motion, for example—motion Aristotle had lamely explained by invoking the ambient air as the required mover—Philoponus suggested that the thrower endowed the projectile with a certain power to move itself. Philoponus's views in turn sparked critical responses from other commentators, and because he so focused the debate on specific problems in Aristotle's writings on natural philosophy, Philoponus was later influential among Islamic and European natural philosophers when they came to review Aristotle's work. Having studied the science of the Greeks and writing in Greek, his career and his accomplishments are landmarks in the tradition of Byzantine science.

A full social history of Byzantine science would display the subject in a more favorable light than does intellectual history alone, which stresses originality and pure theory. Such a social history would pay close attention to intellectually unambitious medical tracts, to treatises published by veterinary surgeons retained by Byzantine monarchs, to the many farmers' manuals and herbals produced under Byzantine governance, as well as to astrology and alchemy. In a society where bureaucratic centralization was extreme, support came precisely for encyclo-

*Map 6.1.* Byzantium and Sassanid Persia. In late antiquity two derivative civilizations took root in the Middle East—the Byzantine Empire centered in Constantinople and Sassanid Persia in the heartland of ancient Mesopotamia. Both assimilated ancient Greek science and became centers of learning. (*opposite*)

pedists, translators, and writers of manuals on subjects useful and mundane. And it is precisely the kind of work that historians intent on detecting theoretical novelty tend to neglect.

The loss of Egypt and the productive resources of the Nile Valley to invading Arabs in the seventh century was a severe setback to the economy and society of Byzantium. Yet a reduced Byzantine civilization maintained itself, its cities, its institutions, and its science for hundreds of years. Inevitably, however, decline set in after the year 1000, as Byzantium faced challenges from the Turks, from the Venetians, and from friendly and not-so-friendly European Christians on crusade. In 1204 Crusaders pillaged Constantinople and occupied it until 1261. Finally, in 1453 the city and the empire fell to the Turks.

Although Byzantium never became a center of significant original science, it did not repudiate the tradition of secular Greek learning. Indeed, it tolerated and even preserved that tradition alongside the official state religion of Christianity.

## Mesopotamia Revisited

In the heartland of ancient Mesopotamia the Sassanid dynasty created a typical Near Eastern system of scientific institutions along with a typical Near Eastern economy based on hydraulic agriculture and the restoration and maintenance of the old irrigation systems. The Sassanid dynasty was founded in 224 CE, and was characterized by a strong central government and a bureaucratic caste that included scribes, astrologers, doctors, poets, and musicians. By the sixth century the royal residence at Jundishapur, northeast of present-day Basra, had become a cultural crossroads where many different learned traditions mingled: Persian, Christian, Greek, Hindu, Jewish, and Syrian. Persian cultural life became enriched when Nestorian Christians—bringing Greek learning with them—fled Byzantium after their center at Edessa in Turkey was shut down in 489. A significant translation effort, centered in Jundishapur, rendered Greek texts into Syriac, the local language. Texts deemed to contain useful knowledge were generally chosen for translation—mainly the medical arts, but also scientific subjects, including Aristotle's logical tracts, mathematics, and astronomy. Jundishapur also became the site of a hospital and medical school, enriched by the presence of Indian medical masters; later taken over by Arab-Islamic caliphs, the medical school at Jundishapur continued to flourish until the eleventh century. Persian government authorities also sponsored astronomical and astrological investigations. While recent reappraisals have tempered its importance, Jundishapur was nonetheless a cosmopolitan intellectual center and a center of scientific patronage for several centuries before Persia fell to the forces of Islam in 642 CE.

Sassanid civilization illustrates once again that centralization of authority to manage a hydraulic agricultural economy fostered scien-