Chapter Three
The Spread of Copernicanism in Northern Europe

3.1 Robert S. Westman, *The Copernicans and the churches**

In 1543, on his deathbed, Nicolaus Copernicus received the published results of his life's main work, a book magisterially entitled *De Revolutionibus Orbium Coelestium Libri Sex* (*Six Books on the Revolutions of the Celestial Orbs*), which urged the principal thesis that the earth is a planet revolving about a motionless central sun. In 1616, seventy-three years after its author's death, the book was placed on the Catholic Index of Prohibited Books with instructions that it not be read 'until corrected'. Sixteen years later – and, by then, ninety years after Copernicus first set forth his views – Galileo Galilei (1564–1642) was condemned by a tribunal of the Inquisition for 'teaching, holding, and defending' the Copernican theory. These facts are well known, but the dramatic events that befell Galileo in the period 1616–1632 have tended to overshadow the relations between pre-Galilean Copernicans and the Christian churches and to suggest, sometimes by implication, that the Galileo affair was the consummation of a long-standing conflict between science and Christianity.

...It will be helpful if we can suspend polar categories customarily used to describe the events of this period, such as Copernican versus anti-Copernican, Protestant versus Catholic, the individual versus the church. The central issue is better expressed as a conflict over the standards to be applied to the interpretation of texts, for this was a problem common to astronomers, natural philosophers, and theologians of whatever confessional stripe. In the case of the Bible, should its words and sentences in all instances be taken to *mean* literally what they say and, for that reason, to describe

* Robert S. Westman, 'The Copernicans and the churches', in D. Lindberg and R. Numbers (eds), *God and Nature: Historical Essays on the Encounter between Christianity and Science* (Berkeley, CA: University of California Press, 1986), pp. 76–85, 89–91.

actual events and physical truths? Is the subject matter of the biblical text *always* conveyed by the literal or historical meaning of its words? Where does the ultimate authority reside to decide on the mode of interpretation appropriate to a given passage? In the case of an astronomical text, should its diagrams be taken to refer literally to actual paths of bodies in space? Given two different interpretations of the same celestial event, where does the authority reside to decide on the particular mode of interpretation that would render one hypothesis preferable to another? When the subject matters of two different *kinds of text* (e.g., astronomical and biblical or astronomical and physical) coincide, which standards of meaning and truth should govern their assessment? And finally, how did different accounts of the God–Nature relationship affect appraisal of the Copernican theory? Questions of this sort define the issue faced by sixteenth- and early seventeenth-century Copernicans.

Copernicus's achievement

...Nicolaus Copernicus (1473–1543) was a church administrator in the bishopric of Lukas Watzenrode, located in the region of Warmia, now northern Poland but then part of the Prussian Estates. Watzenrode was Copernicus's uncle and guardian, and it was through his patronage that the young man was able to study medicine and canon law in Italy before returning to take up practical duties, including supervision of financial transactions, allocation of grain and livestock in peasant villages, and overseeing the castle and town defenses in Olsztyn. Though a member of the bishop's palace, Copernicus was not a priest but a clerical administrator or canon.

In his spare time Copernicus worried about a problem that had long concerned the church – accurate prediction of the occurrence of holy days such as Easter and Christmas. Now calendar reform was an astronomical problem that demanded not primarily new observations but the assimilation of old ones into a model capable of accurately predicting the equinoxes and solstices, the moments when the sun's shadows produce days of longest, shortest, and equal extent. But predictive accuracy had never been the astronomer's only goal. The mathematical part of astronomy was complemented by a physical part. The object of the latter was to explain why the planets moved, what they were made of, and why they are spaced as they are. According to Aristotle's heavenly physics, the sun, moon, and other planets are embedded in great spheres made of a perfect and invisible substance called aether. The spheres revolve uniformly on axes that all pass through the center of the universe. This model yielded an appealing picture of the universe as a kind of celestial onion with earth at the core; but it failed to explain why the planets vary in brightness. As an alternative, the astronomer Ptolemy (*fl.* A.D. 150) used a mathematical device according to which the planet moves uniformly about a small circle (the epicycle) while the center of the epicycle moves uniformly about a larger circle (the deferent). Such a model could account for variations in both speed and brightness. Ptolemy also invented another device, however, called the 'equant' .... Here the center of an epicycle revolves *nonuniformly* as viewed both from the sphere's center and from the earth but *uniformly* as computed from a noncentral point (situated as far from the center on one side as the earth is on the other). As a predictive mechanism the equant is successful. But now ask how it can be that the planet, like a bird or fish, 'knows' how to navigate uniformly in a circle about an off-center point while, simultaneously, flying variably with respect to the center of the same sphere? In response to objections like this it was quite customary for astronomers in the universities to consider the planetary circles *separately* from the spheres in which they were embedded. This meant that conflict between the mathematical and physical parts of astronomy could be avoided by not mixing the principles of the two disciplines. If, however, an astronomer were determined to reconcile physical and mathematical issues, it would be customary within the Aristotelian tradition (which prevailed within the universities) to defer to the physicist, for in the generally accepted medieval hierarchy of the sciences, physics or natural philosophy was superior to mathematics.

Copernicus, like all great innovators, straddled the old world into which he was born and the new one that he created. On the one hand he was a conservative reformer who sought to reconcile natural philosophy and mathematical astronomy by proclaiming the absolute principle that all motions are uniform and circular, with all spheres turning uniformly about their own centers. But, far more radically, Copernicus argued for the earth's status as a planet by appealing to arguments from the *mathematical part* of astronomy. In so doing he shifted the weight of evidence for the earth's planetary status to the lower discipline of geometry, thereby violating the traditional hierarchy of the disciplines. If anything can be called revolutionary in Copernicus's work, it was this mode of argument – this manner of challenging the central proposition of Aristotelian physics.

We are now prepared to consider the general logical structure of Copernicus's argument. Briefly, it looks like this: *If* we posit that the earth has a rotational motion on its axis and an orbital motion around the sun, then (1) all known celestial phenomena can be accounted for as accurately as on the best Ptolemaic theories; (2) the annual component in the Ptolemaic models, an unexplained mirroring of the sun's motion, is eliminated; (3) the planets can be ordered by their increasing sidereal periods from the sun; and (4) the distances of the planets from the center of the universe can be calculated with respect to a 'common measure', the earth–sun radius (a kind of celestial yardstick), which remains fixed as the absolute unit of reference .... Although they were certainly among the most important consequences, these four were not the only ones to follow from the assumption of terrestrial motion. However, from the viewpoint of the prevailing logic of demonstrative proof, found in Aristotle's *Posterior Analytics*, there was no *necessity* in the connection between the posited cause and the conclusions congruent with that cause. Thus, while Copernicus's premises certainly authorized the conclusions he drew, there was no guarantee that other premises might not be found, equally in accord with the conclusions. In short, Copernicus had provided a systematic, logical explanation of the known celestial phenomena, but in making the conclusions the grounds of his premises, he failed to win for his case the status of a demonstrative proof.

Pre-Galilean Copernicans were thus faced with several serious problems. First, their central premise had the status of an assumed, unproven, and (to most people) absurd proposition. Second, whatever probability it possessed was drawn primarily from consequences in a lower discipline (geometry). Third, even granting the legitimacy of arguing for equivalent predictive accuracy with Ptolemy, the practical derivation of Copernicus's numerical parameters was highly problematic. Fourth, the Copernican system flagrantly contradicted a fundamental dictum of a higher discipline, physics – namely, that a simple body can have only one motion proper to it – for the earth both orbited the sun and rotated on its axis. And finally, it appeared to conflict with the interpretations of another higher discipline, biblical theology – in particular, the literal exegesis of certain passages in the Old Testament.

Under the circumstances Copernicus resorted to a rhetorical strategy of upgrading the certitude available to 'mathematicians' – by which he meant those who practiced the mathematical part of astronomy – while underplaying the authority of natural philosophy and theology to make judgments on the claims of mathematicians. Final authority for interpreting his text, he said, rested with those who best understand its claims. Church fathers such as Lactantius had shown a capacity for error in astronomy and natural philosophy, as when Lactantius declared the earth to be flat. Theologians of this sort should stay away from a subject of which they are ignorant.

Copernicus's strategy of appealing to the autonomy and superiority of mathematical astronomy was undercut by a prefatory 'Letter to the Reader' that appeared immediately after the title page of *De Revolutionibus*. That brief epistle bespeaks the extraordinary circumstances surrounding the publication of the book. It was only at the very end of Copernicus's life that he was finally persuaded to publish his book – not by one of his fellow canons, some of whom were eager to see the manuscript in press, but by a young Protestant mathematics lecturer who had come to visit the old canon from the academic heart of the Lutheran Reformation, the University of Wittenberg. Georg Joachim Rheticus (1514–1574) was permitted by Copernicus to publish a preliminary version of the heliocentric theory (*Narratio Prima*, 1540) and also to attend to the eventual publication of *De Revolutionibus*. But Rheticus lacked the time to oversee the work and so entrusted it to a fellow

Lutheran, Andreas Osiander (1498–1552). Osiander, without permission from either Copernicus or Rheticus, took it upon himself to add an unsigned prefatory 'Letter' written in the third person singular. Upon reading the manuscript, Osiander had become convinced that Copernicus would be attacked by the 'peripatetics and theologians' on the grounds that 'the liberal arts, established long ago on a correct basis, should not be thrown into confusion'. Osiander hoped to save Copernicus from a hostile reception by appealing to the old formula according to which astronomy is distinguished from higher disciplines, like philosophy, by its renunciation of physical truth or even probability. Rather, if it provides 'a calculus consistent with the observations, that alone is enough'. *De Revolutionibus* was thus to be regarded as a strictly mathematical-astronomical text unable to attain even 'the semblance of the truth' available to philosophers; and both mathematicians and philosophers were incapable of stating 'anything certain unless it has been divinely revealed to them'.

Early Protestant reaction: the Melanchthon circle and the 'Wittenberg Interpretation'

When Rheticus returned to his teaching duties at Wittenberg after his long visit to Copernicus, he brought back strongly favorable personal impressions of the Polish canon and his new theory. Rheticus himself was Copernicus's first major disciple, and many of the Wittenberger's students read and studied *De Revolutionibus*. Furthermore, Rheticus composed a treatise, recently rediscovered, in which he sought to establish the compatibility of the Bible and the heliocentric theory.[1] All of this tempts us to ask whether Protestants were particularly well disposed toward the Copernican theory.

To answer this question, we must distinguish between the Protestant Reformers and men who happened to be Protestants and were also well versed in the reading of astronomical texts. The Reformers Luther and Calvin were learned men who knew enough astronomy to understand its basic principles; but neither had ever practiced the subject. It used to be thought that Luther played an important role in condemning Copernicus's theory when, in the course of one of his *Tischreden* or *Table Talks*, he said: 'That fool wants to turn the whole art of astronomy upside down.' But the statement itself is vague on details and, in any event, was uttered in 1539, sometime before the publication of either Rheticus's *Narratio Prima* or Copernicus's *De Revolutionibus*. As for Calvin, there is no positive evidence that he had ever heard of Copernicus or his theory; if he knew of the new

---

1 G. J. Rheticus, *Holy Scripture and the Motion of the Earth* [1540], trans. R. Hooykas, from G. J. Rheticus *Treatise on Holy Scripture and the Motion of the Earth* (Amsterdam: North-Holland Publishing Company, 1984). Cf. Doc 2.2 in *Science in Europe, 1500–1800: A Primary Sources Reader*, the companion Reader to this volume.

doctrine, he did not deem it of sufficient importance for public comment. In short, there are no known opinions by these two leading Protestant Reformers that significantly influenced the reception of the Copernican system.

There was, however, a third Reformer, a close associate of Luther's and the educational arm of the Reformation in Germany, Philipp Melanchthon (1497–1560), known as *Praeceptor Germaniae.* A charismatic man, beloved teacher, and talented humanist, Melanchthon was also a brilliant administrator with a gift for finding compromise positions. In the face of serious disturbances from the Peasants' Revolt of 1524–1525 and plunging enrollments all over Germany, Melanchthon instituted far-reaching reforms that led to the rewriting of the constitutions of the leading German Protestant universities (Wittenberg, Tübingen, Leipzig, Frankfurt, Greifswald, Rostock, and Heidelberg), profoundly influencing the spirit of education at several newly founded institutions (Marburg, Königsberg, Jena, and Helmstedt). Most important of all, Melanchthon believed that mathematics (and thus astronomy) deserved a special place in the curriculum because through study of the heavens we come to appreciate the order and beauty of the divine creation. Furthermore, mathematics was an excellent subject for instilling mental discipline in students. Such views alone would not predispose one toward a particular cosmology, but they did help to give greater respectability to the astronomical enterprise. Thus, a powerful tradition of mathematical astronomy developed at Wittenberg from the late 1530s and spread throughout the German and Scandinavian universities. At Wittenberg itself, three astronomers in the humanistic circle gathered around Melanchthon were preeminent: Erasmus Reinhold (1511–1553), his pupil Rheticus, and their joint pupil and the future son-in-law of Melanchthon, Caspar Peucer (1525–1603). Melanchthon was the *pater* of this small *familia scholarium*. Many of the major elements in the subsequent interpretation of Copernicus's theory in the sixteenth century would be prefigured in this group at Wittenberg.

The 'Wittenberg Interpretation', as we will call it, was a reflection of the views of the Melanchthon circle. Melanchthon himself was initially hostile to the Copernican theory but subsequently shifted his position, perhaps under the influence of Reinhold. Melanchthon rejected the earth's motion because it conflicted with a literal reading of certain biblical passages and with the Aristotelian doctrine of simple motion. But Copernicus's conservative reform – his effort to bring the calculating mechanisms of mathematical astronomy into agreement with the physical assumption of spheres uniformly revolving about their diametral axes – was warmly accepted. Reinhold's personal copy of *De Revolutionibus*, which still survives today, is testimony; it has written carefully across the title page the following formulation: 'The Astronomical Axiom: Celestial motion is both uniform and circular or composed of uniform and circular motions.' As it stands, this proposition simply ignores physical claims for the earth's motion, but commits itself to an equantless astronomy. It is, we might say today, a 'research program', one which Copernicus tried to make compatible with the assumption that the earth is a planet. But the Wittenbergers, with the noticeable exception of Rheticus, refused to follow Copernicus in upsetting the traditional hierarchy of the disciplines. Instead, Reinhold and his extensive group of disciples accepted Melanchthon's physical and scriptural objections to the Copernican theory. In the prevalent mood of reform, Copernicus was perceived not as a revolutionary but as a moderate reformer (like Melanchthon), returning to an ancient, pristine wisdom before Ptolemy.

If Melanchthon and Reinhold saw Copernicus as a temperate reformer, Rheticus saw the radical character of his reform. Rheticus returned to Wittenberg in 1542 as an inflamed convert, writing of Copernicus as of one who has had a Platonic vision of The Good and The Beautiful – though in the harmony of the planetary motions. ... Even more enthusiastically than Copernicus, Rheticus extolled the 'remarkable symmetry and interconnection of the motions and spheres, as maintained by the assumption of the foregoing hypotheses', appealing to analogical concordance with musical harmonies, to the number six as a sacred number in Pythagorean prophecies, to the harmony of the political order in which the emperor, like the sun in the heavens, 'need not hurry from city to city in order to perform the duty imposed on him by God', and to clockmakers who avoid inserting superfluous wheels into their mechanisms. Copernicus's unification of previously separate hypotheses had a liberating, almost intoxicating, effect on Rheticus, which Rheticus expressed almost as a personal revelation fully comprehensible only by visualizing the ideas themselves.

A wide spectrum of early Protestant opinion is defined between Melanchthon's cautious promotion of Copernicus's reform and Rheticus's radical espousal of the core propositions of Copernican cosmology. In general, the Wittenberg Interpretation dominated until the 1580s, while Rheticus's vision was typically ignored in public discussions. By the late 1570s, however, there were signs of the emergence of a cosmological pluralism among Protestant astronomers. A Danish aristocrat named Tycho Brahe (1546–1601) established an extraordinary astronomical castle on the misty island of Hveen, near Copenhagen, where he commenced a major reform of astronomical observations and, by the early 1580s, proposed a new cosmology in which all the planets encircle the sun, while the sun moves around the stationary, central earth. This system – the Tychonic or geoheliocentric – adopted Copernican-heliocentric paths for the planets, causing the orbits of Mars and the sun to intersect, while preserving Aristotelian terrestrial physics ...; but in another quite important respect, Tycho departed from Aristotle by abolishing the solid celestial spheres. In 1600 the Englishman William Gilbert (1540–1603) suggested that the earth possesses a magnetic soul that causes it to turn daily on its axis; but he was cryptic about the ordering of Mercury and Venus.

Throughout the second half of the sixteenth century, Copernicus's book was widely read and sometimes studied in both Catholic and Protestant countries. Compared to the fairly large number of people aware of the central claims of *De Revolutionibus*, however, there were relatively few who actively adopted its radical proposals and whom we can justifiably call 'Copernicans' in that sense. To be precise: we can identify only ten Copernicans between 1543 and 1600; of these, seven were Protestants, the others Catholic. Four were German (Rheticus, Michael Maestlin, Christopher Rothmann, and Johannes Kepler); the Italians and English contributed two each (Galileo and Giordano Bruno; Thomas Digges and Thomas Harriot); and the Spaniards and Dutch but one each (Diego de Zuñiga; Simon Stevin). [. . .]

The Copernican theory and biblical hermeneutics

The Protestant Reformers were agreed in emphasizing the plain, grammatical sense as the center of biblical interpretation, thereby making it accessible to anyone who could read. Additional help was sometimes sought from spiritual or allegorical readings, but the literal, realistic meaning always remained central. Now, the literalism of the Reformers was twofold: they believed that the Bible was literal both at the level of direct linguistic reference (nouns referred to actual people and events) and in the sense that the *whole story* was realistic. The Bible's individual stories needed to be woven together into one cumulative 'narrative web'. This required the earlier stories of the Old Testament to be joined interpretatively to those in the New Testament by showing the former to be 'types' or 'figures' of the latter. Luther and Calvin were agreed that there was a single theme, a primary subject matter, which united all the biblical stories: the life and ministry of Christ.

Although Protestants rejected the Catholic appeal to allegorical and anagogical interpretations of Scripture as an illegitimate stretching of the plain meaning, both groups of exegetes had available to them a method of interpretation to which they could appeal: the principle of accommodation. One purpose of this hermeneutic device was to resolve tensions between popular speech, wedded to the experience of immediate perception, and the specialized discourse of elites. The necessity of sacrifices or anthropomorphic references to God as a man with limbs were types of references that could easily evoke appeal to the principle of accommodation. In the seventeenth and eighteenth centuries, Jesuit missionaries in China sparked a controversy over accommodation when they allowed Chinese converts to pray to Confucius, worship ancestors, and address God as *Tien* (sky). Like the Jesuit missionaries, the sixteenth-century followers of Copernicus made use of the option of accommodation. For them, however, the problem was not the alien belief-systems of a foreign society but the disciplinary hierarchy of the universities in which theology occupied the highest rank.

. . . [L]et us look briefly at four specific classes of biblical passages that were relevant to the Copernican issue – references to the stability of the earth, the sun's motion with respect to the terrestrial horizon, the sun at rest, and the motion of the earth. Both Protestant and Catholic geocentrists customarily cited verses from the first two categories and interpreted them to refer literally to the physical world. Consider, for example, Psalm 93:1: 'The world also is stablished, that it cannot be moved'; or Ecclesiastes 1:4: 'One generation passeth away, and another generation cometh: but the earth abideth for ever'; Ecclesiastes 1:5: 'The sun also ariseth, and the sun goeth down and hasteth to his place where he arose'; Psalm 104:19: 'He appointed the moon for seasons: the sun knoweth his going down.' The literal interpretation of these passages springs from different sources for Protestants and Catholics. For Protestants, such as Melanchthon, it came from a steadfast faith in the inerrancy of the grammatically literal text; for Catholics, such as Tolosani, the literal meaning was legitimated by appeal to the (allegedly unanimous) authority of previous interpreters. In both cases the geocentrists ignored verses from categories three and four.

The Copernicans had available to them two hermeneutical strategies. The first, which we may call 'absolute accommodationism', declares that the verses in all four categories are accommodated to human speech. The virtue of this position is that it draws a radical line of demarcation between biblical hermeneutics and natural philosophy, so that the principles and methods of the one cannot be mixed with those of the other. It is also in keeping with the moderate Christocentric reading of Scripture advocated by the Reformers. Far more dangerous was the second strategy, which we may call 'partial accommodationism', according to which the interpreter provides a literal, *heliostatic* or *geomotive*, construal of either Joshua 10:12–13 or Job 9:6 and then accommodates it to verses conventionally read as geostatic. In the Joshua text we read: 'Then spake Joshua to the Lord in the day when the Lord delivered up the Amorites before the children of Israel, and he said in the sight of Israel, Sun, stand thou still upon Gibeon; and thou, Moon, in the valley of Ajalon. And the sun stood still, and the moon stayed, until the people had avenged themselves upon their enemies.' The construction 'stand still' is certainly plain talk to the senses; thus, the heliocentrist, if he wished to pursue a partial-accommodationist line, must point out that we need not intend the horizon as our reference frame and that the sun could be rotating on its own axis, while remaining at rest at the center of the universe. A similar kind of ambiguity of reference frame is present in the Job text: 'Which shaketh the earth out of her place, and the pillars thereof tremble.' The phrases 'out of her place' and 'tremble' could be taken to denote either diurnal or annual motion or simply the earth quaking. The sixteenth-century Copernicans, perhaps taking the lead from Copernicus's brief remarks about Lactantius, tended to adopt the position of absolute accommodation. [. . .]