

8 Galileo on science and Scripture

AT THE ROOT OF THE GALILEO AFFAIR¹

In Bertolt Brecht's play, *Galileo*, an aged cardinal denounces the upstart astronomer from Florence:

I am informed that Signor Galilei transfers mankind from the center of the universe to somewhere on the outskirts. Signor Galilei is therefore an enemy of mankind and must be dealt with as such. Is it conceivable that God would trust this most precious fruit of his labor to a minor frolicking star? Would He have sent His Son to such a place? . . . (To Galileo) You have degraded the earth despite the fact that you live by her and receive everything from her. I won't have it! I won't have it! I won't be a nobody on an inconsequential star briefly twirling hither and thither. . . . The earth is the center of all things, and I am the center of the earth, and the eye of the Creator is upon me. About me revolve, affixed to their crystal shells, the lesser lights of the stars and the great light of the sun, created to give light on me that God might see me – Man, God's greatest effort, the center of creation: "In the image of God He created him."²

Brecht puts in the mouth of the old cardinal what he himself may well have believed the primary motive to be on the church's side of the "Galileo affair." Certainly, this reading of history has been a common one from the time of the Enlightenment onwards. Why were Galileo's Copernican views met with such hostility on the part of his Church? What could have explained the violent opposition of the Roman authorities to the views of someone who was after all recognized by these same authorities as the leading astronomer in the Italy of his day? Why would they have risked such a clash where the stakes were obviously so high?

Brecht's cardinal echoes the many whose Galileo is the principal mover in the "Copernican revolution" that displaced human beings from the center of the cosmos. Had not Christian theology from the beginning portrayed human beings as the focal point of God's creation, the only creatures capable of affirmation or denial, creatures whose history showed the Creator's special concern? And did not the common-sense Aristotelian Earth-centered cosmos give philosophical body to this theological framework of belief? No wonder, then, that the Roman theologians would have been so concerned, so intent to crush the Copernican challenge at all costs, just as later theologians would oppose those other great diminishers of human uniqueness, Darwin and Freud.

In this essay, I want to argue by way of prologue that this reading of Galileo's conflict with the Catholic Church is wrong. Not *entirely* wrong, of course, since cosmological issues were obviously involved in the opposition to Galileo on the part of the Roman Curia, but substantially wrong nonetheless. Brecht located the conflict at just the point where *he* would have seen the threat had *he* been a Roman theologian of that time. And historians of science who take the cosmological thesis propounded in the *Dialogue on Two Chief World Systems* to be the key not surprisingly tend to suppose that the strongly negative reaction of the Church authorities to that book was prompted by their adherence to the "Chief World System" so effectively undermined there, that of Aristotle.³

The theologian-consultors who were asked in 1616 to evaluate the Copernican assertion that the Sun is at rest at the center of the world saw the matter differently, however. The Copernican claim was, they said, "foolish and absurd in philosophy" (or, as we would say, in science), but, far more seriously in their eyes, it was

formally heretical, since it explicitly contradicts in many places the sense of Holy Scripture according to the literal meaning of the words and according to the common interpretation and understanding of the Holy Fathers and the doctors of theology.⁴

What these consultors showed themselves committed to defend was not primarily a cosmology. In their own eyes, they were vindicating the authority of Scripture in regard to the truth of its literal content. The Copernican theses about the Earth's motion and the Sun's stability were, in their view, clearly at odds with specific passages in the

Bible. To affirm such theses, therefore, was equivalent to calling the authority of Scripture into question. It was that, and not a presumed link between Aristotelian cosmology and the *content* of Christian doctrine, that led them to condemn the Copernican claim about the Sun as “formally heretical.”⁵

Looming just as large in Roman eyes was the challenge that the Copernicans offered to Church authority. At the fourth session of the Council of Trent in 1546, in order to “control petulant spirits,” it had been decreed that:

in matters of faith and morals pertaining to the edification of Christian doctrine, no one relying on his own judgment and distorting the Sacred Scriptures according to his own conception shall dare to interpret them contrary to that sense which Holy Mother Church, to whom it belongs to judge of their true sense and meaning, has held or does hold, or even [to interpret them] contrary to the unanimous agreement of the Fathers...⁶

Yet here were the Copernicans, petulant spirits surely as far as the theologians were concerned, disputing on their own authority as individuals the traditional interpretation of various biblical passages. To the consultors, this would have seemed a direct violation of the mandate of Trent. The challengers were setting themselves dangerously close to the camp of the Reformers for whom the individual’s right to interpret Scripture according to his or her own lights was paramount.

The issue that had most bitterly divided the two sides in the century-old dispute that had sundered Christendom was this very one: With whom does authority lie in the interpretation of disputed passages in Scripture? Cosmology offered the occasion for the complaint that had been laid before the consultors, to be sure. And they were convinced that the Copernican cosmology was false even on purely philosophical (in our terms, scientific) grounds, an important link in their overall argument. But, as theologians, their primary motive for rejecting the new cosmology lay deeper: It contradicted the literal sense of the words of Scripture where the literal sense was clearly the proper one, as far as they were concerned. Furthermore, its proponents undoubtedly seemed to the consultors to have arrogated to themselves an authority in interpreting Scripture that belonged properly only to the Church, speaking through its bishops and theologians.

Ponder for a moment a simple counter-factual conjecture. Suppose the biblical writers had not found occasion to refer in passing to the motion of the Sun or the stability of the Earth; this could, so far as one can see, have happened very easily. Would the Church still have condemned the Copernican doctrine? Would the comfortable coherence between the common-sense geocentrism of Aristotle and the anthropocentrism of the Christian tradition have been sufficient of itself to warrant the charge of heresy against the Copernican challenge to the Aristotelian world system? It would surely seem not. At the very least, a completely different argument would have had to be advanced for such a charge, an argument of which there is hardly a hint, to the best of my knowledge, in the theological writings of the day.

Had Galileo made his case for Copernicanism a century earlier or a century later, it seems unlikely that it would have evoked the strong response it did on the part of the Roman theologians. After all, Nicole d'Oresme, a prominent ecclesiastic, had given cautious credence to the arguments for a rotating earth long before Copernicus, without exciting any notable reaction among theologians. When, however, a respectable theologian, like Paolo Foscarini, signified his support for the Copernican arguments in 1615, his book was summarily banned. What had changed in the meantime? It would be risky to rely too much on the comparison between two such diverse and such complex historical contexts. But it seems fair to say that the most significant changes were those associated with the Protestant Reformation, notably the deep division regarding the role of authority in the interpretation of Scripture.

The Council of Trent repeated the traditional view that God is the "author" of the Bible but did little to clarify the nature of the influence by which God was said to move the human writers, other than to describe it in passing by the metaphor of dictation. It is clear in the context that this was not intended in the sense of a direct revelation or of a literal dictation of text, since the "dictation" is said to extend to the later "unwritten traditions" of the Church, whose authority the Council was concerned at all costs to safeguard against the attacks of the Reformers.

Nevertheless, the notion that even the very word choice of the biblical text was God's, and thus inerrant, gained ground among Catholic and Protestant theologians alike, engaged as they were in doctrinal duels where the main weapons were proof-texts drawn

from Scripture, deployed quite often independently of biblical context. The Dominican theologian, Melchior Cano, to recall one well-known example of this hardening of exegetical approach, claimed in his *De Theologicis Locis* of 1585 that “not only the words but even every comma has been supplied by the Holy Spirit.”⁷ A similar view can be found on the Reformation side also, in the *Formula Consensus Helvetica* of 1675, for example, which maintained that even the very letters of the Bible must be regarded as inspired by God. In the defensive climate that prevailed in Roman theological circles by the early seventeenth century, Galileo’s attempt to appeal to more tolerant exegetical principles, like that of accommodation, for instance, was not likely to be greeted with any sympathy, even though these principles could find a warrant all the way back to Augustine. Galileo had the misfortune to bring the Copernican claims to public notice at just the wrong time, a time when sensitivities in regard to questions involving scriptural interpretation and Church authority were at their most intense.

The Galileo affair ought not then be construed, as it so often has been, as primarily a clash between rival cosmologies, with the resistance of the Church authorities to the new cosmology to be explained by their stubborn adherence to an outmoded Earth-centered cosmos. The embattled Aristotelian natural philosophers who, when the astronomical evidence went strongly against them, called in their support what Galileo called the “terrible weapon”⁸ of Scripture *did*, of course, view their battle with the Copernicans in primarily cosmological terms. But the same was not true of those theologians who came later to the fray. What called them into action was a perceived threat to the authority of Scripture as well as to their own authority as its licensed interpreters. Once *they* entered the lists, the ground of battle shifted, as Galileo very quickly saw. He realized that if he were ever to get a hearing for the new cosmology on its philosophic (scientific) merits, he would have to defend himself on an entirely different front first. And it was on *this* front that the battle was lost before it was ever really joined on the side of cosmology.

Does the authority of Scripture attach to the literal reading of phrases that describe the Sun as being in motion or the Earth as being fixed on its foundations? That was the issue, as far as Rome was concerned. Galileo was convinced that the appeal to Scripture in a case like this was a last-ditch diversionary attempt on the part of the

Aristotelian philosophers to save their position. And he evidently thought that the theologians could be persuaded of this by a mixture of common-sense arguments and appeals to the Church's own exegetical tradition. He must also have believed that the theologians would listen to such a case even if it were being made by someone from outside their own ranks, a layman without theological training. Not for the first time, nor indeed the last, did he overestimate his own powers of persuasion, as well as underestimating the antagonism that his entrance into theological territory would unleash among its professional occupants.

What has come to be called the "Galileo affair" went through two more or less distinct phases, each terminating in a decisive action on the part of the Roman authorities.⁹ The first comprises the events leading up to the condemnation of Copernican doctrine in 1616; the second covers the events leading up to Galileo's trial in 1633 as well as the trial itself. Though the second is the more colorful and always has attracted far more attention, the first is, to my mind, much the more important. By that, I mean that without the first, the second would hardly have happened.

Without the decree of 1616 and the events surrounding the condemnation of Copernican doctrine, the writing of a book in support of that doctrine would not have encountered the sort of obstacles that Galileo faced in composing the *Dialogue*. Nor is it likely that its publication would have led its author to be sent to trial before the Holy Office, any more than did the publication of Foscarini's much more daring work prior to 1616. Though matters of personality, political circumstance, and the rest played a major part in the second phase, it seems fair to say that the root of the Galileo affair must be sought in the events that culminated in the banning of Copernicus's work in 1616. The promulgation of this decree set the Church on a collision course with the new astronomy. If Galileo had not offered the occasion, someone else (Descartes perhaps?) would very likely have done so. Given time and wiser counsel, a collision might perhaps have been avoided. But an extended defense of the Copernican claims coming less than twenty years after they had been officially declared to be contrary to Scripture was all too easy to construe as an open challenge.

The focus of this essay will be upon the first, and decisive, phase of the Galileo affair. It will be divided into two main parts. In the first,

I will trace in summary fashion the series of events leading from the first serious theological challenge to the Copernican cosmology in late 1613 to the completion of Galileo's *Letter to the Grand Duchess Christina* in mid-1615.¹⁰ The period covered is only a year and a half, but during those short months the lines were drawn in the debate that would lead to the momentous decision on the part of the Congregation of the Index in March 1616 to "suspend, until corrected" the work of Copernicus and to declare the "Pythagorean doctrine" of the Earth's motion and the Sun's rest to be "altogether contrary to the Holy Scripture."¹¹ In the second part of the essay, the focus will be on the set of exegetical principles proposed by Galileo as a means of dealing with tensions between science and Scripture. One of their major sources was the *De Genesi ad litteram* of St. Augustine, so we will begin there, pause briefly on Kepler, and then go on to Galileo's formulation of the principles, examining in particular their plausibility and their internal coherence, and asking what moral might have been drawn from them in regard to the Copernican theses.

COPERNICANISM CHALLENGED, 1613–1615

In December 1613, at a breakfast at the Medici palace in Florence attended by the young Grand Duke, Cosimo II, and his formidable mother, the Dowager Grand Duchess, Christina of Lorraine, Galileo's former student, the Benedictine monk Benedetto Castelli, was asked to explain the significance of the new astronomical discoveries. Prompted by an Aristotelian philosopher, Cosimo Boscaglia, who happened to be present, the Grand Duchess pressed Castelli about the apparent contradiction between the Copernican claims and such biblical passages as the one in *Joshua* where the Lord commanded the Sun and Moon to stand still over the valley of Ajalon to allow the Israelites to wreak vengeance on their foes.¹² Castelli, in his own words, "behaved like a champion," and felt that he had deflected this line of attack on the new cosmology.¹³

When he heard of the affair, Galileo was not so sure, and in a long letter to Castelli took the occasion "to examine some general questions about the use of Holy Scripture in disputes involving physical conclusions."¹⁴ His approach was a common-sense one. It seemed to him obvious that the biblical writers would have adapted their mode of expression to the understanding of their readers, and equally

obvious that the aim of Scripture was limited to “persuading men of those articles and propositions which are necessary to salvation.”¹⁵ Since there could be no real conflict between the two sources of truth, Scripture and what “sense experience or necessary demonstration” establishes concerning nature, one must suppose that when an apparent conflict arises, Scripture has to be interpreted in an alternative, less literal, way. We already know, after all, that passages like those attributing hands and eyes as well as human emotions to God cannot be taken literally. Galileo ended with a telling *ad hominem* argument, directed against his Aristotelian opponents.¹⁶ To stop the apparent motion of the Sun across the sky would require those who defend the Aristotelian world system to suppose that what God *really* did was to stop the *Primum Mobile*, the outermost sphere on which the diurnal motions of all the other celestial bodies depend. To stop the Sun alone in this scheme would actually have shortened the day, not lengthened it. Thus the passage in *Joshua* not only does not support the Aristotelian position but would have to be understood non-literally to be made compatible with it.

His opponents in Florence saw to it that a copy of the letter would find its way to Rome where it eventually reached the Congregation of the Holy Office, the Church’s arbiter in matters of faith and morals. But when the letter was submitted to a theologian–consultor of the Congregation for his judgment as to its orthodoxy, he found little to object to.¹⁷ Aware that the letter was under scrutiny in Rome, Galileo took care to send what he describes as the “correct” version to one of his Florentine friends there, Monsignor Piero Dini, suggesting that he might pass on a copy to the most influential member of the Holy Office, Cardinal Robert Bellarmine. This, as Galileo must have realized, was to court risk. Another Roman friend, Prince Federico Cesi, had already reported to him, “As to Copernicus’s opinion, Bellarmine himself who is one of the heads of the Congregation dealing with these matters has told me that he holds it to be heretical and that the motion of the earth is without any doubt against Scripture.”¹⁸

Dini did, it seems, pass on a copy of the *Letter to Castelli* to Bellarmine and reported back to Galileo that Bellarmine discounted the likelihood that Copernicus’s book would be condemned but indicated that it might be necessary to insert a note in the book reminding readers that the work was to be understood as no more than “a way

to save the appearances, in the manner of those who have put forth epicycles but do not really believe in them."¹⁹ There would obviously be no reason to ban the *De Revolutionibus* if it were clearly understood to make no claims about the real motions of Sun and Earth.

This view of the inherent limitations of mathematical astronomy, that its "hypotheses" were no more than calculational devices making no claim on truth, was of course not original with Bellarmine. It went back to medieval natural philosophy and perhaps further, being prompted by the Aristotelian separation between physics and mathematics as well as by the evident inconsistency with one another of the "two chief world systems" of that earlier day, the mathematical astronomy of Ptolemy and the physical astronomy of Aristotle.²⁰ The favored way among natural philosophers of dealing with this inconsistency was to attribute truth to the causal account given by Aristotle on the grounds that causal argument was required for demonstration, while maintaining that the mathematical formalism of Ptolemy, supported as it was only by its claim to "save the appearances," should be treated as no more than a practical aid to determining planetary positions and periods.

Bellarmino's reasons for adopting this fictionalist account of the constructs of the mathematical astronomer were, however, rather different. As a young man he lectured on astronomy at the University of Louvain. He departed quite radically from Aristotle (and hence from Aquinas) in his account of the heavens.²¹ He rejected the Greek method of composition of planetary motions, that is, breaking the irregular observed planetary motion down into a combination of circular motions, thus making a mathematically tractable analysis possible. (Aristotle had physical reasons also for adopting a compositional approach since it allowed him to offer a quasi-mechanical explanation of the planet's motion.) Bellarmine argued that the Sun's *real* motion is the complex variable one: the circles are invention, of practical use, perhaps, but of no ontological significance. Guided much more by the Bible than by Aristotle, he accepted geocentrism but rejected other Aristotelian tenets regarding, for example, the composition of the heavenly bodies (he claimed that they were composed of fire) and their incorruptibility. He would thus have been even less disposed than an Aristotelian would to accepting the Copernican composition of motions as testimony to the "real" motions of Earth or Sun. His evident conviction in this regard

undoubtedly played a crucial role in the early stages of the Roman debate regarding the Copernican challenge.

Bellarmino relied for additional support in this regard (as casual readers of the *De Revolutionibus* had from the beginning done) on the fact that the preface to the work had portrayed it in instrumentalist terms as making no claims about real motions. In his response to Dini, Galileo objected strongly to this construal; only those who had not read the text, he responded, could say such a thing. (He was apparently unaware of the true authorship of the preface; Kepler had already noted that it was the work of a Lutheran theologian, Andreas Osiander.)

In the text, Copernicus had “put on philosophical garments” and set out to declare the “true structure” of the world; all six books of the work are in consequence “full of the doctrine of the earth’s motion and of explanations and confirmations of it.”²² In reply to Bellarmine’s allegation that those who make use of epicycles “do not really believe in them,” Galileo drew an interesting distinction, claiming that they believe in the reality of the motions as they describe them but not in:

the solid, material, and distinct orbs, introduced by the builders of models to facilitate understanding by beginners and computations by calculators; this is the only fictitious and unreal part, as God does not lack the means to make the stars move in the immense celestial spaces within well-defined and definite paths, but without having them chained and forced.²³

According to Dini, Bellarmine had mentioned a passage in *Psalms*, where the Sun is described as “running its course” (18, 6), finding it particularly telling against the claim that the Sun is really at rest. In his letter to Dini, Galileo ventured a cautious suggestion that this passage might also be interpreted in a way that would *support* Copernicus or more exactly support the view that a “penetrating spirit” spreads outward from the Sun and is responsible for warmth, life, and the motions of the planets. He goes on: “It seems to me that from Holy Writ we can acquire *evident certainty* that the solar body is, as I have said, a receptacle and, so to speak, a reservoir of this spirit and this light which it receives from elsewhere.”²⁴

This was a dangerous ploy. Galileo was, effectively, challenging the leading theologian of the Holy Office on the proper exegesis of a biblical text. And, of course, he was also violating his own

prohibition against using Scripture to support a philosophical thesis about the natural world. Perhaps he meant it as an *ad hominem* argument, intended only to counter Bellarmine's own use of this passage. In closing, Galileo suggested to Dini that he might, at his discretion, pass the letter on to Bellarmine. Needless to say, Dini decided against this.

In the meantime, another Roman friend, Giovanni Ciampoli, had written to reassure Galileo that the Dominicans in Rome were not, as he feared, in league against him. But in another quarter, the news was not so good:

Cardinal Barberini, who as you know from experience, has always admired your talents, told me only yesterday evening that with respect to these opinions he would like greater caution in not going beyond the arguments used by Ptolemy and Copernicus, and finally in not exceeding the bounds of physics and mathematics. For to explain the Scriptures is claimed by the theologians as their field, and if new things are brought in, even though to be admired for their ingenuity, not everyone has the dispassionate faculty of taking them just as they are said.²⁵

Later, as Pope Urban VIII, Barberini permitted Galileo to proceed with the writing of the *Dialogo* with the proviso that he treat Copernicanism as a "hypothesis" only. Were the limitations traditionally set on mathematical astronomy and echoed in the preface to Copernicus's work what he had in mind? In part, they must have been. But his unwillingness to allow that the Copernican theses might possibly come to be *demonstrated* almost certainly rested on other grounds also.²⁶ In any event, in the conversation relayed to Galileo in 1615, he may only have been warning the astronomer to stay out of biblical exegesis.

At this point, Galileo received a copy of a letter Bellarmine had written to Paolo Antonio Foscarini, a Carmelite theologian, author of a treatise, "in which it is shown that [the Copernican] opinion agrees with, and is reconciled with the passages of Sacred Scripture which are commonly addressed against it," to quote the subtitle of the treatise.²⁷ Foscarini proposed a set of exegetical principles resembling those Galileo had already defended in his *Letter to Castelli*. For example: "The Sacred Scripture speaks in accordance with the common language of popular reason and of ordinary people, and thus according to the appearances and not according to actual reality"; and

again: "The Scriptures have no other purpose than the attainment of salvation."²⁸ Foscarini laid out a natural philosophy that differed significantly from Aristotle's (whose philosophy, he claimed, had "fallen into ruin.")²⁹ But then he went much further than Galileo had done by setting out to "accommodate many passages of Holy Scripture" to this philosophy and more specifically to the Copernican doctrine, described by him as "clearly probable."³⁰

Bellarmino's response to Foscarini is an odd document and has been interpreted very differently by different scholars. It is moderate in tone, given that Foscarini is defending a doctrine that Bellarmine has, according to Cesi at least, characterized as heretical. He begins by giving Foscarini and Galileo the benefit of the doubt: He assumes (or pretends to assume) that they are speaking *ex suppositione* (which he paraphrases as saying that they are claiming only that the Copernican formalism saves the appearances better than the Ptolemaic one does), "as I have always believed that Copernicus spoke."³¹ The firm conviction that mathematical astronomy could not *in principle* provide a demonstration of the Earth's motion, and that without such a demonstration the literal sense of Scripture ('literal' in our usage) could not be challenged, seems to have been Bellarmine's guiding light throughout. But of course he knew that both Foscarini and Galileo made the stronger realist claim for the Copernican theses and so he goes on to warn them: To make such a claim "is a very dangerous thing, likely not only to irritate all scholastic philosophers and theologians, but also to harm the Holy Faith by rendering Holy Scripture false."³² Why would it do that?

Here Bellarmine lays down his own exegetical principle, one that went significantly beyond the declaration of the Council of Trent and the theological tradition that preceded Trent:³³

Nor can one answer that this is not a matter of faith [as Foscarini had claimed], since if it is not a matter of faith *ex parte objecti* [because of the subject matter], it is a matter of faith *ex parte dicentis* [because of the speaker]. And so it would be as heretical to say that Abraham did not have two children and Jacob twelve, as it would be to say that Christ was not born of a virgin, because both are said by the Holy Spirit through the mouth of the prophets and the apostles.³⁴

One can see here the effect on Bellarmine of years of controversy with the leading Reformation theologians. Note his use of the term,

"heretical."³⁵ If the Holy Spirit is, indeed, the principal author of the Bible, Bellarmine presumes that the literal sense must be accorded full authority, down to the last detail of the text. At this point, the gulf between him and the Copernicans seems almost unbridgeable.

The last paragraph of Bellarmine's letter has often been taken to show that Bellarmine was, in fact, open to persuasion in regard to the Copernican issue; all that was required was a proper *demonstration* of the Earth's motion, something that Galileo could not produce.³⁶ Bellarmine does say that *if* there were a "true demonstration" of the Copernican theses, "one would have to proceed with great caution in explaining the Scriptures that appear contrary and say rather than we do not understand them than that what is demonstrated is false." But in context, one can see that he was not conceding this allusion to the traditional Augustinian principle to be a real possibility. It is his innate courtesy to his correspondent, a respected theologian, that leads him to add the qualifier "until it is shown me" to the assertion: "I will not believe that there is such a demonstration." He has already indicated that he thinks such a demonstration to be permanently out of reach; indeed, he lists three separate reasons for this.

One reason is, once again, that merely "saving the appearances" in astronomy cannot provide a true demonstration of real motion. A second is the "common consensus" of the Fathers and scriptural commentators, here recalling the criterion specified by the Council of Trent. And the third, directed against Foscarini's suggestion that the biblical writers are speaking "in accordance with the appearances," is that we clearly *experience* that the Earth stands still and so this cannot be treated simply as "appearance." None of these arguments leave room for a concession on his part that a demonstration of the Earth's motion might at a later time be discovered. Bellarmine is *not* merely pointing to the fact that the Copernicans have not yet come up with a proper demonstration of the Earth's motion. He is, in his own mind, at least, giving reasons to believe that they never *could*. Thus, he is implicitly setting aside the prudential principle well stated by Foscarini:

Since something new is always being added to the human sciences, and since many things are seen with the passage of time to be false which previously were thought to be true, it could happen that, when the falsity of a philosophical opinion [to which the authority of Scripture has been attached] has been detected, the authority of the Scriptures would be destroyed. . . .³⁷

Galileo obtained a copy of Bellarmine's letter and made a series of notes that may have been intended to aid Foscarini in preparing a response to the letter.³⁸ The notes contain a variety of briefly stated arguments, some good, some surprisingly bad. Among the former: The Council of Trent did not affirm Bellarmine's exegetical principle, which would attach authority to phrases in the Bible that have no bearing whatever on faith and morals. Moreover, even if one were to admit the validity of this principle for such claims as that Tobit had a dog, this would still not validate its application to phrases bearing on the motions of Sun and Earth. The literal sense of the former sort of phrase is not in question, so there would be no reason for the Holy Spirit to use this phrase "if it did not state the truth." However, this is just what *is* in question for the other sort of phrase, where one can argue that the Holy Spirit would "accommodate the words of Scripture to the capacities of the common man."³⁹

Galileo's objection points to a serious difficulty for Bellarmine's "*ex parte dicentis*" principle. Bellarmine admits, on the one hand, that the Bible uses metaphorical language when speaking about God. In such a case, the language is clearly being accommodated to our capacities. It has thus to be *established* regarding any given passage whether the language of that passage is to be understood literally or not; it cannot simply be taken for granted, as Bellarmine is evidently doing when discussing the texts that refer to the Sun and Earth. What Foscarini and Galileo are asking is why it is acceptable to allow a principle of accommodation in one case and not in the other. Part of the problem lies in the ambiguity in the notion of the "literal," which Bellarmine understands to refer both to the sense intended by the author and to the "plain" sense that the average reader would take from the words used.

In an earlier discussion of this issue in one of his exegetical works, Bellarmine had urged that arguments regarding the sense of Scripture "ought to be sought in the literal meaning alone. For it is certain that that meaning, which is taken immediately from the words, is the meaning of the Holy Spirit."⁴⁰ In his letter to Foscarini, Bellarmine asserts that since the "literal" interpretation of the disputed passages is evidently that the Sun "rotates around the Earth with great speed," and the Earth "stands immobile in the center of the world,"⁴¹ this must be the sense intended *ex parte dicentis* and is therefore "a matter of faith." The argument plainly begs the question.

But the confusion was not all on Bellarmine's side. He had failed, as a theologian, to grasp as fully as he should have, the consequences of the exegetical principle he was employing. However, Galileo likewise failed, as a scientist, to grasp what was called for in the way of proof in the context of cosmology or to appreciate the epistemic value of probable reasoning.

In his notes on Bellarmine's letter to Foscarini, he says that if the Copernicans "were to have no more than 90 percent of the arguments on their side, they would be rebutted."⁴² (The implication seems to be that *all* arguments have to be on the Copernican side, otherwise they fail. On theological grounds?) "It is clear that those who are on the false side cannot have any arguments or evidence of value; while on the side of truth, there is the advantage that everything agrees and is consistent." He had already remarked in his *Letter to Castelli*: "The one who supports the true side will be able to provide a thousand experiments and a thousand necessary demonstrations for his side, whereas the other person can have nothing but sophisms, paralogisms, and fallacies."⁴³ He goes on: "When everything offered by the philosophers and astronomers on the other side is proven to be for the most part false . . . then the position of the [Copernican] proponents should not be scorned . . . because of the fact that it cannot be demonstrated conclusively."

If the only arguments of value must lie on the side of truth, then it is easy to slip from "well supported" to "demonstrated". The possibility that more than one explanatory hypothesis might have evidence in its support is being set aside. Then, most strangely, he adds:

It is true that to show that the appearances are saved by the mobility of the earth and the stability of the Sun is not the same thing as to demonstrate that this hypothesis is really true in nature. But it is equally or even more true that the other commonly accepted system is not able to give reasons for these appearances. The latter is undoubtedly false, just as it is clear that the former, which corresponds to the appearances perfectly, could be true. No greater truth can be, or ought to be, sought for in a position than that it corresponds to all the particular appearances.⁴⁴

Granted that these notes are no more than jottings, it is still disturbing to find Galileo so uncertain regarding the principal philosophical issue separating Bellarmine and himself. He says first that saving the appearances is not enough to demonstrate the truth of

a hypothesis and ends by remarking that saving the appearances is the *most* that can be demanded of an hypothesis. This seems to go a long way toward conceding Bellarmine's contention that a hypothesis in mathematical astronomy cannot, in principle, reveal the true motions of the heavenly bodies. The most that can be said of a hypothesis (like that of Copernicus) that "fits the appearances perfectly" is, apparently, that it *could* be true. But this is far too weak to carry any weight in the face of Bellarmine's objection.

In his *Apologia pro Tychone contra Ursum* (1600), Kepler had earlier faced a very similar objection from Ursus (Nicolaus Baer). Kepler admits that saving the appearances is not sufficient to establish truth. But he goes on to argue that there are other criteria of astronomical theory that, if satisfied, can go far toward achieving that goal. And he sees these as favoring Copernicus over Ptolemy, even though the two systems have roughly equal merit as far as saving the appearances is concerned. The Copernican model can *explain* many features of the planetary motions that had to be arbitrarily postulated in the earlier scheme ("Copernicus did not have to ask why it is that the planets at their evening risings are [at their brightest and therefore] at their nearest to the earth."⁴⁵)

In the *Astronomia Nova* (1609), Kepler carried this theme further, as the full title of the work reminds us: *The New Astronomy Causally Explained; or Celestial Physics Based on the Motions of the Planet Mars*. He is reiterating the Aristotelian emphasis on "physical" (causal) explanation as the testimony of truth in natural philosophy. Merely to *save* the planetary motions is not enough, since many other mathematical constructions may save them equally well. One must in addition *explain* them causally.⁴⁶ Having successfully saved the motions of Mars by a simple ellipse, he searches therefore for physical reasons why a planet should follow such an orbit. If he can find these and they hold up over time, he is assured that the theory must be true.

Galileo almost surely had not read the *Astronomia Nova* (except perhaps for the preface). And there is little sign in his writings from this period that he had thought through the epistemological puzzles surrounding proof in astronomy in the systematic way that Kepler had. He could not seem to find an appropriate category at this point to describe the epistemic status of the Copernican hypothesis.⁴⁷ He wanted to say that it did more than save the appearances (though

in the final sentence in the passage from his notes above, he seems to concede that it cannot do this). But he also had to admit that it fell short of demonstration. What lies in between? Perhaps it was because he was so heavily influenced by the traditional Aristotelian emphasis on demonstration that he did not develop in response to Bellarmine the notions of likelihood or probability that he so badly needed. It was all or nothing – and in the intellectual climate of Rome in 1615, the latter was the more likely verdict on Copernicanism.⁴⁸

Nor did he have a *theory* of the planetary motions to offer, even of the most tentative sort. Given that he was still working with the circles and epicycles bequeathed by Copernicus, this was hardly surprising. Kepler had recognized the epistemological significance of such a theory for anyone who would make a claim for the reality of the Earth's motion. Nonetheless, Galileo had high hopes at this stage for his tidal theory which, if it were successful, *would* give him a “physical” argument of the needed sort.⁴⁹ But he would have to be able to claim not just that postulating the double motion of the Earth explained, in causal terms, the general phenomena of the tides but that it gave the only *possible* explanation, if his argument were to have the demonstrative form that his Aristotelian critics regarded as canonical.⁵⁰

We are almost to the end of our story. During these months, despite bouts of severe ill health, Galileo had been working on a systematic response to the challenge posed by those who would call on Scripture to refute Copernican cosmology. It was all very well for Barberini to advise leaving theology to the theologians. But the theologians were not leaving science to the scientists! Galileo must have known that his foray into theology would be resented. However, he evidently felt impelled to do everything he could to prevent an outcome that was now beginning to seem imminent, one that would be a tragedy (he was convinced) for the Church itself.

His *Letter to Castelli* had been lacking in one crucial respect: support from the Fathers and major theologians of the Church. Galileo resolved to make that lack good in the new work. He had no expertise whatever in that area, so he evidently asked his Benedictine friend, Castelli, to seek out references that would support the exegetical principles he had outlined in his earlier letter to him. Castelli apparently enlisted the aid of others. He writes from Rome in January 1615 to say that an unnamed Barnabite priest has promised to send

citations from St. Augustine and other Fathers in confirmation of Galileo's views on the *Joshua* passage.⁵¹ The list of authorities that Galileo goes on to present in his support was surely not the product of extensive reading on his part; it was needed to persuade his opponents that his exegetical views found support in the tradition, notably in St. Augustine, the most revered of the Church's early theologians.

His main resource would obviously be Augustine's *De Genesi ad Litteram* which was already well known among exegetes for its treatment of the relations between "natural knowledge" and Scripture. Galileo quotes no less than fourteen passages, some of them quite lengthy, from the first two books of that work. These texts could have been passed on to him by Castelli, but it is also possible that he might have been induced to read these two short books for himself. The choice of texts certainly testifies to a close reading of the books in question, as we shall see when we come to examine them for ourselves below.⁵²

Galileo also draws on the most authoritative commentary on *Genesis* of the day, by a leading Scripture scholar, Benito Pereira, S. J.⁵³ Pereira prefaces his massive work with a page where *he* lays out four "rules" intended to guide the exegesis of passages where conflict arises between the literal reading of Scripture and other sources of knowledge.⁵⁴ This page was an obvious choice for Galileo's purposes. He quotes the fourth of the rules, one that enjoins the exegete never to interpret Scripture in a way that runs contrary to "manifest evidence and the arguments of philosophy or other disciplines." From the same page, Galileo also almost certainly draws the reference he immediately goes on to make to Augustine's *Seventh Epistle to Marcellinus*, hardly common coin, as well as a passage from Augustine's *De Genesi ad Litteram*, which he quotes in the paraphrase version found in Pereira.⁵⁵ There is no evidence, so far as I can tell, of Galileo's drawing any other of his references to Augustine from Pereira's text.⁵⁶ Thus it is possible that what he was working with was a copy simply of that single highly relevant page from Pereira listing the four exegetical "rules."

One other likely source was Foscarini's *Defensio*, the brief defense of his position that Foscarini composed when he heard that his *Letter* was under attack in Rome. Foscarini quotes the same passage from Pereira that Galileo uses; it could have been this reference that drew

Pereira's text to Galileo's attention.⁵⁷ Further evidence that Galileo had seen the *Defensio* is his use of two quotations from Jerome (commenting on *Jeremiah* and on *Matthew*), which are also featured in the *Defensio*.⁵⁸

The work was finished around June 1615. It took the form of a letter, freeing it from the need to pass through a censorship procedure but enabling it to be circulated privately. Galileo eventually decided⁵⁹ to address it to the Dowager Grand Duchess, mother of his patron, the person whose interrogation of Castelli had first led Galileo to realize that a full-scale defense of Copernicanism from theological attack might be necessary. How widely the letter was circulated at that time remains unclear.⁶⁰ It was first published in 1636 in Strasbourg, translated by Elio Diodati, with Italian and Latin in parallel columns and later appended to the Latin version of the *Dialogo* that became the standard text of that work for Northern European readers. It thus eventually did reach a wide readership.

One feature of the work that might have commended it to many of those readers was the contemptuous and dismissive tone in which Galileo addressed those with whom he was disagreeing. But in the context of the readership for which the *Letter* was originally intended, this constitutes something of a puzzle. Galileo was not unaware of the maxims of rhetoric, a much studied art in his day.⁶¹ How could he have violated in so obvious a manner the elementary advice for any work of persuasion that one should gain the goodwill of the reader or hearer first (*captatio benevolentiae*)? As one example of such a failure, the *Letter* is addressed to an elderly woman interested in Scripture, yet he quotes a passage from St. Jerome that is hardly calculated to win her favor, to say the least:

The garrulous old woman, the doting old man, and the wordy sophist, one and all take in hand the Scriptures, read them in pieces and teach them before they have learned them. Some with brows knit and bombastic words, balanced one against the other, philosophize concerning the sacred writings among weak women. Others – I blush to say it – learn from women what they are to teach to men. . .⁶²

One may excuse, perhaps, the violence of the language in which he attacks his Aristotelian critics (“superficial and vulgar writers”) throughout the letter for their “simulated religious zeal” and their

"insincerity"; he was certainly not aiming to win *their* assent.⁶³ But the people he really needed to persuade were the Roman theologians. It was all very well to appeal to the educated general audience, but if he antagonized those who at that very moment were debating the issues in Rome, he would surely compromise the goal he had clearly set himself in composing the *Letter*: to persuade the Church authorities not to proceed against the work of Copernicus.

Yet when he addresses "some theologians whom I regard as men of profound learning and of the holiest life-style," men whom he holds "in high esteem and reverence" (Bellarmine would be an obvious referent), he confesses himself to be troubled by the fact that these men seem "in disputes about natural phenomena to claim the right to force others by means of the authority of Scripture to follow the opinion they think most in accordance with its statements, and at the same time they think they are not obliged to answer observations and reasons to the contrary."⁶⁴ Later, even more devastatingly: "Officials and experts in theology should not arrogate to themselves the authority to issue decrees in professions they neither exercise nor study."⁶⁵ In other words, theologians have no business assessing the merits of astronomical arguments (as Bellarmine and his colleagues have, of course, been doing).

The first reaction of theologian readers to passages such as these would surely have been an angry one.⁶⁶ And their second one might have been one of incredulity that Galileo could chastise them for trespassing in science, to all appearances in exactly the way he was himself in the process of doing in theology. Had he given up hope of persuading the theologians and was he, effectively, going over their heads to the educated lay people among whom the *Letter* would circulate? It seems unlikely. Or had he simply allowed himself to be carried away by his anger at those who simply would not see the light? Whatever be the answer, one would seem forced to conclude that in strictly rhetorical terms, the *Letter* showed strikingly poor judgment.

However, this is not my main interest. What about the *logic* of Galileo's exegetic analyses? There is no more effective rhetorical device than a good argument. I intend to examine the exegetical principles he proposes, ask how appropriate they were in the context of the time, and reflect on their mutual coherence. Pope John Paul II summed up Galileo's contribution to exegesis: "Paradoxically,

Galileo, a sincere believer, showed himself to be more perceptive [in regard to the criteria of scriptural interpretation] than the theologians who opposed him."⁶⁷ How good a theologian was the Galileo of the *Letter to the Grand Duchess*? To answer this question, it will be necessary first to return to Augustine on whom Galileo could rely at (almost) every turn.

BACK TO AUGUSTINE

It was not surprising that Galileo would look back to Augustine for support when he was challenged for his handling of the biblical texts that were being used by his opponents to condemn the Copernican system. For Augustine had had to contend with a very similar challenge when trying to meet the criticisms launched by the Manichaeans, his former co-religionists, against the *Genesis* account of cosmic origins. They claimed to find a variety of inconsistencies between *Genesis* and what we may call the "natural knowledge" (accepted views about the physical world) of the day. How, they asked, could there be "days" before the Sun itself was formed, as the *Genesis* narrative seemed to require? How could there be "waters above the firmament," when the proper place of water is below? Augustine struggled with objections such as these over much of his scholarly lifetime. Two early commentaries on *Genesis*, the second unfinished, left him dissatisfied. Finally, in A.D. 401 he began the composition of what would be one of his major works, the *De Genesi ad Litteram*, a "literal"⁶⁸ commentary on *Genesis*, which would eventually run to twelve books and occupy him on and off for fourteen years.⁶⁹

In this work, Augustine goes through the creation narrative systematically, treating problems as they come up. He makes no attempt to give a general account of the principles that guide his exegetical practice. It is, however, possible to reconstruct what this account might look like by examining his frequent asides on how to deal with specific instances of apparent conflict between Scripture and natural knowledge.⁷⁰ He presupposes, of course, as a first principle that no *real* conflict can arise between the two, our twin sources of truth. How does he proceed after that? The maxims he offers, drawn from common sense as well as being rooted in the philosophy and theology of the day, were to guide later Christian thought and

would be echoed in Galileo's *Letter to the Grand Duchess* more than a thousand years later.

Early in the *De Genesi ad Litteram*, Augustine remarks:

In matters that are obscure and far beyond our vision, even in such as we may find treated in Holy Scripture, different interpretations are sometimes possible without prejudice to the faith we have received. In such a case we should not rush in headlong and so firmly take our stand on one side that, if further progress in the search for truth (*diligentius discussa veritas*) justly undermines this position, we too fall with it. That would be to battle not for the teaching of Holy Scripture but for our own, wishing its teaching to conform to ours, whereas we ought to wish ours to conform to that of Holy Scripture.⁷¹

His advice might be summed up in the following principle:

Principle of Prudence (PP): When trying to discern the meaning of a difficult Scriptural passage, one should keep in mind that different interpretations of the text may be possible, and that, in consequence one should not rush into premature commitment to one of these, especially since further progress in the search for truth may later undermine this interpretation.⁷²

Augustine relies here on two different prudential considerations. First, the Scriptures themselves, dealing as they do with "matters far beyond our vision," do not yield their proper (for him their "literal") sense readily. Furthermore, a deeper consideration of the question involved may well show a too-hastily adopted reading of Scripture to be in error, thus weakening the credibility of the Scriptures generally. This last theme is one to which he often returns; his constant concern is to protect the Scriptures from challenge. He asks whether the heavenly bodies are guided by intelligences, as the philosophers suppose, and is cautious in reply. On matters such as these:

we should always observe that restraint that is proper to a devout and serious person and on an obscure question entertain no rash belief. Otherwise, if the truth later appear (*quod postea veritas patefecerit*), we are likely to despise it because of our attachment to our error, even though this explanation may not be in any way opposed to the sacred writings. . .⁷³

Notice that Augustine is stressing that progress in knowledge (he does not mention natural knowledge specifically) might force a

reevaluation of the interpretation to be given to the scriptural text. In both passages quoted above, the presupposition is that the scriptural text is an obscure one, lending itself to different interpretations. Hence there is need for caution, lest “the truth later appear.” But it might be that the fault lies, to begin with, in an overly hasty or overly dogmatic interpretation of Scripture:

Usually, even a non-Christian knows something about the earth, the heavens, and the other elements of this world, about the motion and orbit of the stars and even their sizes and relative positions, about the predictable eclipses of the sun and moon, the cycles of the years and the seasons, about the kinds of animals, shrubs, stones, and so forth, and this knowledge he holds to as being certain from reason and experience. Now it is a disgraceful and dangerous thing for an infidel to hear a Christian, presumably giving the meaning of Holy Scripture, talking nonsense on these topics, and we should take all means to prevent such an embarrassing situation, in which people show up vast ignorance in a Christian and laugh it to scorn. The shame is not so much that an ignorant individual is derided, but that people outside the household of the faith think our sacred writers held such opinions, and, to the great loss of those for whose salvation we toil, the writers of our Scripture are criticized and rejected as unlearned men. If they find a Christian mistaken in a field which they themselves know well and hear him maintaining foolish opinions about our books, how are they going to believe those books in matters concerning the resurrection of the dead, the hope of eternal life, and the kingdom of heaven, when they think their pages are full of falsehoods on facts which they themselves have learnt from experience and the light of reason?⁷⁴

It is worth quoting this long passage in full (as does Galileo) in order to bring out how strongly Augustine felt about the dangers that apparent conflicts between Scripture and natural knowledge pose to the Christian community. For such conflicts to constitute a threat, however, it is clear that the claim to natural knowledge must qualify as “certain from reason and experience.” This emphasis recurs over and over in his pages:

But someone may ask: “Is not Scripture opposed to those who hold that the heavens are spherical, when it says [of God] ‘who stretches out the heavens like a skin’?” Let it be opposed indeed, if what they say is false. The truth is rather in what God reveals than in what groping men surmise (*humana infirmitas conicit*). But if they are able to establish their doctrine with proofs that cannot be denied (*si forte illud talibus illi documentis probare*

potuerint, ut dubitari inde non debeat), we must show that this statement of Scripture is not opposed to the truth of their conclusions.⁷⁵

And again:

Whatever they [the Manichaeic critics of Scripture] could demonstrate about the nature of things by means of reliable evidence (*quidquid ipsi de natura rerum veracibus documentis demonstrare potuerint*), we shall show not to be contrary to our Scripture. But when they produce from any of their books something contrary to Scripture, that is (*id est*), contrary to the Catholic faith, we shall either by some means or other show, or else without any shadow of doubt believe, that it is absolutely false.⁷⁶

Two complementary principles seem to flow from passages such as these. The first is straightforward:

Principle of Priority of Demonstration (PPD): When there is a conflict between a proven truth about nature and a particular reading of Scripture, an alternative reading of Scripture must be sought.

I am using the term “demonstration” here in a broad sense to include any form of convincing proof and not just deductive proof from principles grasped as true in their own right (the technical Aristotelian sense of the term, to which Augustine does not confine himself). Augustine’s emphasis is on the certainty that is needed for the claim to natural knowledge to count as a challenge to a Scripture reading. He uses phrases in this context such like “the facts of experience,”⁷⁷ “knowledge acquired by unassailable arguments or proved by the evidence of experience,”⁷⁸ and “proofs that cannot be denied” (above).

Augustine accepts the ability of our God-given powers of sense and reason to arrive at truth in our accounts of the natural world. Such truths cannot be in real conflict with Scripture, our other major source of truth. If there is an appearance of conflict, it can only be that an incorrect interpretation has been given of the scriptural passage in question. One would, therefore, be justified in such a case in departing from what appears at first sight to be the obvious sense of the passage and in adopting a metaphorical or other alternative sense instead, assuming that the sense that gives rise to the conflict cannot possibly have been what the original writer intended.

But now suppose that the claim to natural knowledge is something less than certain. What then? Augustine’s constant emphasis on the certainty that is required of such a claim for it to constitute a warrant

to search for an alternative reading of a scriptural text would seem to imply that in the absence of such certainty, the supposed challenge from natural knowledge no longer materializes. When interpreting the scriptural text that speaks of the heavens as being “suspended like a vault,” for example, we would not (he says) want our interpretation to contradict the theory that the heavens are spherical, “provided only that this is proved (*si tamen probatur*).”⁷⁹ If it is not proved, it would, it seems, no longer carry decisive weight in the exegetical discussion. There are overtones here of the traditional Greek distinction between knowledge (*epistêmê*) and opinion (*doxa*). But there is a more distinctively Augustinian flavor also.

When, for example, he is dealing with the objections raised by those who argue “from the relative weights of the elements” against the placement of waters above the firmament in *Genesis* I, his response is to give a highly speculative account of how such waters might well exist in the distant planetary regions in the form of ice. He concludes: “Whatever the nature of that water and whatever the manner of its being there, we must not doubt that it does exist in that place. The authority of Scripture in this matter is greater than all human ingenuity.⁸⁰ Or, again, when discussing the shape of the heavens in the passage quoted earlier, he asserts: “The truth is rather in what God reveals than in what groping men surmise.”⁸¹ When the claim to natural knowledge is a matter, then, only of “surmise,” or “human ingenuity” (in other words, it lacks demonstration), the normal meaning of the scriptural text is to be given priority because of its greater dignity.

In Augustine’s theory of knowledge, Divine illumination is the source of the intelligibility that enables the human reason to render true judgment. In this perspective, the illumination that comes directly from God through the words of Scripture far outshines the mere products of human ingenuity. Surmise about the world of sense cannot be allowed any weight in a matter as grave as discerning the meaning of God’s word. This points to a principle that is complementary to PPD:

Principle of Priority of Scripture (PPS): Where there is an apparent conflict between a Scripture passage and an assertion about the natural world grounded on sense or reason, the literal reading of the Scripture passage should prevail as long as the latter assertion lacks demonstration.⁸²

When Augustine says things like “the truth is rather in what God reveals,” he is laying aside a difficulty that he himself constantly stresses elsewhere, namely, that deciding just what God *has* revealed in a particular passage may be no easy matter. He is, effectively, assuming that the passage does have a straightforward literal meaning. Attributing priority to Scripture in the context of conflict with natural knowledge, therefore, is still open-ended. If the Scriptural passage lends itself to different interpretations, might not a well-supported (though not demonstrated) knowledge-claim make a difference in deciding on the proper interpretation? This will, of course, be the crucial issue when we come to the Copernican conflict. Note that PPS leaves open the possibility that the claim to natural knowledge might at a *later* time be demonstrated. It merely states that as long as this claim is *not* demonstrated, the literal reading of the scriptural text is to be maintained.

Two other exegetical principles can be found in Augustine’s pages. Christian theologians long before his day were aware that in certain scriptural contexts, the normal sense of the terms used might have to be set aside. In speaking of God, the scriptural writers were forced to use human language of a Being for whom such language is clearly inadequate. God does not have a right hand, nor should God be understood to have literally walked in the Garden of Eden.⁸³ And the manner in which God brought about the creation of the world likewise transcends the capacities of literal language. Augustine does not hesitate, as we have already noted, to attribute to the “days” of Creation a purely metaphorical sense. In contexts such as these, he remarks: “Sacred Scripture in its customary style is speaking with the limitations of human language in addressing men of limited understanding.”⁸⁴ Obviously, then, we must take into account a further principle:

Principle of Accomodation (PA): The choice of language in the scriptural writings is accommodated to the capacities of the intended audience.

There were two main reasons for admitting such a principle: 1) the inadequacies of human language in the face of realities that lie beyond normal human reach and 2) the inherent limitations of human powers of acquiring knowledge. Augustine mentions a context of particular interest to us where accommodation might be called for.

"We must hold," he says, "to the pronouncement of St. Paul that . . . 'star differs from star in glory (brightness).' But, of course, one may reply, without attacking St. Paul, 'they differ in glory to the eyes of men on earth.'"⁸⁵ Though he prefers the literal alternative that the heavenly bodies differ from one another in *intrinsic* brightness (the Sun in the Creation narrative is described as the "greater" of the two lights), he admits that it would be acceptable to suppose that Paul is speaking according to the appearances only.

The accommodation here is to the limitations of the human visual perspective. The celestial phenomena are described *as they appear to us*; this form of accommodation is built into the very structure of our language. It would, thus, be unreasonable to insist on a literal reading in such a case: When we speak of the brightness of the heavenly bodies in an everyday context, it is their brightness as it appears to us that is meant. The relevance of this form of PA to the later Copernican conflict hardly needs emphasis. As it happens, Galileo misses this text.⁸⁶

Augustine ends his discussion of this issue with a caution: "For us it is neither necessary nor fitting to engage in subtle speculation about the distances and magnitudes of the stars or to give to such an inquiry the time needed for matters weightier and more sublime." Elsewhere, he is even more explicit:

The sacred writers have omitted [discussing the shape of the heavens]. Such subjects are of no profit to those who seek beatitude, and what is worse, they take up precious time that ought to be given to what is spiritually beneficial. What concern is it of mine whether heaven is like a sphere and the earth is enclosed by it and suspended in the middle of the universe, or whether heaven, like a disk above the earth, covers it on one side? . . . I must say briefly that in the matter of the shape of the heaven, the sacred writers knew the truth but the Spirit of God, who spoke through them, did not wish to teach men such things as would be of no avail for their salvation.⁸⁷

And again, in response to a question about whether the heavens move, given the scriptural use of the term, "firmament," Augustine replies that this usage "does not compel us to imagine a stationary heaven." Furthermore:

There is a great deal of subtle and learned inquiry into these questions for the purpose of arriving at a true view of the matter; but I have no further

time to go into these questions and discuss them, nor should they have time whom I wish to see instructed for their salvation.⁸⁸

What he seems to be saying here is that one should not expect to find in Scripture a technical treatment of the details of such sciences as astronomy. The concerns of Scripture and of the sciences are in the end quite different and must be held separate. The Scriptures are written for man's salvation, and astronomy simply does not bear on this.

It must be admitted that these texts are not addressed directly to the issue of how a particular Scriptural passage is to be interpreted, but to why a particular sort of topic has not been treated more explicitly in Scripture. Nonetheless, this way of handling the differences in aim between Scripture and natural science would lead one naturally to a more radical way of defusing tensions between them when they arise:

Principle of Limitation (PL): Since the primary concern of Scripture is with human salvation, texts of Scripture should not be taken to have a bearing on technical issues of natural science.

Augustine might have been reluctant to subscribe explicitly to so limiting a principle, were it to be directed to knowledge of nature in general and not just to technical issues of natural science. Over and over in his commentary on *Genesis* he takes the word of Scripture to carry weight on a wide diversity of issues involving natural knowledge, such as the placement of waters above the firmament. Still, he is obviously impatient with those who would look to Scripture for technical detail on astronomical matters "of no avail for salvation." It is not unreasonable, then, to discern a principle like PL not far from the surface as he struggles with the Manichaean challenge to the credibility of Scripture in the light of the natural knowledge of the day.

This was the first large-scale struggle of this sort, opposing the literal interpretation of specific scriptural texts to accepted natural knowledge. There would not be another until the Copernican controversy erupted more than a millennium later.⁸⁹ My use here of the term, "principle," might be challenged, since it could suggest a greater degree of deliberation on Augustine's part than was perhaps the case. The *Literal Meaning of Genesis* was not written as a treatise on the principles of exegesis. Nevertheless, the work does

enable us to see what sorts of considerations Augustine relied on in dealing with the conflicts that propelled him to the writing of the commentary in the first place.

Though he does not argue in any detail for these “principles,” it is not hard to imagine how he would have defended them, if pressed. PP and PA are no more than common sense, whereas PL follows from a general understanding of the role of Scripture in the life of the Christian. PPD and PPS, taken together, reflect a theory of knowledge that presupposes a sharp distinction between demonstration and anything short of demonstration, as well as a theory of scriptural interpretation that tends to give priority, in matters of dispute, to the literal sense of Scripture. PPS and PL are not explicit in Augustine’s text but are suggested by comments he made while discussing the exegetical problems encountered in the texts under study.

Why devote so much space to Augustine in an essay on Galileo? Because later I will make two points: First, the exegetical positions laid out in the *Letter to the Grand Duchess* are already contained in germ in Augustine’s work. Despite the claims made for it in recent Galileo scholarship, Galileo’s contribution to exegesis was not especially novel. What distinguishes it is the forceful and effective way in which it is argued. That it should have appeared daring says more about the state of theological discourse in his time than about the novelty of its contents. My second point will be that a strain already latent in the Augustinian principles of exegesis reappears, but now with a troublesome consequence beginning to show, one that had far-reaching implications for the Copernican debate.

ON TO KEPLER

It will be instructive to take a brief look at Kepler’s foray into biblical exegesis before going on to Galileo, in order to note some significant differences between the ways in which the two faced the problem of reconciling the Copernican system with the authority of Scripture. Kepler was the first major supporter of Copernicus after Copernicus’s own day; at a time when his senior, Galileo, was still hesitant to commit to the Copernican cause,⁹⁰ Kepler was already building an elaborate theoretical astronomy around the Copernican system. But he had to face the objections from Scripture to this thesis that had already been widely voiced.

In his first work, the *Mysterium Cosmographicum* (1596), a reference to the exegetical issues raised by the Copernican doctrine had to be deleted from the manuscript sent for publication because of objections on the part of the authorities at the University of Tübingen. However, he prefaced his next work, the ground-breaking *Astronomia Nova* (1609), with a forthright treatment of the troublesome scriptural passages, arguing that they pose no real challenge to Copernicanism. These few pages were to attain a wider readership in the seventeenth century than anything else he wrote; they were usually bracketed with the *Letter to the Grand Duchess* from their first publication together in 1636.

His exegetical advice is a sensible combination of PA and PL, as he asks what the original writers would be likely to have intended by the texts under scrutiny. For example, they would surely have accommodated their language in the context of judgments of perception. And it was not their business to teach physics.

The Holy Scriptures, when treating common things, concerning which it is not their purpose to instruct humanity, speak with humans in the human manner in order to be understood by them. . . . No wonder, then, if Scripture also speaks in accordance with human perception when the truth of things is at odds with the senses. . . .⁹¹

The psalmist “considered the Sun to move for the precise reason that it appears so to the eyes.” When Joshua prayed for the Sun to stop, what he wanted was that it should “appear so to him, whatever the reality might meanwhile be.” It would have been “quite inappropriate to think, at that moment, of astronomy and of visual errors.”⁹² Those who call upon Scripture to settle matters like this ought to “refrain from dragging the Holy Spirit into physics class.” The supposed challenges to Copernicanism can be met if we but “turn our eyes from physics to the aims of Scripture.” “You do not hear any physical dogma” when Ecclesiastes says that generations come and go, but “the earth stands forever.” Rather, “the message is a moral one.” Likewise, in Psalm 104, when the Earth is described as “founded on its stability,” “nothing could be farther from the psalmist’s intention than speculation about physical causes.” Regarding other texts, the writer “does not wish to teach things of which men are ignorant”; he “is not writing as an astronomer”; he “tells us nothing that is not generally acknowledged, because his purpose was to praise things that are known, not to seek out the unknown.”

Kepler does not cite any authorities, whether contemporary theologians or the early Fathers. Indeed, in a much-quoted passage, he even gently mocks those who do turn to “the opinions of the holy ones in matters of nature”:

While in theology it is authority that carries the most weight, in philosophy it is reason. Therefore, Lactantius is holy who denied that the earth is round, Augustine is holy who, though admitting the roundness, denied the Antipodes, and the Holy Office nowadays is holy which, though allowing the earth's smallness, denies its motion. To me, however, the truth is more holy still, and (with all due respect to the Doctors of the Church) I prove philosophically not only that the earth is round, not only that it is inhabited all the way round at the Antipodes, not only that it is contemptibly small, but also that it is carried among the stars.⁹³

Galileo could never have dared venture a passage like this. The authority of the Fathers, as we shall see, was one of the weapons most often turned against him.

Had Kepler wanted to quote a theologian, he might have turned to John Calvin who, though he never discussed the Copernican issue, was quite comfortable with both PA and a moderate version of PL:

The Holy Spirit had no intention to teach astronomy; and in proposing instruction meant to be common to the simplest and most uneducated persons, He made use by Moses and the other prophets of popular language, that none might shelter himself under the pretext of obscurity... The Holy Spirit would rather speak childishly than unintelligibly to the humble and unlearned.⁹⁴

Would he have agreed with Kepler's use of these principles to defuse the Copernican issue? That is impossible to say.⁹⁵

What is most striking from our perspective about Kepler's way of resolving the scriptural objections is that there is no mention of PPD/PPS, no emphasis on the need for demonstration of the Copernican position, and no suggestion that the literal interpretation of the texts regarding Sun and Earth ought to have priority in the absence of demonstration on the side of the astronomers. Though he had early become convinced of the truth of the claims of the Copernican cosmology, he had (as we have seen above) a clear grasp of the hypothetical status of the individual arguments from effect to cause that the astronomer had to accumulate in order to arrive at such an assurance. As a mathematical astronomer, besides, he did not share

the preoccupation with demonstration that Galileo had absorbed from his early exposure to Aristotelian logic and natural philosophy. In his view, the astronomical texts in Scripture *obviously* ought not be taken literally, both because the writers would have accommodated their references to Sun and Earth to the understanding of their hearers (PA), and because teaching truths about nature was foreign to their aim (PL). His convictions in that regard would have made it seem irrelevant whether the Copernican view could be demonstrated or not. The Scriptures simply had nothing to say about the true states of motion of Sun and Earth.

GALILEO AS THEOLOGIAN

This brings us, finally, to Galileo's treatise on exegesis, the *Letter to the Grand Duchess*. The principles that make up the framework of the *Letter* will by now be familiar since they echo those already announced by Augustine in the *De Genesi ad Litteram*. However, Galileo works them out much more explicitly than Augustine had done and provides arguments, often very persuasive arguments, in their support. The same five principles reappear here. From the rhetorical standpoint, as we have already seen, the *Letter* is an exceedingly complex document. I shall lay aside much of the detail of the text to focus on the principles that propel the main argument. The aim of the *Letter* is simply to reassure his readers that there is no real conflict between the new Copernican doctrine and the Scriptures, properly understood.

In his *Letter to Castelli*, Galileo had, as we have seen, already given a response to the exegetical challenge he was facing because of the recourse of the beleaguered Aristotelians to the weapon of Scripture. The principles he enunciated there were those I have identified in Augustine's work as PP, PA, PL, and PPD. This was all before Galileo had turned for explicit support to Augustine. It is unlikely, to my mind, that he already knew at this time about the texts in the *De Genesi ad Litteram*; had he known, he would almost surely have called explicitly on Augustine in his support. It is not hard to see how he would have hit on PP, PA, and PL; they were pretty much what a thoughtful layman would have been likely to propose in disputes of the kind. And he could well have encountered PA and PL in the preface to Kepler's *Astronomia Nova*. It seems likely also that

he would have already discussed these matters with Castelli and others better versed in theology than he, in the aftermath of the astronomical discoveries he had been making. PPD would have been the natural reaction of someone who took the Aristotelian emphasis on demonstration as seriously as Galileo did. Missing in the *Letter to Castelli* is any indication of the problematic Augustinian principle, PPS. More of that later.

Galileo opens the argument of the *Letter to the Grand Duchess* with a forceful statement and lengthy justification of the principle of accommodation (PA). The meaning of Scripture is frequently recondite; the authors are often forced to depart from the literal meaning of the words they use in order to convey a deeper truth. They attribute to God feet, eyes, and hands, human feelings like anger, and human conditions like forgetfulness, in order to accommodate themselves to the capacities of the unlearned, the "common people." This being so:

Who will categorically maintain that in speaking incidentally of the earth, water, sun, or other created thing, the Scripture has . . . chosen to limit itself rigorously to the literal and narrow meanings of the words. This would be especially implausible when mentioning features of these created things that are very remote from popular understanding and not at all pertinent to the primary purpose of the Holy Writ, that is, to the worship of God and the salvation of souls.⁹⁶

The notion of accommodation presupposes a deliberate action on the part of authors who themselves know better. Galileo quotes the opinion of "the holiest and most learned Fathers," in a somewhat noncommittal way to the effect "that the writers of Holy Scripture not only did not pretend to teach us about the structure and motions of the heavens and the stars, and their shape, size, and distance, but that they deliberately refrained from doing so, even though they knew all these things very well."⁹⁷ In this case they *would* have been accommodating their writing to the capacities of their readers.⁹⁸ But, of course, for the theologians of Galileo's day, as we have seen, God is the principal author of the Bible, and thus the "accommodating" would ultimately be referred back to God's action in inspiring the human writer.

However, if it be allowed that the language of the Bible is accommodated in this way, a second, more far-reaching, principle suggests

itself. In the text above, Galileo asserts that deep truths about the natural world are simply not “pertinent to the purposes of Holy Writ.” What he is proposing here is, in essence, a *limitation* of the scope of scriptural authority; the Bible is simply not relevant to discussions about the nature of the physical world. For reasons that are rooted both in a proper understanding of the aims of Scripture and in a reflection on the human ability to arrive at demonstrative knowledge of the world revealed by the senses, he can conclude that the Bible ought not be assigned any special authority in regard to the nature of the physical phenomena alluded to in its pages:

In disputes about natural phenomena one must begin not with the authority of Scriptural passages but with sensory experience and necessary demonstrations. For the Holy Scripture and nature derive equally from the Godhead, the former as the dictation of the Holy Spirit and the latter as the most obedient executrix of God’s orders. Moreover, to accommodate the understanding of the common people, it is appropriate for Scripture to say many things that are different (in appearance and in regard to the literal meaning of the words) from the absolute truth. On the other hand, nature is inexorable and immutable, never violates the terms of the laws imposed on her, and does not care whether or not her recondite reasons and ways of operating are disclosed to human capacities. But not every Scriptural assertion is bound to obligations as severe. . . .⁹⁹

Interpreting nature is thus, he suggests, more attuned to our knowing capacities than is interpreting Scripture. Consequently, claims to natural knowledge, provided they can be demonstrated, ought to be given precedence when the issue is one of understanding a scriptural text dealing with natural phenomena (PPD):

So it seems that a natural phenomenon which is placed before our eyes by sensory experience or proved by necessary demonstration should not be called into question, let alone condemned, on account of Scriptural passages whose words appear to have a different meaning.¹⁰⁰

Or, more emphatically:

In questions about natural phenomena that do not involve articles of faith, one must first consider whether they are demonstrated with certainty or known by sensory experience, or whether it is possible to have such knowledge and demonstration. When one is in possession of this [demonstration], since it too is a gift from God, one must apply it to the investigation of the

true meaning of Holy Writ at those places which apparently seem to read differently.¹⁰¹

Thus natural science can serve as an "appropriate aid to the correct interpretation of Scripture."¹⁰²

However, the reverse is not the case. The Scriptures are not concerned with, or in the end relevant to, matters of natural science (PL):

The authority of Scripture aims chiefly at persuading men about those articles and propositions which, surpassing all human reason, could not be discovered by scientific research (*per altra scienza*) or by any other means than through the mouth of the Holy Spirit himself.¹⁰³

The authority of Scripture is limited to those truths that are inaccessible to natural knowledge:

I do not think that one has to believe that the same God who has given us senses, language, and intellect would want to set aside the use of these and give us by other means the information we can acquire with them, so that we would deny our senses and reason even in the case of those physical conclusions which are placed before our eyes and intellect by our sensory experiences or necessary demonstrations.¹⁰⁴

And he adds a second consideration in support of this version of PL:

This is especially implausible for those sciences discussed in Scripture to a very minor extent and in a disconnected way. Such is the case for astronomy, so little of which is contained therein that one does not find there even the names of the planets, except for the Sun, the moon, and only once or twice Venus. . . .¹⁰⁵

If the authors of Scripture had wanted to teach their readers some astronomy, they would surely have done something more systematic and more explicit.

Later he sums up his discussion of the passages we have already examined in Augustine:

We have seen that the Holy Spirit did not want to teach us whether heaven moves or stands still, nor whether its shape is spherical. . . , nor whether the earth is at its center or on one side. So it follows. . . that the Holy Spirit also did not intend to teach us about other questions of the same kind and

connected to those just mentioned in such a way that without knowing the truth of the former one cannot decide about the latter, such as the question of the motion or rest of the earth or Sun. But if the Holy Spirit deliberately avoided teaching us such propositions, inasmuch as they are of no relevance to His intention (that is, to our salvation), how can one now say that to hold this rather than that proposition on this topic is so important that one is an article of faith and the other erroneous?¹⁰⁶

Though Galileo is relying on Augustine here, he goes beyond his predecessor by presenting well-considered arguments in support of PL, some of which would almost surely have given Augustine pause. The reader is meant to be persuaded that mentions of natural phenomena in Scripture are accommodated to the capacity of the reader and, in any event, carry no particular authority as natural knowledge; the aims of those who composed the books of the Bible did not extend to natural science. PL, as we have defined it, applies only to issues bearing on natural science. A much broader principle of limitation would restrict the authority of the Bible to matters that bear specifically on human salvation and *only* to them.

Such a principle is, in fact, suggested by the quip that Galileo attributes to Cardinal Baronio: "The intention of the Holy Spirit is to teach us how to go to heaven, and not how the heavens go."¹⁰⁷ But this is obviously far more debatable.¹⁰⁸ It would, for example, have called into question Bellarmine's assertion that every historical detail in the Bible (that Abraham had two sons, for instance) is a matter of faith. Galileo was skeptical about this latter claim, as we have seen when discussing the notes he made for a response to Bellarmine's letter to Foscarini. He does hint several times at the more sweeping version of a limitation principle in the *Letter to the Grand Duchess*. However, he did not need it for his purposes; the arguments he gave work primarily for PL in the narrower sense, restricting its application to contexts where natural science is involved.

Interspersed in this discussion is a frequent reminder that the sort of natural knowledge Galileo has in mind has to be "demonstrated with certainty or known by sensory experience" (PPD). This leads to a recognition of the other major emphasis of the *Letter*: "Let us go back and examine the importance of necessary demonstrations in conclusions about natural phenomena."¹⁰⁹ In Galileo's eyes, only

demonstration or direct sensory evidence carries weight in natural philosophy:

I should like to ask these very prudent [theologians] to agree to examine very diligently the difference between debatable and demonstrative doctrines. Keeping firmly in mind the compelling power of necessary deductions, they should come to see more clearly that it is not within the power of practitioners of demonstrative sciences to change opinion at will, choosing now this, now that one; that there is a great difference between giving orders to a mathematician or a philosopher and giving them to a merchant or a lawyer; and that demonstrated conclusions about natural and celestial phenomena cannot be changed with the same ease as opinions about what is or is not legitimate in a contract. . . .¹¹⁰

It is the demonstrated character of natural knowledge that gives it weight, therefore, in scriptural exegesis (PPD). If the proper knowledge-claim is "debatable," this is no longer the case. Galileo's Aristotelian conviction that what distinguishes natural philosophy is its ability to *demonstrate* truths about nature suffuses the language of the *Letter*.¹¹¹ He shared this conviction with those for whom he was writing, the Roman theologians who had been schooled in the Aristotelian categories of the Thomist tradition. He quotes Pereira whose commentary on *Genesis* was well regarded in Rome:

One must take diligent care to completely avoid holding . . . anything which contradicts the decisive observations and reasons of philosophy; since all truths always agree with one another, the truth of Holy Scripture cannot be contrary to the true reasons and observations of human doctrines.¹¹²

And he adds a comment from Augustine's *Seventh Letter to Marcellinus* (taken almost certainly from Pereira):

If, against the most manifest and reliable testimony of reason, anything be set up claiming to have the authority of Holy Scripture, he who does this does it through a misapprehension of what he has read [in Scripture].

He concludes with a strong affirmation of the principle of priority of demonstration:

The true meaning of the sacred texts . . . will undoubtedly agree with those physical conclusions of which we are already certain and sure through clear observation and necessary demonstration.

But what if the claim to natural knowledge falls short of demonstration? Historians disagree as to how Galileo answers this vital question. A number of passages suggest that in such a case the literal sense of the scriptural passage should be given priority, thus acknowledging what we have earlier called the principle of priority of Scripture (PPS):

Even in regard to those propositions which are not articles of faith, the authority of the same Holy Writ should have priority over the authority of any human writings containing pure narration or even probable reasons but no demonstrative proofs (*tutte le scritture umane, scritte non con metodo dimostrativo, ma o con pura narratione o anco con probabile ragione*). This principle should be considered appropriate and necessary inasmuch as divine wisdom surpasses all human judgment and speculation.¹¹³

This last sentence echoes Augustine's own reasoning in favor of PPS, and it seems a clear endorsement of the principle itself. Since, as we shall see more fully in a moment, there is an obvious tension between PPS and several of the other exegetical principles proposed by Galileo (notably PL and PP), those scholars who argue for the consistency of Galileo's exegetical approach to the disputed texts in Scripture are at some pains to deny that a version of PPS can be found anywhere in the *Letter*.

Commenting on the passage above, Fantoli argues that the "fundamental thesis" of the *Letter* is what he calls "the principle of the autonomy of scientific research."¹¹⁴ Thus, Galileo cannot be supposed to "give the last word" to Scripture because this would imply that further scientific research on the disputed topic would have to be abandoned, thus belying his fundamental thesis. However, since this response *assumes* consistency, it runs the risk of begging the question. But more to the point, it draws attention to an ambiguity in the claim that priority is being given to Scripture. A *strong* version of PPS would assign priority to the literal sense of the disputed text once for all. But a weaker sense, the one I would take to be more plausible, would give priority to this sense only in the absence of a demonstration of the conflicting claim to natural knowledge. It does not rule out the possibility that such a demonstration might later be discovered.

Fantoli concedes that the text does appear to convey PPS in this weaker sense. But he argues that the emphasis ought not be put

(as I am putting it here) on the distinction between demonstration and something short of demonstration but rather upon a contrast between “two altogether different sorts of ‘human writings’,” one written (as the text, literally translated, puts it¹⁵) “by a demonstrative method” (thus properly scientific in form), and the other not written in this way (and hence not properly scientific). The priority given to Scripture would therefore, only be in regard to rival *unscientific* claims, leaving the principle of (properly) scientific autonomy untouched.

This reading plays, however, on the ambiguity of the term “scientific.” If it be construed in Aristotelian fashion to mean: yielding demonstration, then the principle of “scientific” autonomy would reduce to PPD; autonomy would *not* be conceded to probable argument (which can be “scientific” in the modern sense) where Scripture would still be given priority (PPS). If, in contrast, the term be construed in the modern sense, the principle of “scientific” autonomy cannot be unambiguously identified in the text.

Perhaps, however, “written with a demonstrative method” might be construed as meaning: yielding (or capable in principle of yielding) demonstration. This would not reduce to PPD; it would exempt claims to natural knowledge that might at a *later* time be demonstrated, from subjection to the priority of Scripture. Because such claims would until that time be no more than “probable” or “speculative,” they would seem to be denied such exemption in the interim, according to the wording of the original passage.

In favor of such an exemption, however, a distinction of this general sort is drawn elsewhere:

Some physical propositions are of the type such that by any human speculation and reasoning one can attain only a probable opinion and a verisimilar [likely] conjecture about them, rather than a certain and demonstrated science; an example is whether the stars are animate. Others are of a type that either one has, or one may firmly believe that it is possible to have, complete certainty on the basis of experiments, long observations, and necessary demonstrations; examples are whether or not the earth and sun move and whether or not the earth is spherical. As for the first type, I have no doubt at all that, where human reason cannot reach, and where consequently one cannot have a science but only opinion and faith, it is appropriate to conform absolutely to the literal meaning of Scripture. In regard to the others, however, I should think as stated above, that it would be proper to ascertain

the facts first, so that they could guide us in finding the true meaning of Scripture; this would be found to agree absolutely with demonstrated facts, even though *prima facie* the words would sound otherwise, since two truths can never contradict one another.¹¹⁶

This is a distinction that Aristotle would hardly have recognized, he had, after all, like most of his successors up to Galileo's day, believed that discussion of whether or not the motions of the planets were due to the action of immanent intelligences was a proper part of natural philosophy. One wonders whether Galileo was not creating this special category of reasoning about natural phenomena, one that could not in principle arrive at full certainty, as a device for allowing suitably limited scope to Augustine's PPS.

How would one know in a given case whether demonstration of the proposed thesis *could* be reached if this had not yet been achieved? Or, again, might it not turn out that the thesis is, in fact, false? Galileo's sanguine treatment of the category of the demonstrable-though-not-yet-demonstrated appears to assume that demonstration is just a matter of time in such a case. However, this interpretation is obviously open to question. And one would have to ask, in particular, why PPS should *not* apply in the interim to these possibly demonstrable, though not demonstrated, claims.¹¹⁷ After all, their status could only be probable; they are still for the moment no more than "likely conjecture," the epistemic category that he allows must yield priority to Scripture.

There is one further passage that seems to give unequivocal support to a particularly strong version of PPS. Galileo quotes Pereira's paraphrase of one of the passages in Augustine that lends itself to a PPS interpretation:

In the learned books of worldly authors are contained some propositions about nature that are truly demonstrated and others that are simply taught. In regard to the former, the task of wise theologians is to show that they are not contrary to Holy Scripture; as for the latter (which are taught but not demonstrated with necessity), if they contain anything contrary to Holy Writ, then they must be considered indubitably false and must be demonstrated such by every possible means.¹¹⁸

This runs so clearly contrary to some of the other principles Galileo is advocating (notably PP) that commentators have tried to find ways

to interpret the passage other than the literal one. Fantoli maintains that Galileo is “certainly aware” that the kinds of assertions that should be shown to be false are *only* those that are, in fact, contrary to the Catholic faith and not those, more generally, that merely seem to conflict with some passage in Scripture.¹¹⁹ This would make the passage innocuous, though it would also shift the point it makes away from the interpretation of Scripture. But the qualifier “that is, contrary to the Catholic faith” is not in Augustine’s text as Galileo reproduces it.¹²⁰

Finocchiaro tries a different tack: the injunction to treat anything taught but not demonstrated as “indubitably false” if it contains anything contrary to Holy Scripture is addressed, he suggests, to “wise theologians,” so it could have been intended simply as “a rule of interdisciplinary communication.” A methodological directive of this sort is desirable because “the inadequacies of an idea can be discovered more easily by those who reject it.”¹²¹ This “ingenious but plausible rule” Finocchiaro takes to be the main conclusion of this part of the *Letter*. But, of course, in this form it does run directly counter to PP. And it appears in Galileo’s text as a flat assertion (“must be considered false”) rather than in the qualified mode appropriate to an “as if” directive.

In the end, it is difficult to know how best to interpret this enigmatic passage. Fantoli remarks that if Galileo had noticed a contradiction between the passage from Augustine and the principles he is defending elsewhere in the *Letter*, he would presumably not have quoted it.¹²² Perhaps so. But these principles all find a precedent in Augustine’s commentary, and Galileo might have simply decided to stay as close to his authoritative predecessor as possible. He may well have believed at this point that the Copernican theses were something more than propositions “taught but not demonstrated with necessity.”

In the opening paragraphs of the *Letter*, he makes his own conviction of the truth of these theses abundantly clear. His critics are aware, he says that:

on the question of the constitution of the world’s parts, I hold that the Sun is located at the center of the revolutions of the heavenly orbs and does not change place, and that the earth rotates on itself and moves around it. Moreover, they hear how I confirm this view not only by refuting Ptolemy’s

and Aristotle's arguments, but also by producing many for the other side, especially some pertaining to physical effects whose causes perhaps cannot be determined in any other way, and other astronomical ones dependent on many features of the new celestial discoveries; these discoveries clearly confute the Ptolemaic system, and they agree admirably with this other position and confirm it.¹²³

Given this degree of confidence in the case he could make for the Copernican claim, it is understandable that he might have been inclined to let pass the dangerously strong wording of the passage from Augustine which, for other reasons, he wanted to draw on.¹²⁴ PPD should be enough of itself to carry the day in the debate over the interpretation of the troublesome Scripture passages. In the circumstances, he could afford to concede (or at least appear to concede) PPS, since it could not, if he were right, be invoked against him. If this *was* indeed his reasoning, it would turn out to be a serious miscalculation, prompted by overconfidence in the demonstrative force of the case he could present for the Copernican theses.

Despite a distinct lack of prudence on Galileo's part in this latter regard, he urges a principle of prudence (PP) on interpreters of Scripture and offers several considerations in its support.¹²⁵ He quotes a passage from Augustine that we have already seen¹²⁶ to the effect that scriptural texts are often ambiguous, so that one ought not rush to judgment in their regard. A second motive is more specific to the issue that was so crucial to the Copernican debate: What about propositions that are possibly demonstrable but not yet demonstrated?

It would be very prudent not to allow anyone to commit and in a way oblige Scriptural passages to have to maintain the truth of any physical conclusions whose contrary could ever be proved to us by the senses and demonstrative and necessary reasons. . . . Who is going to claim that everything in the world that is observable and knowable has already been seen and discovered? . . . One must not. . . block the freedom of philosophizing about things of the world and of nature as if they had all already been discovered and disclosed with certainty.¹²⁷

The reference to the possibility of future discovery in the realm of natural knowledge is more explicit here than it had been in Augustine, reflecting Galileo's own confidence in that regard. Elsewhere, he remarks how particularly unwise it would be, in the context of the Copernican debate, to give premature assent on scriptural grounds

to a geostatic doctrine when:

because of many new observations and because of many scholars' contributions to its study, one is discovering daily that Copernicus's position is truer and truer and his doctrine firmer and firmer. So to prohibit Copernicus now, after being permitted for so many years when he was less widely followed and less well confirmed, would seem to me an encroachment on the truth and an attempt to step up its concealment and suppression in proportion to how much more it appears obvious and clear.¹²⁸

Though he is recommending prudence here, his choice of language ("concealment," "suppression") is itself not entirely prudent in the circumstances! But he had already given up on those who were using Scripture against him, people who were "deficient in the intelligence necessary first to understand and then to criticize the demonstrations" that the sciences make use of. Regarding the efforts of such "superficial and vulgar writers," he urges: "It would perhaps be wise and useful advice not to add without necessity to the articles pertaining to salvation and to the definition of the faith."¹²⁹

Critics of the Copernican doctrine, such as Bellarmine, were making heavy use of an exegetical principle that, in the nature of things, Augustine would have been unlikely to call on. This was the "consensus of the Fathers" in regard to the interpretation of particular scriptural passages. Relying on the weight given such a consensus by the Council of Trent, they urged an independent reason for maintaining the assertion that the Sun is in motion and the Earth at rest: This was how these texts were understood by the Fathers of the Church.¹³⁰

Ought this, then, be recognized as an additional principle? Galileo was insistent that limits had to be set upon it. The consensus of the Fathers ought to carry weight only in regard to "those conclusions which the Fathers discussed and inspected with great diligence and debated both sides of the issue, and for which they all agree to reject one side and accept the other."¹³¹ This was quite obviously not the case regarding the astronomical texts in dispute. Nothing can be inferred from their silence in this matter. It was necessary, after all, for the writers of Scripture to "accommodate popular understanding" in such matters. Indeed, even if the motion of the Earth were now to be demonstrated, popular ways of speech that have the Sun move across the sky would be unlikely to change.¹³²

A consensus on such ways of speech does not testify to truth. And the “consensus” of the Fathers that critics of Copernicanism are calling on is no more than a testimony to the popular usage of their own day. Somewhat daringly, Galileo takes on Bellarmine directly. The authority of the Fathers that was emphasized by the Council of Trent ought to be attributed only to “propositions that are articles of faith or involve morals.”¹³³ And this is clearly not the case regarding the astronomical texts in question. The “holiest Fathers” knew better. Realizing how harmful it would be “to use Scriptural passages to establish conclusions about nature, when by means of observation and necessary demonstrations one could at some point demonstrate the contrary of what the words literally say,” they, and among them most notably Augustine, counseled circumspection.¹³⁴

REFLECTIONS ON CONSISTENCY

How are we to sum up Galileo’s contributions to biblical exegesis? And to what extent did the principles he formulated influence the course of the Copernican debate that culminated in his own trial for suspicion of heresy in 1633? His exegetical principles were not in any sense novel, as he himself went out of his way to stress. They were all to be found in varying degrees of explicitness in Augustine’s *De Genesi ad Litteram*, and, separately, they could call on the support of other earlier theologians.¹³⁵

This is not to say that Galileo originally discovered these principles in Augustine or in other theological sources. The *Letter to Castelli* represents, as we saw earlier, his own first reaction to the way in which his Aristotelian opponents were calling on Scripture to defeat the Copernican challenge; there is no reference in that document to Augustine. Yet we find there four of the principles we first located in Augustine’s work, as clearly enunciated as one could wish: PA (“in order to adapt itself to the understanding of all people. . .”), a strong version of PL (“the authority of Holy Writ has merely the aim of persuading men of those articles and propositions which are necessary for their salvation and surpass all human reason. . .”),¹³⁶ PP (“it would be prudent not to allow anyone to oblige scriptural passages to have to maintain the truth of any physical conclusions whose contrary could ever be proved to us by the senses and demonstrative and necessary reasons”), and finally PPD (“the task of wise interpreters is to strive

to find the true meanings of Scriptural passages agreeing with those physical conclusions of which we are already certain and sure from clear sensory experience or from necessary demonstrations").¹³⁷

Significantly there is no suggestion of PPS in that earlier document. Indeed, if anything, the opposite is true ("you see how disorderly is the procedure of those who in disputes about natural phenomena that do not directly involve the Faith give first place to Scriptural passages..."; "it seems to me that in disputes about natural phenomena, [Scripture] should be reserved to last place").¹³⁸ The clear implication is that the traces of PPS in the *Letter to the Grand Duchess* derive from Augustine, whom Galileo had in the meantime discovered to be an invaluable support, in every other way, of his own position.

Reference has already been made to tensions within the set of principles that Galileo introduces in the course of the *Letter*.¹³⁹ It should be clear by now that these tensions did not originate with him; they were implicit long before in Augustine's treatment of the same issues. Of course, Galileo might have avoided them, as Kepler did. But the intellectual backgrounds and rhetorical situations of the two men were altogether different. Given Galileo's early exposure to Aristotelian concepts and methodology and the theological and philosophical standpoints of those he had to persuade, it was, if not inevitable, at least very likely that the exegetical proposals he would lay out would reflect a latent inconsistency that had deep roots in the ancient exegetical tradition, at once Christian and Greek, an inconsistency that had had little practical effect up to this time but that would have significant implications for the Copernican debate.

I use terms like "tension" and "inconsistency" here rather than the more formal logical term "contradiction." The principles themselves are not expressed in formal fashion in the *Letter*. Galileo almost certainly did not think of them as a set of independent rules of interpretation whose mutual consistency would have to be carefully safeguarded.¹⁴⁰

One of the Augustinian principles, PPS, assigning priority to Scripture where demonstration is lacking on the side of natural knowledge, appears to be implied in the *Letter* but there are, as we have seen, some reasons for hesitation in that regard. Readers, like Bellarmine, for whom PPS was already an exegetical guide, would hardly, however, be persuaded by anything in the *Letter* to relinquish

this principle; they would more likely be led to believe that Galileo was allowing epistemic authority to the literal meaning of the biblical text in cases where an apparently conflicting assertion about nature could not summon in its support "sensory observation or necessary demonstration."

The source of the tension within the principles advocated in the *Letter* is easily stated.¹⁴¹ On the one hand, several of the principles, notably PL and in context PA, imply that Scripture is simply not relevant to matters of natural science, since the biblical writers had something quite different in mind. And their choice of language in describing natural phenomena testifies only to the prevailing usage of the day and not to the underlying reality of the physical situation, particularly when this latter would involve technical issues that would baffle readers and distract them from the real function of the biblical discourse.

On the other hand, PPD emphasizes the importance of demonstration in regard to the relevant claim to natural knowledge. This is the source from which its claim to priority over the normal reading of the scriptural passage is taken to derive. It is not because Scripture is *irrelevant* to the scientific understanding of the natural phenomena involved but because scientist/philosophers can produce an irrefutable opposing claim on their own account. If PL (or, less obviously, PA) were to be the guide, however, it would not matter whether the claim to natural knowledge could be demonstrated or not. Even something well short of demonstration could carry a measure of conviction. Over and over again in the *Letter*, Galileo keeps insisting, effectively, on the "*si tamen probatur*" condition ("as long as it be proved") in regard to scientific claims; this is put forward as the reason why, in this case, the authority of the normal reading of Scripture should be set aside. But if PL is to be heeded, this cannot be the reason.

Might not PL and PPD be regarded as *independent* reasons for giving priority to natural knowledge in the appropriate cases?¹⁴² No, because the practical consequences of the two are significantly different. If PPD be emphasized, the effort will be to find a way to *demonstrate* the claim to natural knowledge. If PL be the guide, this will not be of importance. One might say that if one were to be guided by PL, PPD would be redundant. But this could be misleading, as it might suggest that PPD is a simple consequence of PL.

And this is not the case. PPD conveys the impression that there is a need to achieve the level of demonstration in regard to "physical" propositions, whereas according to PL this is not the case.

The contrast between the two approaches, through PL and PPD, becomes sharper if one asks: What if demonstration is *not* achieved? From the PL standpoint, it does not matter: The Scriptures are not going to be relevant anyway to the scientific understanding of the phenomena in question. So whatever level of probability the natural philosopher can offer in that regard is the best that can be done for the moment in determining the truth of the claim being advanced. However, from the PPD side, the matter is quite different. It depends, of course, on whether a principle of the PPS type be adjoined as corollary, and what precise form it takes. Accepting such a principle inevitably makes it inconsistent with PL. That is, if priority is given to Scripture in the event of the claim to natural knowledge falling short epistemically, this would contravene the assertion made by PL that Scripture is simply not relevant to natural knowledge in the first place.

Drawing on our previous discussion of PPS, suppose we assign a special category to propositions that are "demonstrable though not yet demonstrated." The principle of prudence (PP) could then be applied to these; if there is a chance that they might at some later time be demonstrated, then the theologian should be wary of adopting a Scriptural interpretation that would conflict with them.¹⁴³ (Of course, PP would be redundant in such cases, if PL were to be our guide.) But this still leaves a large and mixed category of propositions that Galileo describes as "debatable," relying on "probable reasons," mounting only to "likely conjecture" or "opinion," and so on. Where *these*, at least, are concerned, Galileo most emphatically urges the priority of Scripture.¹⁴⁴ This, of course, would also contravene PL which would forbid assigning priority to Scripture in regard to natural phenomena generally.

What Galileo was trying to combine here, under the inspiration of Augustine's texts, were three themes that do not readily fit together: the irrelevance of problems about nature to the concerns of Scripture, the epistemically problematic character of propositions that are not known with certainty through "sense-observation or strict demonstration," and the claim that "divine wisdom surpasses all human judgment and speculation."¹⁴⁵ The combination of the second

and third of these is almost bound to challenge the first one. One could attain consistency by relying on PL alone (with a judicious assist perhaps from PA), as did Kepler. But literalistically inclined theologians might have balked at this. After all, had not Bellarmine asserted that it would be heretical to deny anything that was "said by the Holy Spirit through the mouth of the prophets"? And the stilling of the Sun's motion was surely crucial, was it not, to the miracle in *Joshua*? The literal meaning of the text appeared obvious in this case. It would have seemed safer for the author of the *Letter* to rely on PPD, which no one would question. But then that brought with it a train of questions about how to treat propositions that had some degree of likelihood but lacked the cachet of demonstration.

One might, of course, also achieve consistency by relying on PPD and PP alone, leaving aside PL altogether. One would then assign priority to demonstrated propositions about nature and simply counsel prudent caution in regard to all others, withholding priority claims for Scripture but leaving open the possibility that Scripture might, in individual cases, carry a special warrant for its descriptions of natural phenomena. This would be consonant with the second and third of the themes above but not with the first (PL). Yet PL obviously appealed to Galileo because of its forthright simplicity and common-sense plausibility.

Part of the problem with the exegetical advice offered by the *Letter* is due to what in our eyes might seem a rather cavalier treatment on Galileo's part of the category of the probable.¹⁴⁶ The association of science with demonstration and the consequent characterization of anything short of science in that restricted sense as "opinion," "conjecture," "speculation," or "a matter of faith" conveys the unmistakable impression that he took less seriously than did many others of his contemporaries and immediate successors (Kepler, Boyle, Huygens) the merits of a well-supported hypothesis.¹⁴⁷

Yet this impression could also be misleading where his actual practice was concerned, for he made extensive and skillful use of hypothetical reasoning in some parts of his own scientific work, notably in his discussions of such astrophysical issues as the natures of the lunar surface, of comets, of sunspots, and the like. In these contexts, it was clear that strict (*propter quid*) demonstration was unavailable, since the natures involved are not directly accessible. Galileo

sought causal hypotheses that would best explain the phenomena under study, sometimes citing the optimistic principle that only one cause can properly account for a given effect.¹⁴⁸

However, the dominant conception of science in his work in mechanics is always the demonstrative one.¹⁴⁹ His early success in formulating a purely kinematic law of falling bodies clearly encouraged him to suppose that demonstration of a broadly geometric sort was achievable in that domain at least, although he had, in fact, set aside entirely the causal issue as to the nature of gravity. And so his language remained that of the “sense observation and necessary demonstration” tradition that we have seen to be characteristic of the *Letter*. This in turn may have prompted him to draw the rather dubious distinction we have seen between physical propositions that are demonstrable and those that can only attain a degree of likelihood short of demonstration, treating the latter of these categories dismissively as no more than conjecture.¹⁵⁰

He was, consequently, disposed to concede (or, at least, to appear to concede) the priority of Scripture, following Augustine’s precedent, where full-scale demonstration was not available. The premium set on the criterion of certainty in assertions about the natural world was unmistakable. Had Galileo been less an Aristotelian in his manner of treating the requirements of natural knowledge, the exegetical advice offered by the *Letter* might perhaps have taken a simpler, and ultimately a more coherent, form.¹⁵¹

SIGNIFICANCE OF THE LETTER

Would this have made any difference to the events of 1616 and 1633? Might it have made less likely the condemnation of the *De Revolutionibus*? Would it have influenced the outcome of Galileo’s trial? The answer in both cases is almost surely: no. The contents of the *Letter* were quite probably not known to the consultors (the “qualifiers”) who took part in the deliberations of the Congregation of the Index in 1616. And once the decree of the Congregation was promulgated, the exegetical issues discussed in the *Letter* were, effectively, shunted aside; they were scarcely noticed, so far as the remaining record goes, in the negotiations between Galileo and his accusers in 1633. The die by then was cast; as far as the *Letter* was concerned, the worst had happened.

The historical significance of the *Letter* has to be sought elsewhere. The *Letter* conveys, better than any other document remaining to us, perhaps, the strains that existed within the principles of exegesis available in Galileo's day for the resolution of conflicts like the one occasioned by Copernican astronomy. Not everyone agrees, however, that the *Letter* exhibits any such strains. Widely different assessments have been offered by different writers.

The strongest challenge, perhaps, comes from Maurice Finocchiaro. He sets out to refute what he terms the "conventional interpretation" of the *Letter*, the one that claims to find some inconsistency between the exegetical principles the *Letter* professes.¹⁵² Instead, he argues that the *Letter* "provides the philosophical theory of which the *Dialogue* is the scientific practice."¹⁵³ To show this, he proposes, first, to relate the principles I have called PPD, PL, and PP, in a single logical structure. Galileo, he says, takes PPD for granted ("conclusive proof of a physical truth is *sufficient* to force a non-literal interpretation of the Bible") as a principle with which no one would disagree. But then Galileo "goes on to argue that the reason why *this* principle holds is such as to justify also another more controversial but more relevant principle," that is, PL: "the Bible is not an authority in physical investigation but in matters of faith and morals." Then, Finocchiaro continues, "from this we get the novel principle that biblical statements should not be used to condemn physical conclusions which, though not yet conclusively proved, are capable of being conclusively proved," a prudential principle. Finally: "this novel principle justifies what Galileo does in the *Dialogue*, for all he needs is that the geokinetic thesis should be a proposition capable of being proved."¹⁵⁴

However, Galileo at no time argues that the reason why PPD holds is such as to justify PL also. In a recent paper, Finocchiaro makes his point even more explicit:

The crucial step in the argument [of the *Letter*] is to ask for the rationale for... Augustine's traditional principle [PPD]: what is the reason why conclusively proved physical truths are (traditionally and uncontroversially) given precedence over conflicting biblical assertions? Baronio's principle [i.e., PL, in its strongest version] gives the answer, and provides the rationale. That is, Baronio's principle explains why Augustine's principle is correct, and this explanation in turn justifies the former's plausibility.¹⁵⁵

However, PL is not, and could not be, offered either as justification or as explanation for PPD. The latter, according to both Augustine and Galileo, stands in its own right. It is something, as Finocchiaro himself remarks, that is taken for granted. The appropriate testimony of truth in natural philosophy is quite obviously in their eyes "sense experience or necessary demonstration." And two truths cannot contradict. Besides, PL would be far less persuasive in the eyes of the intended readership of the *Letter* than would PPD. (Using Finocchiaro's labels, Augustine would carry much more weight than Baronio!) Most important of all, PL would offer no reason why demonstration *should* be demanded or why demonstration should be thought significant in this context in the first place. The intellectual sources of PPD and PL are ultimately quite different; one of them lies in a philosophical analysis of how truths about nature are to be properly certified and the other in a theological analysis of the aims of Scripture.

Furthermore, PP is not, as we have seen, a novel principle, nor is it derived (either by Augustine or by Galileo) from PL. Indeed, were PL to be insisted on, PP would strictly speaking become redundant. It is hardly correct to describe PP as the "central conclusion" of the *Letter*;¹⁵⁶ this might perhaps be true for a modern reader who is looking at the logical structure of the *Letter* from the perspective of the Copernican debate, but in the rhetoric of the *Letter* as Galileo wrote it, PPD (which Finocchiaro elsewhere describes in fact as the "key premise" of the *Letter*¹⁵⁷) gets greater emphasis.

Finally, PP does not "justify" what Galileo does in the *Dialogue*. The promulgation of the decree of 1616 superseded PP in the most emphatic way. PP is a principle of *prudence*, not an epistemic principle. Once the Copernican doctrine had been declared to be "contrary to Scripture," it would have been the opposite of prudent to claim it to be demonstrable, though not yet demonstrated.

This leads to Finocchiaro's second major claim, which is that the *Letter* could serve as a defense of Galileo against the charge for which he was condemned in 1633, namely, of holding and defending "as probable an opinion... contrary to Holy Scripture." The *Letter* would (Finocchiaro argues) justify the course Galileo followed in the *Dialogue* on the grounds that "such probable reasoning is a necessary prerequisite for arriving at conclusively demonstrated

physical conclusions."¹⁵⁸ Since he had, then, a valid defense against the charge laid against him, the implication is clear: He should not have been found guilty on the grounds cited in the trial sentence.¹⁵⁹

This is a very far-reaching resolution of a question that has been debated over many years regarding the outcome of the Galileo trial. I do not propose to enter into the details of this convoluted issue here, except insofar as they bear on the principles enunciated in the *Letter*. These principles simply cannot be used in this way to defend the propriety, from the standpoint of those who accepted the authority of the decree of 1616, of defending a doctrine that had been *declared* to be contrary to Scripture.

The principle defended by Galileo (PP) was not (as Finocchiaro defines it) that "physical propositions capable of conclusive demonstration should not be condemned even if they conflict with the Bible."¹⁶⁰ It was, rather, that they should not be condemned if they *appear* to conflict with the Bible, that is, with the literal meaning of the scriptural text. Nothing in Galileo's argument for what is, after all, presented as a prudential principle, would suggest that it would be legitimate to defend a proposition that *actually* conflicted with the Bible.¹⁶¹ It is because *apparent* conflict may not be real that PP can be allowed as a principle counseling caution. The formal notification that Bellarmine gave to Galileo in 1616 was that he should not "defend or hold" the Copernican theses.¹⁶² There could be no doubt that the *Dialogue* did defend them,¹⁶³ and thus that, technically, Galileo had violated Bellarmine's admonition, which was no more than was already implied by the decree itself. None of the arguments of the *Letter* could have prevailed against this clear consideration.¹⁶⁴

Though the implications of the *Letter* for the 1616 decree and for the decision as to how the argument of the *Dialogue* should be presented are not perhaps as dramatic as those we have just been examining, they are nonetheless significant. The consultors who were asked to adjudicate on the theological orthodoxy of the Copernican claims in 1616 were in no doubt about their answer, which took them only a few days to formulate. Their first finding, significantly, was: "all said that the [heliostatic] proposition is foolish and absurd in philosophy."¹⁶⁵ Thus, before going on to find this proposition to be contrary to Holy Scripture (and therefore in their eyes "formally heretical"), they first declared it to be false from the perspective of

natural science. There could thus be no question of invoking PPD in its favor, a principle that they (like Bellarmine) would certainly have accepted. PL they very probably would have questioned.

The consultors would have been open to the idea that the writers of Scripture accommodated their texts to their readers in some contexts (PA), but they would very likely have denied that assertions about the Earth's motion or the Sun's rest would qualify under this heading. The prudence counseled by PP they clearly deemed unnecessary. If the heliostatic claim *could* never be demonstrated (and we have seen that this was almost certainly Bellarmine's view), there was no need to be cautious about condemning this claim on the grounds of its conflict with Scripture, literally understood. They were thus, effectively, guided by PPS and by a second principle that Galileo had argued ought not be applied to the Copernican issue, namely, the invocation of the consensus of the Fathers.

What made all the difference here, I suspect, was the conviction on the part of these theologian-consultors, most of them Dominicans schooled in Aristotelian natural philosophy, that there was no shadow of a case for interpreting Copernican astronomy in a realistic manner. The successes of that astronomy would have been seen only as a testimony to its value as an effective way to save the phenomena, just as Ptolemy's astronomy had done for so many centuries. It gave no reason to suppose that the Earth *really* went around the Sun. The consultors almost certainly were not familiar with the detail of the Copernican arguments, the arguments based on the phases of Venus, for example. But it would have availed little to bring these up, if the best that could be achieved by means of such arguments was to show that the Copernican astronomy was superior to that of Ptolemy in the practical order. The entire weight of Aristotle's physics could be thrown against any attempt to take heliocentric astronomy in any other way.

The principle on which Galileo leant so heavily in the *Letter*, PPD, never had a chance in the eyes of his Roman critics of vindicating the Copernican theses. They would indeed have been happy to cite Galileo's own insistence on the testimony of "sense experience or necessary demonstration" as warrant for their verdict against these same theses. Lacking such testimony (and, once again, Bellarmine's *Letter to Foscarini* gives a strong indication of how their deliberations would have been likely to proceed in that regard), they would

have felt entirely justified in proceeding as they did. Even if Galileo had followed Kepler's example and relied on PL and PA alone, leaving aside all mention of the need for demonstration, and even if his *Letter* had been laid before the consultors as a formal brief for the Copernican side, it is unlikely that the outcome would have been any different. PPD was too ingrained as a guide to situations where conflict loomed between Scripture and natural knowledge, and PL would assuredly have seemed too radical, given the literalist climate of Roman theological opinion at the time.¹⁶⁶ And the references in the Bible to the Sun's motion and the Earth's stability could have seemed too closely tied to theological points the biblical texts were making for PA to come into play.

The effect of the decree of 1616 was, therefore, to repudiate much of the exegetical argument of Galileo's *Letter*. And Bellarmine was deputed to make it clear to Galileo that the decision of the Holy Office was such as to exclude further defense of the Copernican position on his part. When, seven years later, Galileo was sufficiently encouraged by the accession of Maffeo Barberini to the papal throne as Pope Urban VIII to renew his efforts in support of the Copernican cause, the work he planned would leave exegesis entirely aside to focus exclusively on the scientific merits of the case. But there would still be one echo of the *Letter to the Grand Duchess*. What sort of epistemic status should he seek for the Copernican argument?

The decree of 1616 and Bellarmine's warning made any sort of public defense of the proscribed view risky. Urban had licensed some sort of "hypothetical" treatment of the arguments, so long as Galileo kept in mind that demonstration was excluded, on both philosophical and theological grounds. But if demonstration was thus formally excluded, how was the case for Copernicus to be made against those who would bring Scripture once more against the Copernican assertion of the Earth's motion? Galileo would not have forgotten PPD; he had made that Augustinian principle his own. Furthermore, if demonstration were to be barred and if "probable reasons" were the best that could be found, would this not automatically sanction the application of PPS to enforce the priority of Scripture?

As Galileo labored to find an acceptable way to present the Copernican case, he found himself therefore in what seems, in retrospect at least, an almost hopeless rhetorical predicament. No wonder, then, that this should be reflected in the argument of the *Dialogue*

itself. Was he or was he not claiming to demonstrate the Earth's motions?

Commentators have long disagreed as to how to respond. There is, indeed, ample evidence on both sides. He would clearly have *liked* to claim the status of demonstration for the Copernican theses, but he equally clearly hesitated to do so, as his choice of the dialogue format for the argument would have implicitly conveyed. On one side, he was surely aware at this point that his arguments did not amount to demonstration of the Copernican world system. And he just as surely must have been continually conscious of the warnings given him by Bellarmine and Urban against claiming demonstration. On the other side, readers of the *Letter to the Grand Duchess* would hardly miss the exegetical moral: Nothing *less* than the certainty afforded by "sense experience or necessary demonstration" would serve to validate a claim to natural knowledge that conflicted with the plain literal meaning of a biblical text. Galileo could not claim demonstration, but in its absence his defense of the Copernican doctrine would not persuade his critics who would appeal to PPD and question PL. To modern eyes, at least, it would seem that the author of the *Letter* had left himself no way out when he came to compose the *Dialogue on Two Chief World Systems*.

Could he have done otherwise? He was writing for an audience schooled in the intellectual traditions of Aristotle and Augustine. He could hardly, in the circumstances, have avoided including PPD in his list of proposed exegetical principles. But once this principle be admitted, the task of defending the Copernican theses, the task he set out to accomplish in the *Dialogue*, becomes difficult, if not impossible, of accomplishment. The onus would now be on him, as Bellarmine had long ago said, to produce a demonstration. And this he did not have. Nor in the aftermath of 1616, would he have been permitted to make public such a demonstration were he to have one. The *Letter* reflected all too well an intellectual predicament Galileo had neither created nor, in the end, had the means to resolve.

NOTES

- 1 An earlier version of this essay was delivered under the title "Galileo as a theologian" as the annual Fremantle Lecture at Balliol College, Oxford, in 1983. I am indebted to a good many Galileo scholars for our

discussions of the topics treated here, notably the late Stillman Drake who communicated some of his own enthusiasm for Galileo studies to me in the early 1960s, Richard Blackwell whose compilation of source material in his *Galileo, Bellarmine and the Bible* (Notre Dame, University of Notre Dame Press, 1991) I have found invaluable, and the late Olaf Pedersen, whose judicious assessment of the historical details of this complex story I long ago came to rely on. I am particularly grateful to Annibale Fantoli for his helpful comments on an earlier draft of this essay.

- 2 Bertolt Brecht, *Galileo*, adaptation by Charles Laughton, New York: Grove Weidenfeld, 1966, pp. 72–3.
- 3 Alexandre Koyré suggests a different link between cosmology and the Church's reaction at this time. Giordano Bruno is "the occult but real cause of the condemnation of both Copernicus and Galileo" because he connected the doctrine of the plurality of worlds with Copernicanism in people's minds (*Galileo Studies*, transl. J. Mepham, Atlantic Highlands, NJ: Humanities, 1978, p. 136). Lacking, as we do, the records of the Bruno trial, it is difficult to determine how significant a role Copernican doctrine played in his condemnation by the Roman Inquisition. Dorothy Yates claimed that the role was, at most, a minor one since graver charges regarding the theology of the Eucharist, for example, clearly took precedence (*Giordano Bruno and the Hermetic Tradition*, Chicago: University of Chicago Press, 1964). But Luigi Firpo, on the basis of a broader documentation, has recently emphasized that Bruno's (broadly) Copernican views regarding the motion of the earth and the immobility of the sun did draw criticism from his judges on the grounds that they clashed with specific passages in Scripture (*Il Processo di Giordano Bruno*, Rome: Salerno, 1993). Though the principal charges against Bruno clearly had nothing to do with natural science, there can be no doubt that his trial had already drawn the hostile attention of Roman theologians to Copernican cosmology more than a decade before Galileo first turned his telescope to the skies.
- 4 Maurice A. Finocchiaro, ed. and transl., *The Galileo Affair* (hereafter *GA*), Berkeley: University of California Press, 1989, p. 146; Sergio Pagano, *I Documenti del Processo di Galileo Galilei*, Vatican City: Pontifical Academy of Sciences, 1984, p. 99.
- 5 This phrase was not repeated in the official decree of the Congregation of the Index issued two weeks later which said only that the suspect doctrine was "altogether contrary to Holy Scripture"; Finocchiaro, *GA*, p. 149; Pagano, *Processo*, p. 103.
- 6 Appendix I to Blackwell, *Galileo, Bellarmine, and the Bible* (hereafter *GBB*), p. 183. For a discussion of the link between the Tridentine decree

and the sequence of events leading to the condemnation of Copernicus's book in 1616, see Olaf Pedersen, *Galileo and the Council of Trent*, vol. I, no. 1, in *Studi Galileiani*, Vatican City: Vatican Observatory Publications, 1991.

- 7 *De theologicis locis*, 2.17. Quoted in Bruce Vawter, *Biblical Inspiration*, Philadelphia: Westminster, 1972, p. 59. A similar view may be found in another Dominican work of the same decade, Domingo Bañez's commentary on the *Summa Theologica* of Thomas Aquinas (Rome, 1584; Venice, 1591): "The Holy Spirit not only inspired all that is contained in the Scripture, he also dictated and suggested every word with which it was written." And to make his meaning doubly clear, he adds: "To dictate means to determine the very words" (I, q. 1, a. 8, *dub.* 3 and conclusion; Vawter, p. 60). Historians of exegesis are divided whether to take assertions such as these at face value, given the complexities of the Thomist doctrine of God's customary action on the human will. But Bañez seems to go out of his way in the remainder of the passage cited to make his commitment to a literal notion of dictation quite explicit. See Richard F. Smith, "Inspiration and inerrancy," in *The Jerome Biblical Commentary*, ed. Raymond E. Brown *et al.*, Englewood Cliffs: Prentice-Hall, NJ, 1968, 2, 499–514; p. 505.
- 8 Letter to Castelli, *Le Opere di Galileo Galilei*, Edizione nazionale (hereafter EN), ed. Antonio Favaro, Firenze: Barbera, V, 285; *GA*, p. 52.
- 9 These are sometimes called the two "trials" of Galileo, though the first was not a trial in the strict sentence, nor was Galileo mentioned in the resulting Index decree of 1616. He was, however, to be privately enjoined by Bellarmine to abandon the "Copernican opinions."
- 10 For a more detailed chronicle, see Annibale Fantoli, *Galileo: For Copernicanism and for the Church*, Rome: Vatican Observatory, and Notre Dame: University of Notre Dame Press, second revised edition, 1996, Chapter 3. I have found Fantoli's work a treasurehouse. See also Blackwell, *GBB*, chapter 3.
- 11 EN XIX, 323; *GA*, p. 149. The decree was issued by the Congregation of the Index but promulgated under the authority of the Congregation of the Holy Office, the supreme doctrinal body of the Church under the Pope, of which the Congregation of the Index was, effectively, a subcommittee.
- 12 *Joshua*, 10, 12–13.
- 13 Castelli to Galileo, December 14, 1613, EN XI, 605–6; *GA*, p. 47.
- 14 Galileo to Castelli, December 21, 1613, EN V, 282; *GA*, p. 49.
- 15 Letter to Castelli, EN V, 284; *GA*, p. 51.
- 16 He repeats, and enlarges on, this argument in the *Letter to the Grand Duchess*; he was obviously proud of it. Some commentators have

claimed that it was inconsistent on his part to make use of Scripture here to support the Copernican claim, given his criticism of his Aristotelian opponents for calling on Scripture in support of *their* world-view. But this is to misunderstand Galileo's rhetorical point. He is merely arguing that *if* one wishes to interpret the scriptural texts literally (as his Aristotelian opponents claim they want to do), then this would favor the Copernican world-view, not the Aristotelian one. This was a perfectly fair argument. It does *not* mean that he would himself favor this use of Scripture in support of a scientific theory.

- 17 He objected only to some turns of phrase in the copy of the *Letter* originally submitted to the Holy Office which do not appear in the version that Galileo later forwarded to Dini. The usual explanation of this discrepancy, one strongly hinted at in Galileo's covering letter to Dini (*EN*, V, 291–2; *GA*, p. 55), is that someone, probably Niccolò Lorini, Galileo's Dominican critic who was responsible for sending the *Letter* to Rome in the first place, had tampered with the text out of ill will towards Galileo (see, for example, Blackwell, *GBB*, pp. 196–7). Against this, however, Mauro Pesce has recently argued that Lorini's copy was, in fact, a fair copy of the original and that Galileo, knowing that the *Letter* was under scrutiny in Rome, prudently deleted some of the expressions most likely to give offence before sending the "correct version" to Dini ("Le redazione originali della Lettera Copernicana di G. Galilei a B. Castelli," *Filologia e Critica*, 17, 1992, 394–417). Fantoli leans to this latter view; see *Galileo*, pp. 177, 240–1.
- 18 Cesi to Galileo, January 12 1615, *EN* XII, 129–31; Fantoli, *Galileo*, pp. 175–6. R. S. Westfall thinks this note especially significant in indicating that the original moving force in the process that led to the banning of Copernicus's book was Bellarmine (*Essays on the Trial of Galileo*, Vatican City: Vatican Observatory Publications/Notre Dame: University of Notre Dame Press, 1989, Chapter 1). Fantoli, however, discounts the significance of Cesi's note in this regard, arguing that if Bellarmine had really believed that the Copernican doctrine was heretical, he would hardly have consented to the more moderate wording of the Index decree of 1616. (*Galileo*, pp. 241–2). I am not convinced by this latter argument, for reasons that will become clear later. Bellarmine undoubtedly had a hand in shaping the course of events, particularly the form taken by the 1616 decree, which banned the work of Foscarini outright, never mentioned Galileo, and permitted the work of Copernicus to remain in circulation as long as it was made clear that it was only aimed at saving the appearances. This was just what, as we shall see, one would have expected Bellarmine to advise. But I think it unlikely that Bellarmine wanted the matter to come to a head

as it did in so public a way in 1616; the indications are that although he would have preferred negotiation, overt action was forced on him. Fantoli himself sums up the evidence as indicating that “Bellarmine was one of the principal personages, though certainly not the only one, responsible for the decision of 1616” (p. 233).

- 19 Dini to Galileo, March 7, 1615, EN XII, 151–2; *GA*, p. 58.
- 20 Karl Popper was thus wrong to describe Bellarmine as a “founding father” of the instrumentalism Popper criticizes in “Three views concerning human knowledge” (*Conjectures and Refutations*, New York: Basic Books, 1962, p. 68). Pierre Duhem long ago drew attention to the tension between “mathematical” and “physical” astronomy during this early period (*To Save the Phenomena*, transl. E. Dolan and C. Maschler, Chicago: University of Chicago Press, 1969). His account has been challenged by some for imposing a modern brand of instrumentalism on many of the authors in the “mathematical” tradition; see G. E. R. Lloyd, “Saving the appearances,” *Classical Quarterly*, 28, 1978, 202–22. It should be emphasized that the “instrumentalist” interpretation of mathematical astronomy found in the works of such medieval philosophers as Thomas Aquinas was confined to astronomy only; the arguments in its support would not have applied to other parts of natural philosophy, notably not to physics, where Aquinas and after him the entire Thomist tradition were resolutely realist (Thomas Litt, *Les Corps Célestes dans l’Univers de St. Thomas d’Aquin*, Louvain: Publications Universitaires, 1963; E. McMullin, “The goals of natural science,” *Proceedings of the American Philosophical Association*, 58, 1984, 27–58). Though Bellarmine’s views on mathematical astronomy were undoubtedly instrumentalist, he could hardly be described as an instrumentalist in the modern sense since his approach to natural science generally was unquestioningly realist (E. McMullin, “Robert Bellarmine,” *Dictionary of Scientific Biography*, ed. Charles Gillispie, New York: Scribner, 1970, vol. 1, 587–90).
- 21 See Ugo Baldini and George Coyne, *The Louvain Lectures of Bellarmine*, Vatican City: Vatican Observatory Publications, 1984. I am indebted to Dr. Baldini for our discussion of Bellarmine’s key role in the events of 1614–1616. See also Bellarmine’s own *De Ascensione Mentis in Deum* written in 1614, just as the Copernican controversy was about to spread from Florence to Rome (English translation: *The Mind’s Ascent to God by the Ladder of Created Things to God*, in *Robert Bellarmine: Spiritual Writings*, transl. J. P. Donnelly and R. J. Teske, New York: Paulist Press, 1989). Step 7 (“The consideration of the Heavens, the Sun, the Moon, and the Stars,” pp. 119–30) is especially revealing. The cosmology it describes draws heavily from the Old

Testament, notably the Psalms. The motion of the Sun is particularly emphasized: the Sun runs “tirelessly and extremely fast,” and “covers an immense space in a short time” (pp. 120–1). Regarding the nature of the stars: “we are not seeking opinions,” as he describes the views of the philosophers, “but certain knowledge or the teaching of the faith” (p. 125).

- 22 Galileo to Dini, March 23, 1615, EN V, 299–300; *GA*, p. 60.
- 23 *GA*, pp. 61–2.
- 24 Galileo to Dini, *GA*, p. 63; emphasis added.
- 25 Ciampoli to Galileo, February 28, 1615, EN XII, 145–7; Fantoli, *Galileo*, pp. 179–80.
- 26 There is evidence from the text of the *Dialogo* itself that the main source of Urban’s restriction was the principle that had animated the nominalist challenge to the Aristotelian ideal of demonstration in the fourteenth century: that claims to necessity in demonstration in natural philosophy would unduly constrain the power of God. The fateful argument that Galileo put in the mouth of Simplicio in the closing lines of the *Dialogo* is implicitly attributed to Urban, and it suggests that the reason that the tidal argument cannot *demonstrate* the Copernican thesis is that since one is inferring from observed effect (the tidal motions) to an unobserved cause (the earth’s double motion), it has to be admitted that God could, in principle, bring about this effect equally well by some other (unobserved) cause. (The argument has an interesting affinity with the “underdetermination” argument in recent philosophy of science. Theories are said to be “underdetermined” by the data brought in their support, since there will ordinarily be more than one theoretical explanation for a given set of observed effects.) Urban’s argument would thus exclude strict demonstration in natural philosophy on purely theological grounds. It should be noted that calling the Copernican proposal a “hypothesis” on these grounds could still allow it some degree of likelihood as a truth-claim, unlike the “hypotheses” of mathematical astronomy in Bellarmine’s instrumentalist interpretation.

Cardinal Agostino Oregio mentions in his *De Deo Uno* (Rome, 1629) that Urban had argued around 1615 with a “very learned man” (quite probably Galileo) that since God, being omnipotent, might have arranged earth, sun, planets, and their motions differently, there can be no question of asserting the *necessity* of the present configuration. Copernicans cannot, then, claim to demonstrate their theory; they can at best only claim to save the phenomena (A. Favaro, *Oppositore di Galileo: Maffeo Barberini*, Venice, 1921, p. 27; quoted by Rivka Feldhay, *Galileo and the Church: Political Inquisition or Critical Dialogue*, Cambridge: Cambridge University Press, 1995, p. 209). This is

not the same argument as the one that appears in the *Dialogo*, though its conclusion is the same.

It is conceivable, therefore, that Urban had several different objections in mind to the claim that the Copernican proposal could be demonstrated. Niccolò Riccardi, the Dominican Master of the Sacred Palace, whose task as censor was to decide whether or not to allow the printing of the *Dialogo*, may have conflated the several sorts of reservation when reporting on the Pope's intentions in regard to the work, in a letter of May 24, 1631, to the Inquisitor of Florence, Clemente Egidi, to whom he was entrusting the responsibility for giving the *Dialogo* a final *Imprimatur*. He reminds Egidi that the Pope desires the focus of the work not to be on the tidal argument (which Galileo regarded as the best hope for demonstration of the Copernican theses):

but absolutely on the mathematical examination of the Copernican position on the earth's motion, with the aim of proving that, if we remove divine revelation and sacred doctrine, the appearances could be saved with this supposition; one would thus be answering all the contrary indications which may be put forth by experience and by Peripatetic philosophy, so that one would never be admitting the absolute truth of this opinion, but only its hypothetical truth without the benefit of Scripture. (*EN XIX*, 327; *GA*, p. 212).

The first part of this reminder suggests that Urban wishes Galileo to treat the Copernican hypothesis in instrumentalist terms, merely as a means of saving the phenomena; the second part appears to allow that this could also serve to answer the Aristotelian physical objections, thus granting the Copernican claim a measure of physical likelihood. Riccardi describes without demur the *Dialogo* as discussing the Copernican system "in probable fashion." It makes a considerable difference what sort of "hypothesis" Urban had in mind when it comes to assessing whether the *Dialogo* violated the mandate laid by him on its author. This long parenthetical note carries the story well beyond the cut-off date of 1616 at which our formal narrative ends. It is needed, however, in order to bring out the significance of the discussions of "hypothesis" at the earlier stage of the affair.

- 27 It was written in the form of a lengthy letter to the General of the Carmelite order. For a translation, see Blackwell, *GBB*, pp. 217–51.
- 28 *Ibid.*, pp. 228, 233.
- 29 *Ibid.*, p. 241.
- 30 *Ibid.*, p. 223.
- 31 Bellarmine to Foscarini, April 12, 1615, *EN XII*, 171–2; *GA*, pp. 67–9.
- 32 *GA*, p. 67.
- 33 The Council specified that the books of the Bible "in all their parts" are to be regarded as "sacred and canonical" (Blackwell, *GBB*, p. 182).

No further specification of this last provision was given; later theologians would fill it out in very different ways. As late as the nineteenth century, a passionate controversy followed Cardinal Newman's suggestion that *obiter dicta*, such as a reference to Abraham's two sons, ought not be supposed to carry with them the authority (and hence the inerrancy) of Scripture. For a review, see Raymond F. Collins, "Inspiration," *The New Jerome Biblical Commentary*, ed. Raymond Brown *et al.*, Englewood Cliffs, NJ: Prentice-Hall, 1990, 1023–33.

34 *Ibid.*, p. 68.

35 Fantoli, *Galileo*, pp. 185–8. Fantoli thinks that characterizing as "heretical" any departure from the literal sense of such claims as that Abraham had two sons would foreclose any discussion of taking texts about the Sun's motion or Earth's rest nonliterally. But as Galileo himself would point out in response to Bellarmine (see below), a principle of accommodation could well apply to texts of the astronomical kind where it would not to texts of the former simpler sort. For the use of the term, 'literal' in this context, see Note 68 below.

36 See, for example, Pope John Paul II's speech to the Pontifical Academy of Sciences terminating the work of the Galileo Commission, which he had instituted in 1981 to restudy the details of the Galileo affair:

Robert Bellarmine, who had seen what was truly at stake in that debate, personally felt that in the face of possible scientific proofs that the Earth orbited around the Sun, one "should interpret with great circumspection" every biblical passage that seems to affirm that the Earth is immobile and "say that we do not understand, rather that what had been demonstrated is false." Before Bellarmine, this same wisdom and same respect for the divine word guided St. Augustine ("Lessons of the Galileo case," *Origins: Catholic News Service*, November 12, 1992, 22, 370–6; p. 372).

Rivka Feldhay gives a similarly sympathetic reading of Bellarmine's letter (*Galileo and the Church*: pp. 35–6).

37 Blackwell, *GBB*, p. 261.

38 Foscarini had already composed a spirited *Defensio* in response to a critical assessment of his original letter by an unnamed theologian in Rome. (For the criticism and the *Defensio* see Blackwell, *GBB*, Appendices VIIA and VIIB.) Foscarini argued in his defense that the testimony of the Fathers ought be given weight only in matters of faith and morals, and not at all on issues bearing on natural philosophy. He asserts further that this is not a novel principle, citing in particular the testimony of the leading Dominican theologian, Melchior Cano, to that effect. In the original *Letter*, Foscarini quotes extensively from Scripture but not at all from theological authorities. He rectifies this omission in the *Defensio*, which is mainly concerned with showing that his views find

support in Augustine, as well as in such contemporary authorities as Cano and Pereira.

- 39 These notes constitute Appendix IX in Blackwell, *GBB*; see p. 270.
- 40 *De Controversiis*, I, 3, 3; this chapter is translated as Appendix III in Blackwell, *GBB*, see p. 190.
- 41 Blackwell, *GBB*, p. 266.
- 42 Blackwell, *GBB*, p. 271.
- 43 EN V, 285; *GA*, p. 52. This rather simplistic mode of assessing rival hypotheses appears again in his later work: "It is not possible within the bounds of human learning that the reasons adopted by the right side should be anything but clearly conclusive, and those opposed to them vain and ineffective." *Dialogue Concerning the Two Chief World Systems*, translated by Stillman Drake, Berkeley: University of California Press, 1953, p. 356; EN VII, 383.
- 44 Blackwell, *GBB*, p. 271.
- 45 Text and translation of the *Apologia* in Nicholas Jardine, *The Birth of History and Philosophy of Science*, Cambridge: Cambridge University Press, 1984; see p. 145. See also E. McMullin, "Rationality and paradigm change in science," in *World Changes: Thomas Kuhn and the Nature of Science*, ed. Paul Horwich, Cambridge, MA: MIT Press, 1993, 55–78; see pp. 71–5.
- 46 The assumption is that this requirement sets much tighter constraints on candidate theories than does merely "saving the appearances" by means of a mathematical formalism. The issue of how to limit the number of acceptable causal hypotheses in effect-to-cause (retroductive) reasonings had already been much debated in later Aristotelian natural philosophy and had attracted ever increasing notice as the seventeenth century wore on. See E. McMullin, "Conceptions of science in the Scientific Revolution," in *Reappraisals of the Scientific Revolution*, ed. D. Lindberg and R. Westman, Cambridge: Cambridge University Press, 1990, 27–92.
- 47 Blackwell, *GBB*, p. 85.
- 48 Later on, in the *Dialogo* of 1632, Galileo did rather better in this regard, though still groping for the proper way to say that the Copernican hypothesis was much the best one available and thus had a higher degree of credibility. In the Third Day, he writes:

The principal activity of pure astronomers is to give reasons [the same phrase he had used in the notes above] just for the appearances of celestial bodies, and to fit to these and to the motions of the stars such a structure and arrangement of circles that the resulting calculated motions correspond with those same appearances. (Drake, *Dialogue Concerning the Chief World Systems*, p. 341; EN, VII, 369).

But this, he goes on, is not enough. "However well the astronomer might be satisfied merely as a calculator, there was no satisfaction or peace for the astronomer as a philosopher." And then he shows what the "philosopher" can find to recommend Copernicus over Ptolemy: the "wonderful simplicity" that explains planetary retrogression, substitutes the single annual motion of Earth for a plethora of epicycles, and so on. The argument is not nearly as convincing as Kepler had made it; it is never quite clear just why simplicity should carry the epistemic weight that Galileo gives it. With the tidal argument of the Fourth Day, he hoped to provide the causal argument needed to close the gap further, though he did not attempt a causal explanation of the planetary motions themselves and dismissed Kepler's appeal to attraction in that connection as a "puerility" (*Dialogue*, p. 462; EN VII, 486).

- 49 On January 8, 1616, Galileo presented to Cardinal Orsini in Rome a treatise on the tides, similar in its thrust to the tidal argument for the Copernican motions in the Fourth Day of the *Dialogo* of 1632 (EN V, 377–95). He chose an inauspicious time. By the time Orsini spoke to Pope Paul V on Galileo's behalf on February 23, 1616, the Pope had already set in motion the procedures of the Holy Office that led to the condemnation of the Copernican theses a few days later (March 5, 1616).
- 50 Matters would get worse for Galileo's hopes of demonstration when he set down to construct the argument of the *Dialogo*. To respond to the crucial Aristotelian objection to the motion of the Earth (why don't winds whistle, towers fall, and birds fall from the air?), he argued that the effects of the shared circular motions of bodies on or near the surface of the Earth are imperceptible (Second Day of the *Dialogo*). But if this is so, how can there be tidal effects of the Earth's motions? Galileo never acknowledged this inconsistency; it was due to the ambiguity in his notion of inertia (is inertial motion rectilinear or circular?) and to the lack on his part of a theory of gravity. If the Earth were to rotate fast enough, gravity would no longer prevent the effects that the Aristotelians asserted should accompany the Earth's motion. See my introduction to *Galileo Man of Science*, New York: Basic Books, 1967, p. 41.
- 51 Castelli to Galileo, January 6, 1615; EN XII, 126. Fantoli argues plausibly that the Barnabite priest was Pomponio Tartaglia, Superior of the College of San Frediano in Pisa. A number of his Barnabite colleagues are known to have been sympathetic to the Copernican cause. See Fantoli, *Galileo*, pp. 247–8.
- 52 Galileo misses, as we shall see, just one passage (in II, 16) which could have strengthened his case. Quoted at Note 85.

- 53 Benedictus Pererius (Benito Pereira), *Commentariorum et Disputationum in Genesim Tomi Quatuor*, Rome: Ferrari, 1591–5; second edition, Cologne: Hierat, 1601.
- 54 I, 1, p. 8. See Rinaldo Fabris, *Galileo Galilei e gli Orientamenti Esetici del Suo Tempo*, Vatican City: Pontifical Academy of Sciences, *Scripta Varia* 62, 1986, pp. 29–31; Blackwell, *GBB*, pp. 20–2. Ironically, however, Pereira devotes a lengthy section of his work to showing that the Biblical texts referring to the Sun's motion and the Earth's immobility must be taken literally, despite his support elsewhere for a principle of accommodation. See Irving A. Kelter, "The refusal to accommodate: Jesuit exegetes and the Copernican system," *Sixteenth Century Journal*, 26, 1995, 273–83; p. 280.
- 55 Pereira was in the habit of paraphrasing or abbreviating the passages he presents as direct quotations from Augustine. All three of the passages he quotes on this opening page are fairly extensively reworded in one way or another.
- 56 There is, in fact, counter-evidence. When Galileo quotes another of the three passages from Augustine that Pereira lists on this opening page (*De Genesi ad Litteram*, I, 18), he quotes it exactly as it appears in Augustine's original text, rather than in the Pereira reworded version (see Pierre-Noel Mayaud, "Deux textes au coeur du conflit: Entre l'Astronomie Nouvelle et l'Ecriture Sainte: La lettre de Bellarmin à Foscarini et la lettre de Galilée à Christine de Lorraine," in *Après Galilée*, ed. Paul Poupard, Paris: Desclée, 1994, 19–91; p. 86). Furthermore, in all of the remaining twelve passages from the *De Genesi* quoted by Galileo (seven of these represent Book I, Chapters 18 and 19 quoted almost in their entirety), the text is the authentic original, allowing for small variations in the different editions of Augustine's work.
- 57 Galileo, however, must have seen this relevant page in Pereira for himself, since he quotes from it in a slightly fuller form than that given by Foscarini. See Mayaud, "Deux textes," p. 27. Pereira had already come to Galileo's attention much earlier in another context. In his notebooks on various physical questions compiled at the beginning of his teaching career, probably while he was still at Pisa, Galileo draws on Pereira's influential textbook on Aristotelian natural philosophy, *De Communibus Omnium Rerum Naturalium Principiis et Affectionibus* (Rome, 1581). See William Wallace, *Galileo's Early Notebooks: The Physical Questions*, Notre Dame: University of Notre Dame Press, 1977, especially pp. 14–15, 257, 294.
- 58 Galileo received a copy of Foscarini's original *Letter* from Cesi in early March 1615 (EN XII, 150). The *Defensio* was composed in late March

or early April; Foscarini sent a copy of the *Letter* and the *Defensio* to Bellarmine, whose response, already discussed above, was sent on April 12. It seems likely that Foscarini would have passed on a copy of the *Defensio* to Galileo whose work he praises in his *Letter*.

- 59 Galileo evidently had someone else in mind originally as official recipient of the *Letter*; an early draft uses "Paternità" as the form of address instead of the "Altezza Serenissima" of the final version, leading Favaro to guess that the original intended recipient was probably Castelli. Drake thought it more likely to have been one of Galileo's ecclesiastical patrons in Rome. There is much about the *Letter* that seems to me to make Drake's suggestion the more likely one.
- 60 Favaro lists thirty-six manuscript copies he had consulted in preparing his critical edition (EN V, pp. 272–4). Most are in Italian collections. Many, however, could have been made at a later time since the printed version of 1636 was not readily available in Italy. Fantoli believes that the *Letter* originally circulated only among Galileo's most trusted friends, so that it had "practically no influence on the scriptural debate from 1615 until Galileo's trial in 1633." (He notes in passing that Gianfrancesco Buonamici, in his diary for May 2, 1633, remarks that Pope Paul V was prevented from issuing a stronger condemnation of Copernicanism in 1616 in part by the "learned writing" of Galileo to the Lady Christina of Tuscany. Fantoli, rightly to my mind, finds this account unlikely, p. 262.) Westfall argues that Bellarmine, at least, is likely to have received a copy. There is no reference to the *Letter* in the Roman documents bearing on the decree of 1616. It is mentioned by Melchior Inchofer, a Jesuit philosopher, who was one of those commissioned by the Holy Office to write an evaluation of the *Dialogo* in 1632; in his strongly negative report, he concludes that Galileo does, indeed, defend the Copernican view in the *Dialogo* just as he had done years before in the *Letter to the Grand Duchess*, which, he adds, "if I am not deceived, here in Rome [has] passed through the hands of quite a few" (GA, p. 263; EN XIX, 349).
- 61 For a detailed treatment, see Jean Dietz Moss, "Galileo's *Letter to Christina*: Some rhetorical considerations," *Renaissance Quarterly*, 36, 1983, 547–76. Rhetoric is concerned with the techniques involved in *persuasion*. Where demonstration is available, these techniques are not needed. But when the argument is a probabilistic one (a dialectical argument, in the Aristotelian terminology familiar to Galileo), rhetoric can be an important aid in effecting persuasion.
- 62 St. Jerome, Letter 53 to Paulinus, EN V, 323; GA, p. 99, translation slightly modified.
- 63 Moss, who regards Galileo as an "astute rhetorician," is puzzled by "his castigation of his adversaries for their stupidity and hypocrisy";

he clearly “departs from advice offered by classical rhetoricians . . . not to antagonize the audience or readers through arrogance.” The answer, she suggests, “seems not to lie in innate maliciousness: rather it appears that Galileo was very sensitive to criticism” (“Galileo’s *Letter to Christina*,” p. 555).

- 64 EN V 323–4; *GA*, p. 99.
- 65 EN V 325; *GA*, p. 100.
- 66 Inchofer in his report on the *Dialogo* in 1632 recalls that in the *Letter to the Grand Duchess*, Galileo “ridiculed those who are strongly committed to the common scriptural interpretation of the sun’s motion as if they were small-minded, unable to penetrate the depth of the issue, half-witted, and almost idiotic” (*GA*, p. 263).
- 67 “Lessons of the Galileo case,” p. 372.
- 68 The term “literal” meant something other for Augustine than its usual modern sense. He took it to signify the sense intended by the author (which could well be metaphorical), contrasting it only with “allegorical” usage where the sense attributed is something over and above what the original author intended. His work on *Genesis* features speculative interpretations of all sorts that in his sense of the term count as “literal,” though for us they would be metaphorical. See Taylor’s introduction to *LMG*, vol. 1, pp. 9–11. I use the term in its more restrictive modern sense in this essay.
- 69 The Latin text can be found in vol. 34 of the Migne *Patrologia Latina* (1841) as well as in vol. 28 of the Zycha *Corpus Scriptorum Ecclesiasticorum Latinorum* (1894). The full text is now available in English translation for the first time: John H. Taylor, *The Literal Meaning of Genesis*, New York: Newman, 1982, in two volumes (*LMG*).
- 70 An earlier attempt at a reconstruction of the principles guiding the exegesis of the “conflict” passages in *LMG* will be found in my “How should cosmology relate to theology?” in *The Sciences and Theology in the Twentieth Century*, ed. A. R. Peacocke, Notre Dame: University of Notre Dame Press, 1981, pp. 19–22.
- 71 *LMG*, I, 18; vol. 1, p. 41. Quoted by Galileo.
- 72 Blackwell calls this the “Pragmatic Rule,” *GBB*, p. 76.
- 73 *LMG*, II, 18; vol. 1, p. 73. (I have amended Taylor’s translation of the Latin phrase above.) Galileo evidently thought this to be a key passage, since he quotes it at the beginning of the *Letter to the Grand Duchess*.
- 74 *LMG*, I, 19; vol. 1, pp. 42–3. Quoted by Galileo.
- 75 *LMG*, II, 9; vol. 1, p. 59. Quoted by Galileo.
- 76 *LMG*, I, 21. Quoted by Galileo. The translation is my own. The passage is a puzzling one. An implicit term needs to be made explicit: “Whatever they demonstrate about the natures of things by means of reliable evidence, we shall show not to be *really* contrary to Scripture

[though it may appear to be]. But when they produce from any of their books something *really* contrary to Scripture [and hence] contrary to the Catholic faith, we shall . . . show . . . that it is absolutely false." Fantoli argues that the intended contrast must be between "questions in natural philosophy which are open to discussion because not connected with the Christian faith, and those which are not, precisely because they are related to the faith" (*Galileo*, p. 197). But this seems questionable. The first term in the contrast refers rather to propositions about nature known to be true because they are demonstrated. The contrast is thus an imperfect one since it leaves hanging the all-important issue of propositions about nature that *appear* to conflict with the literal sense of Scripture but are neither demonstrated nor clearly contrary to the Catholic faith. The important point, as far as I am concerned, however, is Augustine's continued emphasis on the need for demonstration, if a new meaning for the scriptural text is to be sought.

- 77 *LMG*, III, 8; vol. 1, p. 81.
- 78 "quod vel certis rationibus perceperunt vel experimentis manifestissimis probaverunt" (*LMG*, II, 1; vol. 1, p. 48).
- 79 *LMG*, II, 9; vol. 1, p. 59.
- 80 *LMG*, II, 5; vol. 1, p. 52.
- 81 *LMG*, II, 9; vol. 1, p. 59.
- 82 This principle can take a number of slightly different forms, depending on which of the Augustinian themes one stresses: the epistemic weakness of human surmise or the epistemic strength of scriptural revelation. The crucial implication is that a natural knowledge claim has to qualify as certain for it to carry weight in the matter of scriptural exegesis.
- 83 *LMG*, XI, 33; vol. 2, p. 166. See also *VI*, 12; vol. 1, p. 192.
- 84 *LMG*, V, 6; vol. 1, p. 157.
- 85 St. Paul is using this as an analogy for the way in which the bodies of the resurrected differ from one another in glory. (*I Corinthians*, 15, 41) *LMG*, II, 16; vol. 1, p. 70.
- 86 This might lead one to wonder, as we have seen, whether he *had* read these pages of Augustine's commentary for himself or whether the citations he uses had been supplied to him.
- 87 *LMG*, II, 9, vol. 1, p. 59. Quoted by Galileo.
- 88 *LMG*, II, 10; vol. 1, pp. 60–1. Quoted by Galileo.
- 89 The protracted struggle between the devotees of Aristotle's "natural" works and more tradition-bound theologians in the thirteenth and fourteenth centuries did indeed concern the relations between natural science and the Scriptures. But the focus was rarely on the interpretation of specific texts; rather, it had to do with more general issues, like

the eternity of the world and the freedom of God in creating. Furthermore, the new Aristotelian "natural knowledge" stayed close to the appearances; its empiricist emphasis ensured that a clash between it and the common sense cosmology of the ancient Hebrew writers would be unlikely to arise.

- 90 There is some disagreement as to when, finally, Galileo *did* become convinced of the superiority of the Copernican system. See, for example, Willy Hartner, "Galileo's contribution to astronomy," in *Galileo Man of Science*, ed. E. McMullin, 178–94, and Fantoli, *Galileo*, pp. 74–81.
- 91 Johannes Kepler, *New Astronomy*, transl. William H. Donahue, Cambridge: Cambridge University Press, 1992, p. 60.
- 92 *New Astronomy*, p. 61. All the texts cited below will be found on pp. 61–5.
- 93 *New Astronomy*, p. 66. I have translated "sanctus" as "holy" here, instead of "pious" as Donahue has it. At the time Kepler wrote these words (1609), the Holy Office had not, in fact, yet denied the motion of the Earth. Galileo's telescopic discoveries still lay ahead.
- 94 John Calvin, *Commentary on Psalms*, Grand Rapids: Eerdmans, 1963, vol. 5, p. 184. Quoted in Edward Rosen, "Calvin's attitude toward Copernicus," *Journal of the History of Ideas*, 21, 1960, 431–41; pp. 440–1. Rosen shows, to my mind conclusively, that Calvin's supposed rejection of Copernicus in his *Commentary on Genesis* ("Who will venture to place the authority of Copernicus above that of the Holy Spirit?") repeated by a whole series of authors, including Bertrand Russell, Dean Inge, and Dorothy Stimson, was fictive. It derived originally from A. D. White who enlarged on what he found in Frederic Farrar, who misquoted it to begin with. See also Christopher Kaiser, "Calvin, Copernicus, and Castellio," in *Calvin and Science*, ed. Richard C. Gamble, New York: Garland, 1992, 45–71. Calvin's belief that the message of the Bible should be accessible to everybody may have disposed him to favor the notion of accommodation in this way. For his theory of accommodation, see Reijer Hooykaas, "Calvin and Copernicus," *Organon*, 10, 1974, 139–48.
- 95 Hooykaas points out that a number of early seventeenth-century defenders of Copernicus, such as John Wilkins and Jacob van Lansbergen, call on Calvin's doctrine of accommodation to deflect biblically inspired attacks on the Copernican theses ("Calvin and Copernicus," p. 143). Still, it should also be noted that Calvin frequently described the Divine authorship of the Bible in terms of dictation to "scribes" or "amanuenses." This would, of course, still be compatible with the notion of accommodation on the part of *God* as author.

- 96 *Letter to the Grand Duchess Christina*, transl. M. Finocchiaro, EN V, 316; GA, p. 93.
- 97 EN V, 318; GA, p. 94.
- 98 See Carlo M. Martini, "Galileo e la teologia," in *Saggi su Galileo Galilei*, ed. Carlo Maccagni, Firenze: Barbèra, 1972, vol. 3(2), 441–51.
- 99 EN V, 316–7; GA, p. 93.
- 100 EN V, 317; GA, p. 93.
- 101 EN V, 332; GA, p. 105.
- 102 EN V, 317; GA, p. 93.
- 103 EN V, 317; GA, pp. 93–4.
- 104 EN V, 317; GA, p. 94.
- 105 *Ibid.*; translation slightly modified.
- 106 EN V, 319; GA, p. 95.
- 107 EN V, 319; GA, p. 96.
- 108 Nonetheless, Pope John Paul II quotes Baronio's *bon mot* from Galileo approvingly in his 1992 allocution, already alluded to [Note 36]. But he evidently interprets it in the narrower sense expressed in the formulation of PL above: "The Bible does not concern itself with the details of the physical world, the understanding of which is the competence of human experience and reasoning" (p. 373).
- 109 EN V, 319; GA, p. 96. Moss writes that Galileo mentions "the importance of demonstration some 25 times [in the *Letter*], speaking as if such proofs exist" ("*Galileo's Letter to Christina*," p. 567). And she goes on to quote each occurrence of the phrase: "sense experience and necessary demonstration" or its equivalent, noting wryly that "the expressions form almost a litany to mesmerize his readers." See also her "The rhetoric of proof in Galileo's writings on the Copernican system," in *The Galileo Affair: A Meeting of Faith and Science*, ed. G. V. Coyne S. J., et al., Vatican City: Specola Vaticana, 1985, 41–65.
- 110 EN V, 326; GA, p. 101. The opening distinction here is between the "demonstrative" sciences, the sciences where demonstration can be reached, and those fields where demonstration is not possible and whose claims thus always remain debatable. But the distinction that matters in the context of Scriptural debate is clearly between "demonstrated conclusions" which "cannot be changed" and assertions that fall short of that. It is the *demonstrated* nature of these conclusions that makes them privileged; *possibly* demonstrable ones, i.e. ones that may or may not achieve demonstration at a later time, *might* be changed and hence lack the all-important privilege. Speculative claims in natural philosophy would, in this view, carry no weight against the literal word of Scripture merely because they pertain to the "demonstrative sciences."

- 111 Galileo's youthful notes on Aristotle's *Posterior Analytics* have undergone intensive study in recent years. William Wallace makes a strong case for the claim that much of the content of these notes derives from lectures of Paolo Valla S. J. at the Collegio Romano in 1587–8, and he argues that this Aristotelian formation in the terminology of proof was to influence Galileo throughout his career. See his edition of the notes, *Galileo's Logical Treatises*, Dordrecht: Kluwer, 1992, and his accompanying commentary, *Galileo's Logic of Discovery and Proof*, Dordrecht: Kluwer, 1992.
- 112 EN V, 320; *GA*, p. 96.
- 113 EN V, 317; *GA*, p. 94.
- 114 Fantoli, *Galileo*, pp. 198, 200, 249. It turns out, however, that this principle is "applicable only in the case of questions which are open to discussion," p. 200. (It excludes matters bearing on Christian faith.) In the context of the Copernican debate, this could prove a significant limitation, as Bellarmine's response to Foscarini (see Note 41 above) illustrates.
- 115 In his translation of the *Letter*, Stillman Drake puts it: "written in a demonstrative way," *Discoveries and Opinions of Galileo*, New York: Doubleday, 1957, p. 183.
- 116 EN V, 330; *GA*, p. 104. The version of PPS in the sentence beginning: "As for the first type" is clearly incompatible with PL.
- 117 Finocchiaro's claim that the "main epistemological distinction" propounded in the *Letter* lies between physical propositions that are *capable* of demonstration (whether or not they are yet demonstrated) and those that are not, rather than between propositions that "have and those that have not been conclusively proved" This seems, questionable ("The methodological background to Galileo's trial," in *Reinterpreting Galileo*, ed. William Wallace, Washington: Catholic University of America Press, 1986, 241–72; p. 268). The issue that is central to the *Letter*, after all, is the proper interpretation of scriptural texts dealing with the physical world. Yet until the conflicting physical proposition is *demonstrated* (according to PPD), the literal meaning of the scriptural passage cannot, on that account at least, be challenged. To say that it is demonstrable (as we have already seen) carries no weight in that regard; it may, after all, turn out eventually to be false.
- 118 EN V, 327; *GA*, p. 102. Why did Galileo make use of Pereira's version of this passage? After all, he did not use Pereira's paraphrases elsewhere (see Note 56). Was it because it is conveniently abbreviated? Was it because it substitutes "worldly authors" for the "they" of the original, suggesting that Augustine's text was intended for the philosophers of

his day? But Pereira's paraphrase omits a key qualifier that could have softened the extraordinarily strong version of PPS conveyed by the latter part of the quoted passage. Pereira drops the qualification "that is, contrary to the Catholic faith" after "anything contrary to Holy Writ" when speaking of the second sort of assertion, those that are not demonstrated. But it is this qualifier that makes sense of Augustine's original injunction (see Note 76). Omitting it makes Galileo appear to support an even stronger version of the controversial PPS principle than did Augustine. Perhaps Galileo simply did not notice the troublesome omission in the Pereira version.

- 119 Fantoli, *Galileo*, p. 198.
- 120 It is in the original text of Augustine, as we saw earlier (Note 76), but not in the version that Galileo found in Pereira.
- 121 Finocchiaro, "The methodological background to Galileo's trial," p. 266.
- 122 Fantoli, *Galileo*, p. 199.
- 123 EN V, p. 311; *GA*, pp. 88–9.
- 124 Michael Sharratt, *Galileo: Decisive Innovator*, Oxford: Blackwell, 1994, pp. 125–6.
- 125 Unlike the four preceding principles, the prudential principle he advocates does not instruct us how to arrive at the proper reading of a disputed scriptural text. It is, instead, purely pragmatic in nature, urging the withholding of judgment in the absence of a secure exegesis.
- 126 EN V, 339; *GA*, p. 111; quoting *LMG, I*, 18 (see Note 71).
- 127 EN V, 320; *GA*, pp. 96–7. Drake inserts a phrase here that makes the reference to scientific progress more explicit: "when *at some future time* the senses and demonstrative or necessary reasons may show the contrary," *Discoveries and Opinions of Galileo*, p. 187. Emphasis added.
- 128 EN V, 329; *GA*, p. 103.
- 129 EN V, 321; *GA*, p. 97.
- 130 See Pedersen, *Galileo and the Council of Trent*, pp. 26–9.
- 131 EN V, 335; *GA*, p. 108.
- 132 EN V, 333; *GA*, p. 106.
- 133 Finocchiaro, EN V, 337; *GA*, p. 109.
- 134 EN V, 338–9; *GA*, p. 110.
- 135 Many commentators have implied that Galileo's hermeneutic principles were novel, particularly his version of PL. See, most recently, Giorgio Stabile, "Linguaggio della natura e linguaggio della scrittura in Galilei," *Nuncius*, 9(1), 1994, 37–64; Mauro Pesce, "L'interpretazione della Bibbia nella Lettera di Galileo a Cristina di Lorena e la sua ricezione," *Annali di Storia dell' Egesi*, 4, 1987, 239–84. Quoted in

- William E. Carroll, "Galileo, science, and the Bible," *Acta Philosophica*, 6, 1997, 5–37; pp. 7–8.
- 136 Carroll notes that when Galileo repeats this passage in the *Letter to the Grand Duchess*, he softens it by altering "solamente" ("has merely the aim") to "principalmente" ("has principally the aim"). Galileo does not need the more sweeping (and more vulnerable) claim for the purposes of his argument in the later *Letter*. But Galileo is not, it seems to me, in this way implicitly conceding that the Bible may serve as a source of truths about the physical world, though it may contain truths about other matters, historical events, for example. ("The authority of the same holy Writ should have priority over the authority of any human writings containing pure narration," EN V, 317; GA, p. 94.) When he says that a knowledge of natural science would help theologians interpret more correctly ambiguous scriptural passages bearing on the physical world (EN V, 332; GA, p. 105), he clearly does not mean to imply that these passages, correctly interpreted with the aid of the scientist, ought be said to "contain" scientific truth.
- 137 EN V, 282–4; GA, pp. 50–1.
- 138 EN V, 285, 282; GA, pp. 52, 50.
- 139 A number of writers have pointed to such tensions: Jerome J. Langford, *Galileo, Science and the Church*, New York: Desclée, 1966, pp. 72–4; McMullin, introduction to *Galileo Man of Science*, pp. 33–5, and more fully in "How should cosmology relate to theology?," pp. 19–22; Blackwell, *GBB*, pp. 78–82; Sharratt, *Galileo: Decisive Innovator*, pp. 123–6; Edith Sylla, "Galileo and probable reasons," in *Nature and Scientific Method*, ed. Daniel Dahlstrom, Washington: Catholic University of America Press, 1991, 211–34. Two historians have recently argued that this claim is based on a misreading of the *Letter*: Fantoli, *Galileo*, Chap. 3; Finocchiaro, "The methodological background to Galileo's trial." Their arguments will be discussed below. Earlier writers most often assumed that the *Letter* constituted "solid argumentation" (as does, for example, Mario Viganò S. J., "Galileo e l'esegesi biblica," *La Civiltà Cattolica*, 116(1), 1965, 228–39; p. 236).
- 140 PL and PA, for example, are clearly not independent of one another. If God "did not want to teach men such things as would be of no avail for their salvation" (LMG, II, 9) (i.e., PL), some sort of accommodation of the language of Scripture would automatically follow. Strictly speaking, PL makes PA redundant. But because the arguments in favor of the two principles are so different, there were sound rhetorical reasons for retaining both.
- 141 It is noteworthy that something of the same tension reappears in the encyclical, *Providentissimus Deus*, issued by Pope Leo XIII in 1893, a

document that has often been described as a vindication of the exegetical principles of Galileo's *Letter* (*The Papal Encyclicals* 1878–1903, ed. Claudia Carlen IHM, Raleigh: McGrath, 1981, 325–39). On the one hand, the encyclical takes a version of PL from Augustine and quotes Aquinas in support of PA (the writers of Scripture “went by what sensibly appeared,” *Summa Theologica*, I, q. 70, a. 1, *ad* 3). On the other hand, it also calls on Augustine to the effect that interpreters of Scripture must not “depart from the literal and obvious sense, except only where reason makes it untenable or necessity requires” (p. 332). Further, they “should show that those facts of natural science which investigators show to be now quite certain are not contrary to the Scripture, rightly explained,” adding as a cautionary note that “much which has been held as proved certain has afterwards been called into question and rejected,” a cautious affirmation of PPD (p. 335). And in a familiar passage Augustine says: “Whatever they can really demonstrate to be true of physical nature, we must show to be capable of reconciliation with our Scriptures” (p. 334). But if the Holy Spirit “did not intend to teach men these things, i.e. the essential nature of the visible universe, things in no way profitable unto salvation” (Augustine again, PL), why should it matter whether the scientists can “really demonstrate” their claims, show them to be “quite certain,” for them to be taken seriously in the context of potential conflict with Scripture? Might not this once more require Galileo to *demonstrate* the Copernican theses in order to make his case? This troubling implication will appear once again in more recent Roman documents; see Note 151.

- 142 Among the defenders of the consistency of the Galilean exegetical principles, Fantoli takes the “principle of the autonomy of scientific research” to be “the fundamental thesis of the *Letter*” (*Galileo*, p. 198). Finocchiaro, in contrast, takes PPD to be “the key premise of Galileo’s argument” in the *Letter* (“Methodological judgment and critical reasoning in Galileo’s *Dialogue*,” *PSA* 1994, ed. D. Hull *et al.*, E. Lansing, MI: Philosophy of Science Association, 1995, vol. 2, 248–57; p. 253). Pesce takes PL and PPD to be two “convergent” means of limiting the authority of Scripture (“L’interpretazione della Bibbia,” p. 251; quoted in Carroll, “Galileo, science, and the Bible” p. 22).
- 143 As a regulative principle, not an epistemic one like the other four, PP only tells theologians not to commit themselves publicly, but it is strictly speaking, consistent with PPS, that is, with the claim that the normal reading of the Scripture passage is more likely to be correct, as things stand, in cases where the conflicting physical proposition is not demonstrated, though potentially demonstrable.

- 144 Fantoli believes that it is “perfectly self-consistent” for Galileo to urge “absolute conformity to the literal meaning of Scripture” in cases where the best the natural philosopher can aspire to is (in Galileo’s words) “probable opinion or verisimilar conjecture.” He adopts Galileo’s alternative description of such cases as ones “where human reason cannot reach,” or as Fantoli himself puts it, that are “beyond the capacity of human comprehension” (*Galileo*, p. 251). However, where probable reasons can be given or likely conjecture supported by argument, the issues are not entirely beyond human comprehension. If one were to be guided by PL, Scripture would *not* be assigned priority in such cases. On the face of it, PL and Fantoli’s “principle of autonomy of scientific research” might seem to be equivalent. But if “scientific” be defined restrictively to refer only to propositions that are demonstrated or strictly demonstrable, then well-supported hypotheses that are not, in Aristotelian terms, demonstrable would not enjoy autonomy and Scripture could thus be given priority over them. This would violate PL but not Fantoli’s principle of autonomy.
- 145 EN V, 317; *GA*, p. 94.
- 146 Many commentators have pointed also to the ambiguity in the notion of *hypothesis* current in Galileo’s day; see Note 26 above. Was it a saving of the phenomena for practical ends, or an explanatory account with some degree of likelihood? The later course of the Galileo story hinged to a significant extent on this ambiguity. See, for example, Guido Morpurgo-Tagliabue, *I Processi di Galileo e l’Epistemologia*, Milan: Edizione di Comunità, 1963; Feldhay, *Galileo and the Church*; Sharratt, *Galileo: Decisive Innovator*, especially 118–19.
- 147 E. McMullin, “Conceptions of science in the Scientific Revolution,” *passim*. In his *Galileo’s Logic of Discovery and Proof* and elsewhere, Wallace presents a much more positive account of Galileo’s handling of probable reasoning, emphasizing the sophisticated treatment of the varieties of *suppositio* in the Jesuit source from which Galileo derived his early notes on Aristotelian demonstration and Galileo’s own description of the demonstrative *regressus* in those notes. Edith Sylla notes that Galileo’s shift from the context of the formal Aristotelian treatise to that of the dialogue would occasion a shift of expectation on the part of the reader. In the former case, probability would count for little, whereas in the latter it would be what the reader would look for and would carry corresponding weight. She concludes that “this is why, I think, the judges at Galileo’s trial could condemn him,” i.e., for assigning *real* likelihood to a doctrine that had been condemned (“Galileo and probable arguments,” p. 230).

- 148 *Dialogue*, EN VII, 444, 471.
- 149 E. McMullin, "The conception of science in Galileo's work," in *New Perspectives on Galileo*, ed. R. Butts and J. Pitt, Dordrecht: Reidel, 1978, 209–57.
- 150 We saw above that Galileo sometimes asserted that only a true explanation can have valid arguments in its favor: "Those who are on the false side cannot have any arguments of value" (Note 42). If one were to rely on this principle, the gap between what is potentially demonstrable and what is actually demonstrated might come to seem very small.
- 151 The exegetes of today are not likely to demand demonstration from natural scientists when an apparent conflict looms. Yet one catches an occasional echo of PPD even still. In the report he presented to the Pope on the occasion of the official termination of the work of the Galileo Commission in 1992, Cardinal Paul Poupard argued that the key to the Galileo affair was that Galileo "had not succeeded in proving irrefutably the double motion of the earth," as Bellarmine had challenged him to do. When, however, an "optical proof" of the Earth's motion around the Sun became available in the following century, Pope Benedict XIV had the Holy Office grant an *Imprimatur* to Galileo's works in 1741 ("Galileo: Report on Papal Commission findings," *Origins: Catholic News Service*, November 12, 1992, 22, 375–6). The implication seems to be that Galileo ought to have had a proper demonstration of the Earth's motion before he challenged the literalist reading of the disputed biblical passages; it was the "transitional situation" in astronomy, apparently, that was at fault. This was, of course, precisely Bellarmine's response. But it is hardly the exegetical lesson that one would expect today. The cardinal frankly acknowledges the "exegetical confusions" of the theologians of that distant day (and he could have included in this admission Bellarmine and the Congregation of the Holy Office, as well as the consequent error in the 1616 decree of the Congregation of the Index). But, of course, from our perspective the principal exegetical confusion was precisely to require demonstration of the Copernican thesis in the first place, a confusion compounded by the delay in clearing Galileo's works until an "optical proof" of that thesis had been found.
- 152 Whether this *is*, in fact, the conventional interpretation might be challenged. Finocchiaro takes this interpretation of the *Letter* to be part of a larger "anti-Galilean myth"; it is based, he asserts, on an "untenable misreading" of the *Letter* and is "the result of insufficient analysis" ("The methodological background to Galileo's trial," pp. 259, 246–7, 261).
- 153 *Ibid.*, p. 260.

- 154 *Ibid.*, pp. 260–1.
- 155 Finocchiaro, “Methodological judgment and critical reasoning in Galileo’s *Dialogue*,” *PSA* 1994, ed. D. Hull *et al.*, E. Lansing MI: Philosophy of Science Association, 1995, vol. 2, 248–57; p. 253. See my comment in the same volume, “Scientific classics and their fates,” 266–74; p. 270.
- 156 *Ibid.*, p. 271.
- 157 Finocchiaro, “Methodological judgment,” p. 253.
- 158 Finocchiaro, “Methodological background,” p. 270.
- 159 Finocchiaro strengthens this last claim in “Methodological judgment.”
- 160 *Ibid.*, pp. 271–2.
- 161 In the texts quoted by Galileo, Augustine makes it clear how he intends PP to be taken: Prudence is to be exercised in asserting the priority of scripture where the scriptural texts in question are in one way or other “obscure.”
- 162 This is according to the certificate Bellarmine subsequently gave Galileo, and which the latter produced at the trial (*GA*, p. 153).
- 163 Over and over again, the arguments he advances in the *Dialogue* are said to favor the Copernican side, to “strengthen the Copernican hypothesis until it might seem that this must triumph absolutely,” as the Preface puts it. This surely constitutes “defending.” See McMullin, “Scientific classics,” p. 271.
- 164 Finocchiaro leaps to the conclusion that to claim this is equivalent to saying that “the Church was right to condemn Galileo” (“Methodological background,” p. 247). But there were many other factors involved besides the technical one of Galileo’s defense of a doctrine proscribed by a decree issued with the authority of the Holy Office. The major error on the part of the Church authorities was made in 1616. The verdict in 1633 could claim the 1616 Decree as warrant, though a warrant that we would say, with the benefit of hindsight, should not have been invoked, considering all the circumstances.
- 165 EN XIX, 321; *GA*, p. 146.
- 166 Pope Leo XIII in *Providentissimus Deus* (1893) strongly disapproved of the attempt to limit inspiration to “matters of faith and morals” on the part of various Catholic theologians of the centuries after Trent. But the less constraining notion that the aim of Scripture is to communicate “salvific truth,” “that truth which God wanted to put into the sacred writings for the sake of our salvation” (from the declaration of the Second Vatican Council, “On Revelation,” 3:11) now seems widely accepted in Catholic theology. See R. F. Smith, “Inspiration and inerrancy,” p. 514.