



## SCIENCE AND CERTAINTY

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When James of Venice translated the *Posterior Analytics* from Greek into Latin, in the second quarter of the twelfth century, European philosophy got one of the great shocks of its long history. John of Salisbury famously remarked that “it has nearly as many obstacles as it has chapters, if indeed there are not more obstacles than chapters” (*Metalogicon* IV.6). Latin philosophers had taken themselves to have a grip on Aristotle’s logic, but what they were discovering in the twelfth century was that their grasp extended only to what would be called the Old Logic, the *ars vetus*, leaving untouched the New Logic of the *Topics*, the *Sophistical Refutations* and, most importantly, the *Prior* and *Posterior Analytics*. Moreover, as the Latin philosophical canon swelled in the later twelfth century to include not just the full Aristotelian corpus but also the riches of Arabic philosophy, European authors realized just what a central role the *Posterior Analytics* in particular played in all this work. Although we now tend to focus on the recovery of Aristotle’s natural philosophy, metaphysics, and ethics, it is arguably the *Posterior Analytics* – not the *Ethics*, the *Metaphysics*, the *Physics*, or the *De anima* – that had the most pervasive influence on scholastic thought. For it is here that Aristotle sets out the methodological principles that are to be followed in the pursuit of systematic, scientific knowledge: what the Latin tradition would call *scientia*. Inasmuch as scholastic philosophers take the goal of all their inquiries to be the achievement of such *scientia*, the strictures of the *Posterior Analytics* had an influence on virtually every area of scholastic thought, from theology (see Chapter 50) to metaphysics (Chapter 44), and from grammar (Chapter 15) to optics (Chapter 24).

The *Posterior Analytics* was important early in Islamic thought, and below I will suggest one respect in which this tradition had a significant influence on Latin scholasticism. But the focus of this chapter will be on how Aristotle’s conception of science was developed in Christian Europe in the thirteenth and fourteenth centuries. The focus will not, however, be on science in our modern sense, inasmuch as that conception of science as something distinct from systematic inquiry in philosophy or theology is a strictly post-medieval

development. The chapter's focus will be on science in Aristotle's sense: roughly, an intellectual grasp of a true proposition grounded in an understanding of why that proposition is true. Since there is no word in English that refers to this, I will often retain the terminology of the authors in question, and so speak of *epistēmē*, *scientia*, and *ilm*.

#### KNOWLEDGE AND SCIENCE

There were, of course, systematic attempts at knowledge among Latin authors prior to the recovery of the *Posterior Analytics* (see Chapter 16), and there were extensive discussions of what knowledge is. But once medieval philosophy fell under the domination of Aristotle in the thirteenth century, theoretical discussions of knowledge tend to presuppose the apodeictic framework set out in the *Posterior Analytics*. For a proposition to be the object of *scientia* in this sense, it must be necessary and universal, known on the basis of an affirmative demonstration in the first syllogistic figure, the premises of which are necessary and explanatory of the conclusion.

Plainly, there is not much that we know in this way. Accordingly, it was never tempting to treat the *Posterior Analytics* as a treatise of epistemology in our modern sense. Instead, scholastic discussions of *scientia* would typically begin by bracketing off Aristotle's conception of *scientia* from the more casual conception employed – then as now – in ordinary use. Thus, in the first Latin commentary on the *Posterior Analytics*, from the 1220s, Robert Grosseteste distinguishes four ways in which we might speak of *scientia*:

It does not escape us, however, that having *scientia* is spoken of broadly, strictly, more strictly, and most strictly. [1] *Scientia* commonly so-called is [merely] comprehension of truth. Unstable contingent things are objects of *scientia* in this way. [2] *Scientia* strictly so-called is comprehension of the truth of things that are always or most of the time in one way. Natural things – namely, natural contingencies – are objects of *scientia* in this way. Of these things there is demonstration broadly so-called. [3] *Scientia* more strictly so-called is comprehension of the truth of things that are always in one way. Both the principles and the conclusions in mathematics are objects of *scientia* in this way. . . . [4] *Scientia* most strictly so-called is comprehension of what exists immutably by means of the comprehension of that from which it has immutable being. This is by means of the comprehension of a cause that is immutable in its being and its causing.

(*In Post. an.* I.2, ed. Rossi, p. 99)

The most familiar, and so in a way the most striking, of Grosseteste's four kinds of knowledge is the first: common *scientia*. It is not obvious that Aristotle did want to allow *epistēmē* of unstable (and so not even for the most part) contingent truths – at any rate, this takes us quite far from the *Posterior Analytics* framework.

Still, the need for something like this broad conception of knowledge seems to have been widely felt, judging from how pervasive the notion would become among later scholastic authors, who very often cite Grosseteste as their source.<sup>1</sup>

*Scientia* in this broad sense is very much like what we now call knowledge. Rather surprisingly – at least from a modern perspective – such a conception of “ordinary” knowledge received little more than passing, desultory attention in the Middle Ages. It was instead the strict requirements of the *Posterior Analytics* that benefited from exhaustive scholarly inquiry, both in textual commentaries and in independent logical treatises. One might conclude, on this basis, that Aristotle had a negative impact on scholastic thinking about knowledge, leading authors to concentrate on one quite narrow and idiosyncratic conception to the exclusion of anything like a generally adequate epistemology. One response to this charge would be the sort of move often associated with Platonism – namely, to dismiss everyday perceptual knowledge as not worthy of the name at all, or, in a phrase that al-Ghazālī ascribes to the theologians, that such knowledge “is a kind of ignorance.”<sup>2</sup> This was never the common attitude of the scholastics, however, given their empirical, Aristotelian orientation. One might say instead that, in place of epistemology, later medieval Latin authors focused on cognitive theory (see Chapter 25). Yet this, too, would be somewhat misleading, inasmuch as it suggests that Aristotle’s rigorous framework is unacceptable as an epistemic theory. On the contrary, a plausible case can be made for that framework as, if anything, a more attractive paradigm for what epistemology ought to be.

After all, as has become increasingly apparent in recent years, it is doubtful that there is a common conception of knowledge in the “ordinary” sense – even limiting ourselves to speakers of English – that can be given a satisfactory analysis. Moreover, even if such an analysis could be given, the effect would be to set up a rigid bar that beliefs must pass over in order to count as knowledge, yielding a crude binary account on which beliefs either succeed or fail to count as knowledge. So analyzed, all knowledge has the same epistemic credentials, meaning that there is no room to talk about having a more or less satisfactory knowledge of some proposition. By the same token, on this binary approach, questions of skepticism naturally loom large, because it might well be that when

<sup>1</sup> See, e.g., Albert the Great (*In Post. an.* I.2.1); Henry of Ghent (*Summa quaest. ord.* 1.1c); William of Ockham (*Summa logicae* III-2.1); John Buridan (*Summulae* 8.4.3–4). The distinction between a broad and strict sense goes back at least to Themistius’s paraphrase of *Post. An.* (I.2), which was translated into Latin from Arabic by Gerard of Cremona before 1187, and which we know Grosseteste to have used. See Pietro Rossi, “Robert Grosseteste and the Object of Scientific Knowledge,” in J. McEvoy (ed.) *Robert Grosseteste: New Perspectives on his Thought and Scholarship* (Turnhout: Brepols, 1995) 53–76.

<sup>2</sup> *Mi‘yār al-‘ilm*, ed. Shams ad-Dīn, p. 244; tr. J. McGinnis and D. C. Reisman, *Classical Arabic Philosophy* (Indianapolis: Hackett, 2007) p. 239.

we alight upon just the correct height at which to set the bar of knowledge, none of our beliefs will manage to clear it, in which case we will have arrived at the result that no one knows anything.

This is not to say that the precise scheme of the *Posterior Analytics* can be defended today. That discussion is too wedded to the syllogism, and too obscure in many of its details to serve as an attractive model. Still, the *Posterior Analytics* offers a perspective worth taking seriously, in virtue of its overarching ambition to conceive of knowledge in terms of an epistemic ideal: what the perfect cognitive state is for beings such as us. This is how Thomas Aquinas, for instance, begins his gloss on Aristotle's definition of *epistēmē*: "When Aristotle says 'We think we have *scientia*,' etc. [*Post. An.* 71b10], he offers a definition of having *scientia simpliciter*. With respect to this we should consider that to have *scientia* of something is to cognize it perfectly" (*In Post. an.* I.4.5).<sup>3</sup> John Duns Scotus invokes the same idea, in discussing the same passage: "The first condition, that *scientia* be a certain cognition, excluding all deception, opinion, and doubt, applies to every intellectual virtue, because an intellectual virtue is a perfection of intellect, disposing it for perfect operation" (*Additiones magnae* prol. 1.1 [ed. Wadding, XI: 2]).<sup>4</sup> These passages reflect the standard scholastic conception of what it is to have *scientia*; as we will see, the subsequent details of their account follow directly from this starting point.

The above passage from Grosseteste illustrates how the Aristotelian approach puts knowledge on a sliding scale. The theory aims to identify an epistemic ideal – what would be the best epistemic state we could hope to achieve, given our cognitive abilities. This is the notion from which our modern usage of 'science' stems, via the seventeenth century, inasmuch as the scientist aims not just to acquire knowledge, but to achieve an ideally trustworthy and rigorous understanding of a given fact. When epistemology is so conceived, methodological principles immediately suggest themselves: thus, according to Aristotle, to achieve the ideal of *epistēmē*, we must formulate our conclusions in syllogistic form, aiming at necessary truths inferred ultimately on the basis of self-evident first principles. Yet, of course, when one begins with ideal theory, one must be prepared to relax those strictures as necessary, and so a good deal of medieval theorizing over *scientia* concerns what to do in cases where one or more of these

<sup>3</sup> See also *Summa theol.* 1a2ae 67.3c; *Sent.* III.31.2.1.1 obj. 4; *Quaest. de veritate* 11.1 sc 5; *Quaest. de virtutibus in communi* 7c: "someone is said to be understanding or knowing inasmuch as his intellect is perfected for cognizing what is true."

<sup>4</sup> See also *Ordinatio* prol. 3 n. 26; *Ordinatio* III.24 q. un. (ed. Wadding, VII.1: 482–3). Scotus's views are discussed in some detail in Eileen Serene, "Demonstrative Science," in N. Kretzmann *et al.* (eds.) *The Cambridge History of Later Medieval Philosophy* (Cambridge: Cambridge University Press, 1982) 496–517. This remains a useful summary of its topic.

desiderata cannot be achieved – as, for example, in biology, where conclusions tend to hold only for the most part rather than necessarily, or in theology, where first principles often are not self-evident but must be embraced on faith alone.<sup>5</sup> Given this picture, in fact, there is something absurd about singling out one point along the scale and engaging in a pitched battle over whether our beliefs pass that test. Accordingly, medieval authors are rarely very interested in the problem of skepticism (see Chapter 28).

### THE OBJECTS OF KNOWLEDGE

Scholastic authors disagreed in various ways over what *scientia* had as its object. One disagreement, especially prominent in the early fourteenth century, concerned whether knowledge concerns things, linguistic–conceptual entities, or something else altogether. Walter Chatton argues for the first thesis: when one knows something about God, for instance, the object of knowledge is not a sentence or a thought but is, instead, God (*Sent.* prol. 1.1). Robert Holcot argues against this view. When one knows that man is not a donkey, is the object of knowledge man or donkey? Moreover, the object of knowledge is a truth, but things are not truths (*Quodlibet* I.6 in Courtenay, *Revised Text*). According to Holcot, the objects of knowledge must be thoughts and sentences. Ockham had thought this as well, but Holcot insists on something that was not quite clear in Ockham – namely, that the objects in question are particular tokens of a thought or sentence, so that what one knows is the sentence one is hearing right now, or the thought one is thinking (*ibid.*).<sup>6</sup> This is a plainly counterintuitive view: it does not seem that one comes to know more things by listening to people repeat themselves. If one thinks the objects of knowledge are neither things nor sentence tokens, though, then it seems that one needs to appeal to some more abstract sort of entity. This is the approach championed by Adam Wodeham, who contends that when one knows that man is an animal, the object is an abstract sentence type, man-being-an-animal (*hominem esse animal*). As for what that thing is, Wodeham seems to think that no good answer can be given (*Lectura secunda* I.1). Gregory of Rimini would later take much

<sup>5</sup> On for-the-most-part conclusions, see Aristotle, *Post. An.* I.30 and II.12, 96a8–18. On theology as a science, see the classic study of Marie-Dominique Chenu, *La théologie comme science au XIII<sup>e</sup> siècle* (Paris: Vrin, 1957).

<sup>6</sup> There is an insightful discussion of Holcot's view in E. A. Moody, "A Quodlibetal Question of Robert Holcot, O.P. on the Problem of the Objects of Knowledge and of Belief," *Speculum* 39 (1964) 53–74. For the larger debate over the objects of knowledge, see the groundbreaking studies of Gabriel Nuchelmans: *Theories of the Proposition: Ancient and Medieval Conceptions of the Bearers of Truth and Falsity* (Amsterdam: North-Holland, 1973), and *Late-Scholastic and Humanist Theories of the Proposition* (Amsterdam: North-Holland, 1980).

the same approach and famously describe such an abstract entity as a *complexe significabile* – a signifiable complex (see esp. *Sent.* I prol. q. 1).<sup>7</sup>

One of Rimini's arguments in favor of abstract entities as the objects of *scientia* is that the theory of *scientia* requires its objects to be *necessary*, thereby excluding contingent entities such as token thoughts or utterances, or things in the world (ibid., art. 1 [ed. Trapp *et al.*, I: 6]). The necessity argument was part of Aristotle's official definition of *scientia*, which runs as follows: "We think we have *scientia* of a given thing *simpliciter*, and not in a sophisticated way (which is by accident), when [a] we think we cognize the cause on account of which the thing is, and [b] that it is its cause, and [c] that it is not possible for it to stand otherwise" (*Post. An.* I.2, 71b10–12, translating from James of Venice's Latin version). The passage is hardly clear regarding what sorts of entities one has knowledge of, but clause (c) is at least clear that *scientia* concerns things that are somehow necessary. As noted above, this constraint is problematic in many areas of knowledge, such as biology – or indeed in any field where we seek *scientia* regarding particular individuals, or contingent states of affairs. What Aristotle seems to have had in mind in such cases is that *epistēmē*, even when concerned with the particular and the contingent, is nevertheless always concerned with necessary connections (or, minimally, with "for the most part" connections). And what the *Posterior Analytics* stresses as the key to grasping such connections is knowing "what a thing is" – or, in more medieval terms, knowing its essence.<sup>8</sup>

This is the ultimate foundation of the medieval preoccupation with essences. A scientific understanding of the natural world, on this view, is not simply a comprehensive listing of true sentences about that world; instead, it is a grasp of the essential features of the world, which brings with it an understanding of how things necessarily are, and how they necessarily relate to other things (for further discussion of essences, see Chapter 46). Here the methodological precepts of the *Posterior Analytics* interact with both the *De anima*'s theory of soul and the broader cognitive story in which that theory is embedded. It was clear to the earliest Latin commentators that one of the central cruxes of the whole account was how to square the generally empiricist Aristotelian approach with the need to arrive at a grasp of the inner natures or essences of things.

<sup>7</sup> See, most recently, Susan Brower-Toland, "Facts vs. Things: Adam Wodeham and the Later Medieval Debate over Objects of Judgment," *Review of Metaphysics* 60 (2006) 597–642, and Pascale Bermon, *L'assentiment et son objet chez Grégoire de Rimini* (Paris: Vrin, 2007). Both Holcot's and Wodeham's discussions are translated in Robert Pasnau, *Cambridge Translations of Medieval Philosophical Texts*, vol. III: *Mind and Knowledge* (Cambridge: Cambridge University Press, 2002) 302–51.

<sup>8</sup> The need to grasp what a thing is, and to make that the middle term in a demonstration, is the main theme of *Post. An.* Bk. II. On the connection between this and necessity, see the useful remarks in Jonathan Barnes's translation and commentary on *Post. An.* 71b10 (pp. 92–3).

Grosseteste, drawing on the *Posterior Analytics*' notoriously brief concluding remarks about how "perception instills universals" (100b5), offers this account:

And so when, over time, the senses act through their many encounters with sensible things, reason, which is mixed up with the senses and in the senses as if it were carried toward sensible things in a ship, is awakened. Once awakened, reason begins to draw distinctions and to consider separately things that had been confused in the senses. Sight, for instance, confuses color, size, shape, and body, and in its judgment all these things are taken as a single thing. Awakened reason, however, distinguishes color from size and shape from body and then shape and size from the substance of body, and so by drawing distinctions and abstracting, it arrives at a grasp of the substance of body, which supports size, shape, and color.

(*In Post. an.* I.14, ed. Rossi, p. 214)

Scholastic authors generally agree that something like this must happen, as the intellect takes a superficial sensory grasp of perceptual qualities and attempts to arrive at an understanding of the underlying substance or nature or essence of the thing. But the only common ground among authors with respect to the details of this process is their inability to supply persuasive details.

The main divide, in this domain, was over whether a naturalistic story could account for our grasp of essences. Grosseteste himself offers a kind of mixed verdict: in this life, we ordinarily rely on the senses for our intellectual grasp of the universal natures of things. But, sounding more Platonic and Augustinian than Aristotelian, he indicates that this orientation is not inevitable:

If the highest part of the human soul, the so-called intellective part, which is not the actuality of any body and needs no corporeal instrument for its proper operation, were not clouded over and burdened by the weight of the corrupt body, it would have complete knowledge without the aid of sense perception, through an irradiation received from a higher light.

(*ibid.*, p. 213)<sup>9</sup>

Subsequent proponents of divine illumination (see Chapter 27) often argued for its necessity on the grounds that a strictly naturalistic account of concept formation through sense perception would not be adequate to explain our grasp of the natures of things.<sup>10</sup> And although scholastic authors from John

<sup>9</sup> This and the previous passage are based on an unpublished translation by Scott MacDonald. For a discussion of Grosseteste's views in this area, see Steven P. Marrone, *The Light of Thy Countenance: Science and Knowledge of God in the Thirteenth Century* (Leiden: Brill, 2001), and Christina Van Dyke, "An Aristotelian Theory of Divine Illumination: Robert Grosseteste's Commentary on the *Posterior Analytics*," *British Journal for the History of Philosophy* (forthcoming).

<sup>10</sup> This was, for instance, one of the main grounds of Henry of Ghent's protracted defense of divine illumination in the 1270s; see Robert Pasnau, "Henry of Ghent and the Twilight of Divine Illumination," *Review of Metaphysics* 49 (1995) 49–75.

Duns Scotus forward almost always rejected this sort of Augustinian appeal to the supernatural, there remained in their alternative accounts little by way of details regarding how one gets from sensory impressions to a grasp of essences, as well as widespread pessimism regarding the extent to which we in fact do manage to succeed in this.<sup>11</sup>

#### SCIENCE AND CAUSES

The first two clauses in Aristotle's definition of *epistēmē* require that we grasp "the cause on account of which the thing is." This idea gets expressed in scholastic texts as a distinction between a demonstration that merely establishes the fact of something's being so (demonstration *quia*), and a demonstration that establishes the reason why something is so (demonstration *propter quid*). In its original, pre-Kantian sense, an *a priori* demonstration is one that proceeds from principles that are causally prior, whereas an *a posteriori* demonstration reasons from effects back to causes. For this reason, only *propter quid* or *a priori* demonstrations yield *scientia* in the strict sense (see also Chapter 44).

When the Aristotelian program is understood as the characterization of an ideal cognitive goal, the causal requirement cannot really be very controversial. Even before Aristotle, Plato speaks of the need to grasp the "legitimate cause and reason" of natural phenomena (*Timaeus* 28a), and even before the recovery of the *Posterior Analytics*, Peter Abaelard quotes from Virgil's *Georgics* – "Happy the man who has been able to discover the causes of things" (ii.490) – in support of the claim that "the man of understanding is he who has the ability to grasp and ponder the hidden causes of things" (*Logica "Nostrorum,"* ed. Geyer, pp. 505–6). Although historians have sometimes found a rejection of this doctrine in the seventeenth century, in fact this is one part of the scholastic program that would be generally embraced by later thinkers. Even the great atomist Pierre

<sup>11</sup> Roger Bacon, *Opus maius* I.10 remarks that "no one is so wise regarding the natural world as to know with certainty all the truths that concern the nature and properties of a single fly, or to know the proper causes of its color and why it has so many feet, neither more nor less." Aquinas says almost exactly the same thing: "our cognition is so weak that no philosopher could have ever completely investigated the nature of a single fly" (*In Symbolum Apostolorum* prol. [*Opuscula theol.* II, n. 864]). For a discussion of Aquinas's views, see Philip Reynolds, "Properties, Causality, and Epistemic Optimism in Thomas Aquinas," *Recherches de théologie et philosophie médiévale* 68 (2001) 270–309. In the next century, William of Ockham would express great skepticism regarding our ability to distinguish differences in species (*Quodlibet* III.6), as would Francis of Marchia (*Sent.* I.3.1), among many others. For a general and pessimistic discussion of the gap between sense and intellect in scholastic accounts, see Peter King, "Scholasticism and the Philosophy of Mind: The Failure of Aristotelian Psychology," in T. Horowitz and A. Janis (eds.) *Scientific Failure* (Lanham, MD: Rowman and Littlefield, 1994) 109–38.



Gassendi can quote with approval the very same passage from Virgil (*Syntagma* II.1.4.1, ed. 1658, p. 283a).

The Aristotelian causal requirement might better be described as an explanatory requirement, where the kinds of explanations are the famous four causes: material, formal, efficient, and final. One way or another, virtually every scholastic author accepts this list, and also accepts that *scientia* requires a grasp of them all. This is not to say that scholastic authors were always optimistic about our ability to achieve this ideal. John Buridan, for instance, considers the question of whether “perfectly knowing some effect requires knowing all of its causes,” and answers in the affirmative – but he then admits that this is impossible for us. This does not lead him to reject the causal requirement, however, but only to formulate a less demanding standard for *scientia* that we can meet. Nevertheless, that requirement still has a causal component; indeed, Buridan rather surprisingly denies that mathematics should be regarded as the most certain of sciences precisely because its demonstrations do not contain an account of the reason why the theorems of math are true (*Quaest. Phys.* I.5). Subsequent critics of scholasticism were not, in general, any more pessimistic than medieval authors regarding our ability to grasp the underlying explanations of things. Where they differed is in what sorts of explanations they recognized. Although Gassendi, for instance, accepts that a grasp of causes is a prime desideratum in physics, he insists that “only the efficient is properly called a cause” (*Syntagma* II.1.4.1, p. 284a). The rejection of forms, prime matter, and final causes lies at the very heart of what is supposed to be modern in seventeenth-century philosophy.

#### CERTAINTY AND EVIDENCE

Surprisingly, Aristotle says nothing at all about certainty in the *Posterior Analytics*. By the later Middle Ages, however, the link between *scientia* and certainty becomes taken for granted, and the certainty of perfect, demonstrative *scientia* is contrasted with the merely plausible arguments of dialectic. The idea of certainty is hardly present in Grosseteste’s commentary on the *Posterior Analytics*, but it appears very prominently a generation later, at the start of Albert the Great’s commentary:

A human being ought to fill his soul not with what is [merely] plausible (*probabile*) and credible (*opinabile*), because they do not yield a stable (*stantem*) disposition in the soul, but with things that are demonstrable and certain, which render the intellect certain and stable, because such things are themselves certain and eternally stable. And from this it is clear that this alone . . . is the end and most perfect and is unconditionally desirable among the logical sciences.

(I.1.1, ed. Jammy, I: 514a)

Albert invokes the preface to Ptolemy's *Almagest* in defense of this claim, but it seems likely that his true inspiration is not Greek but Arabic authors, for whom certainty (*yaqīn*) was a crucial desideratum in knowledge (*'ilm*) from the start of their discussions.

This association between knowledge and certainty was virtually inevitable within the Arabic tradition, because the standard Arabic translation of the *Posterior Analytics*, by Abū Bishr Mattā, employs *yaqīn* quite liberally throughout the text in places where Aristotle speaks simply of knowledge or demonstration.<sup>12</sup> Al-Fārābī puts particular weight on certainty as a characteristic of science, describing "certain philosophy" as the culmination of a process that first proceeds through sophistical and dialectical reasoning (*Kitāb al-hurūf*, ed. Maḥdī, nn. 108–42). He defines certainty in terms of a kind of meta-conviction about one's beliefs:

Certainty means that we are convinced, with respect to what we assent to, that it cannot possibly be different from our conviction. Moreover, we are convinced that this conviction about it also cannot be otherwise, to the point that when one reaches a given conviction concerning his initial conviction, he maintains that it, too, cannot be otherwise, and so on indefinitely.

(*Kitāb al-burhān*, ed. Fakhry, p. 20)<sup>13</sup>

The interesting idea here is that to be certain is to have something more than a mere conviction. One might be convinced of certain political beliefs, for instance, and yet know that if one had been born in a different time or place, one's political views would most likely be different. Certainty, then, is to be convinced in such a way that one is further convinced that such conviction itself cannot be otherwise, and that this further conviction also cannot be otherwise, and so on, as far upward into higher-order beliefs as one cares to go.

When authors invoke certainty as a requirement on knowledge (*'ilm* or *scientia*), however, it is often difficult to know whether they mean it in a subjective

<sup>12</sup> See Deborah L. Black, "Knowledge (*'ilm*) and Certitude (*yaqīn*) in al-Fārābī's Epistemology," *Arabic Sciences and Philosophy* 16 (2006) 11–45.

<sup>13</sup> The translation is that of McGinnis and Reisman, *Classical Arabic Philosophy*, p. 64 (slightly revised). The relevant parts of the *Kitāb al-hurūf* are translated in Muhammad Ali Khalidi, *Medieval Islamic Philosophical Writings* (Cambridge: Cambridge University Press, 2005) pp. 1–18. See also Avicenna: "certitude is to know that you know, and to know that you know that you know, *ad infinitum*" (as quoted in Black, "Knowledge and Certitude," n. 68). Al-Ghazālī similarly takes for granted the link between demonstrative knowledge and certainty: "know that true demonstration is what provides necessary, perpetual and eternal certainty that cannot change" (as translated in McGinnis and Reisman, *Classical Arabic Philosophy*, p. 239). See also Farid Jabre, *La notion de certitude selon Ghazali dans ses origines psychologiques et historiques* (Paris: Vrin, 1958). For a broader discussion of Islamic scientific methodology, see Jon McGinnis, "Scientific Methodologies in Medieval Islam," *Journal of the History of Philosophy* 41 (2003) 307–27.

or objective sense. Al-Fārābī's definition focuses on the subjective sense, but of course mere subjective certainty can hardly be sufficient for perfect knowledge. The difference between the subjective and objective senses is brought out clearly in the Latin tradition by Buridan, who insists that both are required, and who then goes on to distinguish between two sorts of objective certainty:

In the genus of human cognition there are several kinds of certainty and evidentness. On our part, certainty should not be called that of *scientia* or assent unless it is firm – that is, without fear [of the opposite]. On the part of the proposition, one sort of certainty is that which pertains to a proposition so firmly true that there is no power by which it (or any like it) can be made false . . . Another human certainty on the part of the proposition obtains because the proposition is true and cannot be made false by any natural power and natural manner of action, although it can be made false by a supernatural power and in a miraculous manner.

(*Summulae de dialectica* VIII.4.4, tr. Klima, p. 709)

Subjective certainty consists in the subject's confidence. Buridan takes for granted here the standard scholastic characterization of opinion as a less perfect cognitive state in which we assent to a proposition, but with some concern that the opposite might in fact be true. A minimal condition on *scientia* is that it be distinguished from mere opinion by a sufficient degree of confidence in the proposition believed. A further condition on *scientia*, according to Buridan, is objective certainty, which concerns the truth of the object believed – a proposition that will be certain insofar as it is necessarily true. Here he distinguishes two kinds of necessity, which are plainly versions of what are now called logical and natural necessity.

In the elided parts of the quoted passage, Buridan uses this distinction between two kinds of necessity to respond to Nicholas of Autrecourt's notorious arguments for a nearly global skepticism (see Chapter 28). If propositions must be certain in the first, stronger sense, then there is almost nothing of which we have certain knowledge. Yet, as he points out: "This sort of certainty is not required for *scientiae* that are natural or metaphysical, let alone in the arts or in practical matters" (*ibid.*). In the natural sciences, the second sort of certainty is sufficient. And in practical matters, we do not require even that much. Here Buridan describes a third and still weaker form of certainty:

Yet there is still another weaker evidentness that suffices for acting well morally. This goes as follows: if someone, having seen and investigated all the attendant circumstances that one can investigate with diligence, judges in accord with the demands of such circumstances, then that judgment will be evident with an evidentness sufficient for acting well morally – even if that judgment were false on account of invincible ignorance concerning some circumstance. For instance, it would be possible for a judge to act well

and meritoriously by hanging a righteous man because through testimony and other documents it sufficiently appeared to him in accord with his duty that that good man was a bad murderer.

(*Quaest. Metaph.* II.I, ed. 1518, ff. 8vb–9ra)

This notion of moral certainty would become extremely influential in the seventeenth century, as a strategy for replying to skepticism.<sup>14</sup>

What makes Buridan's moral certainty particularly interesting, however, is not that it weakens the notion of certainty to a point where it is applicable to our practical lives, but that it adds something crucial to any workable systematic account of objective certainty – namely, the notion of a thing's being certain relative to a body of evidence. If we follow the *Posterior Analytics* and focus only on necessary truths (logical or metaphysical), then this notion of relative certainty has no application. The propositions in question will be necessarily *simpliciter*, and our only task will be to produce a syllogism showing why they are necessary. But if we attempt to apply the theory to the contingent truths of everyday life, then we need to consider whether a proposition is certain relative to the evidence that we have for it: is it, for instance, certain that a man is guilty, given the testimony we have heard? Such considerations blur the distinction between demonstrative and dialectical reasoning, and open the door to a wide range of new questions that would emerge in the modern era regarding probability and reasoning in light of probabilistic evidence.

<sup>14</sup> On the later history of moral certainty, see Henry van Leeuwen, *The Problem of Certainty in English Thought: 1630–1690* (The Hague: Nijhoff, 1970). For further discussion of Buridan's views on certainty, see Jack Zupko, "On Certitude," in J. Thijssen and J. Zupko (eds.) *The Metaphysics and Natural Philosophy of John Buridan* (Leiden: Brill, 2001) 165–82. More generally, see Peter King, "Jean Buridan's Philosophy of Science," *Studies in History and Philosophy of Science* 18 (1987) 109–32.