

JEAN BURIDAN'S PHILOSOPHY OF SCIENCE

1. Introduction



BURIDAN'S credentials as a scientist are not in doubt: he is responsible for the impetus theory of projectile motion; he introduced the concept of effective demand in the nascent science of economics; his discussions of astronomy were acute enough to raise Duhem's interest. Neither are Buridan's credentials as a nominalist in doubt, although investigation into his precise relation to William of Ockham continues: he rejected all abstract entities, whether universals, common natures, the *complexe significabile*, or types above and beyond tokens; for Buridan, every thing which exists is a concrete individual. His anti-realism included an epistemological component as well, for Buridan maintained that the source of all knowledge is experience.

Yet surprisingly little attention has been paid to the relation between Buridan the scientist and Buridan the nominalist, especially when we consider the skeptical currents in fourteenth-century nominalism. The anti-realist rejection of abstract entities in the form of eternal and necessary natures of individual things seemed to rob science of its necessary foundations. Further, the attempt to supplement Aristotle's account of science as presented in the *Posterior Analytics* by introducing "intuitive" and "abstractive" cognition, allowing for knowledge of contingent truths, was undermined by worries about the extent of God's power—not that God would deceive us, but that he certainly could do so, and this possibility blocks any claim to genuine knowledge. A closer look at the nature of causality only exacerbated matters: William of Ockham maintained that knowledge of the effect was never sufficient for knowledge of the cause, and Nicolaus of Autrecourt gave an analysis of causation which drove him to deny all knowledge not strictly entailed by the Law of Non-Contradiction or confined to immediate experience.

Buridan's philosophy of science attempts to chart a course through these skeptical waters by allowing room for scientific knowledge without countenancing any proscribed abstract entities thought necessary for such a voyage, uniting his anti-realism and anti-skepticism. He does not completely succeed. But his failure is instructive, for what Buridan gives up in the final analysis is nothing less than truth itself. Natural science, strictly speaking, is not knowledge, for its principles may not be true, yet it compels assent.

Buridan never presents his philosophy of science *ex professo*; we have to collect his remarks, scattered across several commentaries and quaestiones, to construct a balanced statement of his views.¹ I shall in the main rely on Buridan's statements in his questions on Aristotle's *Metaphysics* [QM],² referring to his questions on Aristotle's *Physics* [QSP],³ on Aristotle's *Nicomachean Ethics* [QNE],⁴ and various other works (primarily logical) as required.⁵ All translations will be my own unless specifically noted otherwise.

2. The Aristotelian Paradigm

Consider the following view of knowledge: a certain class of universal propositions are self-justifying and necessary, which are the primary objects of knowledge; other propositions are justified by means of these basic propositions through reduction, for nonbasic propositions are entailed by combinations of basic propositions: there are four principal forms of such entailment, and I say 'entailment' because the connection between basic and nonbasic proposition is intensional, the former the cause of the truth of the latter. Moreover, different branches of knowledge are characterized by disjoint classes of basic propositions. Examples of justified nonbasic propositions belonging to different branches of knowledge are 'God exists' (metaphysics), 'The sum of the interior angles of a triangle is 180 degrees'

¹ The closest thing to an *ex professo* treatment is found in *Summulae de dialectica* VIII-3, the "treatise on demonstration," which has not yet been edited. A summary reading of this treatise as found in MS Uppsala U. B. C-609 shows that Buridan here presents his material in the form of a commentary on the *Posterior Analytics*.

² Jean Buridan, *Quaestiones in Metaphysicam Aristotelis argutissimae*, Paris 1518, reprinted as *Johannes Buridanus: Kommentar zur Aristotelischen Metaphysik*, Minerva G. M. B. H. Frankfurt-am-Main 1964 (which incorrectly gives the date of the incunabulum as 1588).

³ Jean Buridan, *Quaestiones subtilissimae super octo Physicorum libros Aristotelis*, Paris 1509, reprinted as *Johannes Buridanus: Kommentar zur Aristotelischen Physik*, Minerva G. M. B. H. Frankfurt-am-Main 1964.

⁴ Jean Buridan, *Quaestiones in decem libros Ethicorum ad Nicomachum*, Oxford 1637.

⁵ Chief among these will be the "treatise on supposition" [TS], the fourth treatise of the *Summulae de dialectica*, edited by Maria Elena Reina, "Giovanni Buridano: Tractatus de suppositionibus," *Rivista critica di storia della filosofia* 14 (1959), 175–208 and 323–352, and the *Tractatus de consequentiis* [TC], edited by Hubert Hubien in the series *Philosophes médiévaux* 16, Université de Louvain 1976; for each of these I use my translation with the numerical cross-reference system given in *Jean Buridan's Logic* (Dordrecht: D. Reidel 1985). Other important works are the *Sophismata*, edited by T. K. Scott in *Grammatica speculativa* 1, Stuttgart-Bad-Cannstatt: Frommann-Holzboog 1977, and Buridan's questions on Aristotle's *De caelo et mundo* [QCM], edited by Ernest A. Moody: *Mediaeval Academy of America*, Cambridge 1942.

(mathematics), and ‘Thunder is a sound in the clouds’ (physics). This view gives a paradigm of knowledge, representing its idealized form: it is not meant to explain the acquisition of knowledge, but to characterize its final shape, much like the covering-law model of scientific explanation.

It should be obvious that this description, which corresponds to a standard mediæval reading of Aristotle, characterizes Aristotelian ‘science’ as presented in the *Posterior Analytics*. The description clearly presents a foundationalist epistemology: basic propositions are Aristotelian principles, which have to be necessary, universal, and prior to nonbasic propositions; Aristotelian sciences are distinguished by their use of different principles; these principles are grasped by nous after prompting from epagoge; the entailment in question is syllogistic, the four main types of which correspond to the four-cause schema (where the middle term of the demonstrative syllogism gives the formal, final, efficient, or material cause).

In what sense did any mediæval philosopher have a ‘philosophy of science’? The answer should be clear: mediæval ‘philosophy of science’ is the philosophical investigation of the Aristotelian paradigm of knowledge.⁶ Aristotle was not the plaster saint some historians of mediæval philosophy have made him out to be; he was seen as presenting a remarkably sophisticated and articulated system of philosophical claims, some of which were clearly wrong (*e. g.* the thesis that the world is eternal), some clearly right (*e. g.* the Law of Non-Contradiction), and the rest open for philosophical investigation. The theory of knowledge was a fertile ground for philosophical exploration, and Buridan was one of the many pioneers.

3. The Kinds of Scientia

Buridan’s anti-realism led him to depart from the Aristotelian paradigm in several ways. He rejects the abstract notion of ‘proposition’ mentioned above: for Buridan the bearers of truth and falsity are particular inscriptions, utterances, and acts of thought. These are related hierarchically, as languages; Written language immediately signifies Spoken language, which in turn immediately signifies Mental language, the language of thought. Each of these levels can be thought of as encoding the higher level: there is a termwise correspondence between them. Mental is the most interesting, for it functions as a canonical language, one perspicuous in rigor and in which sentences display their logical form. It is the language we think in; a

⁶ For a brief elementary survey see Eileen Serene, “Demonstrative Science” in *The Cambridge History of Later Medieval Philosophy*, Norman Kretzmann, Jan Pinborg, and Anthony Kenny (eds.), Cambridge University Press 1982, 496–518.

“term” of Mental is a concept, which is related to items in the world as a ‘likeness.’ We need not explore the structure of Mental any further in this paper;⁷ it suffices to note that Buridan will cash out his anti-realism with a purely nominalist semantic framework.

In the Aristotelian paradigm, then, we speak of sentences, not propositions, where Buridan holds that all talk of sentences is reducible to statements about particular utterances or inscriptions and the Mental acts which they immediately signify— which, loosely, “give them their meaning.” A linguistic observation is in order: there can be *scientia* of either a single sentence or a body of sentences; the former is most naturally translated ‘knowledge’ and the latter ‘science,’ but this blurs the continuities Buridan finds between the two. We shall retain the Latin term, unless the context makes it clear what is meant.

We are now in a position to introduce a crucial distinction, stated pithily in *QM* VI q. 3 fol. 34va (see also *QSP* I q. 1 fol. 2va):

The *scientia* of something is twofold: (*i*) in one way there is *scientia* of something insofar as it is of a demonstrated or demonstrable conclusion; we speak here of demonstrative *scientia*. And in another way (*ii*) there is *scientia* of something insofar as it is the thing signified by some term of the conclusion.

Thus we may speak of *scientia* of either a sentence or of what the sentence is about (roughly).

There is a somewhat similar distinction found in William of Ockham,⁸ but Buridan applies the distinction in a rigorous and systematic way to

⁷ The primary textual source for the doctrine of Mental language is Aristotle, *De interpretatione* 1 16^a3–8; while there are some hints of the doctrine in the writings of the twelfth-century philosopher Peter Abailard, it was only fully adumbrated at the beginning of the fourteenth century by William of Ockham, Gregory of Rimini, Jean Buridan, Adam Wodeham, Walter Burleigh, and others; the doctrine is not original to Buridan, though some of his uses of it, as noted below, are original. See further John Trentman, “Ockham on Mental,” *Mind* 79 (1970), 586–590; R. Paqué, *Der pariser Nominalistenstatut: zur Entstehung der Realitätsbegriffs der neuzeitlichen Naturwissenschaft*, Berlin 1970, 156–158; Joan Gibson, *The Role of Mental Language in the Philosophy of William of Ockham*, unpublished doctoral dissertation, University of Toronto 1976; and the introduction to Jean Buridan’s *Philosophy of Logic* (*op. cit.* n. 5).

⁸ Ockham’s distinction is not very similar, because he takes the object of *scientia* to be the sentence alone (prologue to his commentary on the *Physics*), and that “properly speaking natural *scientia* is about mental intentions. . . nevertheless, metaphorically and improperly speaking, natural *scientia* is said to be about corruptible and mobile things, since it is of the terms which supposit for those things” (*ibid.*). Buridan criticizes this position in *Soph.* 4 sophism 13, discussed in §5 *infra*.

ground his anti-realist views of *scientia*. Let us examine what he has to say about *scientia* with respect to each part of the distinction.

4. Scientia of the Conclusion

By ‘conclusion’ here we mean simply a sentence, one which in fact is the conclusion of a demonstrative syllogism, and hence we are speaking primarily of a Mental sentence. Thus Buridan will be modifying the Aristotelian paradigm to apply to particular mental acts which combine concepts.

In the Aristotelian paradigm distinct sciences are distinguished by their aim, their subject-matter (which is in part a function of the different things each science considers), and the different principles they employ, with metaphysics as the ‘architectonic’ science (in the sense that it validate the principles which are used in the other sciences). Buridan, however, thinks this view cannot stand up to careful examination.

In *QM* VI qq.1–2 Buridan examines the division of speculative *scientia* into metaphysics, physics, and mathematics, and whether only metaphysics considers the essences of things,⁹ that is, the division of sciences by subject-matter and the things they consider. Buridan argues that the division of the speculative sciences is not based *ex parte rerum*: the very same things—everything—are considered in each of the speculative sciences (fol. 33va–vb; see *QSP* I q. 1 fol. 2va–vb).

Consider a single item in the world: some particular apple, for example. This apple is considered by metaphysics inasmuch as the apple is a being, an *ens*, and so subject to those principles which govern all beings in virtue of the fact that each is a being; furthermore, since the apple is an individual substance, it is subject to principles involving individual substances. The apple is considered by physics inasmuch as it is a physical object, an *ens mobile*, susceptible to motion and rest, generation and decay. The apple is considered by mathematics inasmuch as it is a definite quantity, an *ens mensurable*. Yet it is one and the same item, the particular apple, which is considered by each of the sciences. Loosely, we might say that each of the different sciences takes a different point of view on one and the same object. But that is not a distinction between things, but rather between ‘points of view.’

Nor do the sciences consider different real items even per accidens, for example in that metaphysics treats of God and the Intelligences, while physics

⁹ Some of the same ground is covered in *QSP* I qq. 1–3 and II q. 6. In *QCM* I q. 1 4–5 Buridan states his view in a summary fashion, referring us to *QM* VI qq. 1–2 for his “fuller account.”

is confined to the sublunary sphere. God is no exception. He is considered by metaphysics as the uniquely necessary being, with other interesting properties such as simplicity, perfection, and the like. But He is considered by physics as a Prime Mover, the cause of all motion. “Therefore the distinction is not properly taken from the things considered by the sciences (fol. 33vb).”

The distinction is therefore a conceptual distinction. We need a way to cash out the “different points of view” mentioned above. In Buridan’s terms, this amounts to requiring the distinction to be primarily a linguistic distinction, cashed out in terms of the sentences known and not what the sentences apply to. Since we are concerned here with Mental sentences, which are particular acts of thought, Buridan says that the distinction is taken *ex parte rationum sive conceptum* (*ibid.*). But it is not taken simply by partitioning the conclusions and principles of distinct sciences into disjoint sets, for Buridan holds that they cannot be so partitioned: “the same conclusion is properly considered in physics and metaphysics, although perhaps proved by different principles (*ibid.*)” Buridan’s example is striking: each speculative science proves that the Earth is round—a conclusion familiar to every educated man of the time. Natural science proves that the Earth is round in that its parts uniformly tend toward the center according to the “gravity” of each part; metaphysics (reading *metaphysicam* for *mathematicam*) proves that the earth is round through its diverse relations to the heavenly bodies.¹⁰ Buridan carefully forgets to explain how mathematics proves that the Earth is round, but perhaps it does so through considering (say) the arc of the horizon. Hence the different speculative sciences are not distinguished by their conclusions.

Buridan admits a distinction of principles involved in such demonstrations; can we simply distinguish sciences by dividing the principles (though not their logical closure) into disjoint sets? No. Buridan argues (fol. 33vb) that we cannot base this distinction on the reduction of all the principles of a given science to a single principle. Of course, this is not assumed in the partition into disjoint sets, but presumably what motivates Buridan here is the thought that such a distinction is purely accidental, with no real basis, as might be provided by showing that the principles are reducible to a single principle. Nothing would then prevent us from adding half of the mathe-

¹⁰ This answer is considered metaphysical because the heavenly bodies are the province of the angels (the Intelligences), responsible for their movement. Note also *QCM* II q. 23 234, which takes up the question “whether the Earth is spherical,” which Buridan answers affirmatively by arguing ‘naturally’ and astrologically (by the relative positions of the heavenly bodies). He does not attempt to prove the conclusion mathematically.

mathematical principles to metaphysics and the other half to physics, resulting in two (new) speculative sciences rather than the standard three. And surely this is mistaken (see also *QSP* I q. 1 fol. 2va).

Buridan draws from this the following moral (*QM* VI q. 2 fol. 33vb):¹¹

Hence I finally conclude that the distinction [of the speculative sciences] is originally taken from some incomplex principles [*i. e.* terms], since after all this distinction should be taken from *rationes* or concepts, and not conclusions or principles.

The speculative sciences are distinguished by different “incomplex principles,” that is, by being concerned with different terms of sentences. Since we are speaking, as always, of Mental sentences, these terms are concepts, which are the reasons (*rationes*) for the imposition of the utterance or inscription as a term. Although “it is difficult to say what these terms are,” Buridan remarks, we can nonetheless specify them. Metaphysics is concerned with the term *ens* (being); physics with the term *ens mobile vel quantum* (mobile being or quantity); mathematics with the term *ens mensurabile* (measurable being).¹² In *QSP* II q. 6 fol. 34ra Buridan enlarges upon this point: natural science is called ‘natural’ because it studies terms with natural *rationes*, in that all terms considered in physics are defined by (the term) ‘motion.’ These are terms of Mental language, and hence concepts or *rationes*; each of us has his or her own (*QM* IV qq. 2–4). This is why the speculative sciences are not distinguished *ex parte rerum*: one and the same object may fall under distinct concepts, that is, two terms may with reason be applied to one and the same real object.

Now that we have Buridan’s answer, we can explain the unity of a *scientia*: there is only the sort of unity by attribution to a primary element, which is the relevant term; metaphysics includes sentences dealing with whatever can be predicated of being and whatever it can be predicated of—and these terms are the *passiones entis* which are ordered depending on the type of predication they can appear in (*e. g.* *per se primo modo*, *per se secundo modo*, convertible, *etc.*). Buridan suggests an analogy:¹³ just as an army is a single unit in which an aggregate of individual men are rank-ordered by a chain of command to its single leader, so too a *scientia* is a unity in which an aggregate of sentences have their terms ordered with respect to a pri-

¹¹ Compare the forceful statement in *QNE* I q. 2 7: “Nevertheless, it should be known that the distinction of sciences is not by their objects taken simply, but rather according to determinate formal *rationes considerandi*, and so sciences are distinguished by that which distinguishes such different formal *rationes considerandi*.”

¹² See also *QSP* I q. 3 fol. 4ra and *QCM* I q. 1 3 for a statement of this point.

¹³ *QM* IV q. 3 fol. 14ra and *QSP* I q. 2 fol. 3rb-va.

mary element, the key 'term' of the *scientia*. Technically, we could express this by saying that '*scientia*' supposit for an aggregate and appellates or connotes the rank-ordering of its attributes.

By means of this anti-realist reduction Buridan can easily equate demonstrative *scientia*, whether of a sentence or of a body of sentences, with a particular quality: the *habitus demonstrativus* (*QNE* proemium 3), or disposition to assent to the sentence(s), which the individual who has demonstrative knowledge possesses. *Scientia* is therefore not some ideal but a concrete quality of an individual subject, as any good anti-realist should allow.

5. Scientia of What is Signified

To appreciate the full extent of Buridan's position we need some principles from his philosophy of language, and in particular principles governing the operation of intentional verbs.¹⁴ Such verbs, and the participles and terms derived from them, differ from other verbs in that their "verbal action" each specifies "goes over" to their object not directly, into that for which the terms supposit (*i. e.* what the terms refer to), but indirectly, by means of "certain mediating concepts indicated by those terms" (*TC* 1.6.12–14 and 3.7.3). In particular, such intentional verbs are said to *appellat suas rationes*, that is, to involve the reason for the imposition of the term.¹⁵ We only know items through the mediation of concepts. As Buridan says in *TS* 3.7.10, the logical analysis of a sentence such as "Socrates knows *A*" is "Socrates knows *A* according to the reason (*ratio*) by which the term '*A*' is applied, that is, according to the concept-of-*A*." Since terms immediately signify concepts (terms of Mental), a ratio is something very like the Fregean sense of a term.

¹⁴ By "intentional verbs" I mean verbs that are (*i*) cognitive or epistemic, such as 'know,' 'understand,' 'believe,' and the like; (*ii*) verbs of desire, such as 'want,' 'desire,' 'intend,' and the like; (*iii*) promissory-verbs, such as 'owe' or 'promise.' The fullest list, though Buridan acknowledges its incompleteness, is found in *TC* 3.4.7; their characteristics are discussed in *Soph.* IV sophisms 7–15, on which I shall rely in this paper, and in *TS* 3.8.24–31, *TS* 5.3.1–8, *TC* 1.6.12–16, *TC* 3.7.3–10, *QM* IV q. 8 fol. 19ra and q. 14 fol. 23va, *QSP* II q. 12 fol. 38va.

¹⁵ Some terms are "appellative," others not; in general, a term is appellative if it signifies something which it does not stand for or refer to: the term 'feudal-lord' refers directly to an individual person, but indirectly takes account of that person's land, possessions, and the like: these latter are signified but not directly referred to. Further details about appellation can be found in L. M. De Rijk, "On Buridan's Doctrine of Connotation," in Jan Pinborg (ed.), *The Logic of John Buridan* (Copenhagen 1971), and in the introduction to *Jean Buridan's Logic* (*op. cit.* n. 5).

Buridan notes a peculiarity of intentional verbs that holds in English as well as Latin: when a term follows the verb¹⁶ we have an opaque context: Coriscus may not know the one approaching, although the one approaching is in fact his father, whom he surely knows; we do not infer that he knows his father and does not know his father. The reason is that ‘know’ is intentional, and so the term ‘the one approaching’ (*venientem*) appellates its *ratio*, so that we conclude Coriscus does not know his father as the concept the-one-approaching applies to him. On the other hand, when the term precedes the verb, it is said to appellate all its *rationes* indifferently, so that substitutivity is preserved and we have a transparent reading:¹⁷ the sentence “The one approaching is someone Coriscus does not know” is false, but from “The one approaching is someone Coriscus knows” and “The one approaching is Socrates” we may infer “Socrates is someone Coriscus knows.” We shall concentrate on the verb *scire* and the noun *scientia* derived from it, each of which involve the appellation of the *rationes*.

In his earlier discussion of the distinction among the speculative sciences, Buridan employs this linguistic distinction: ‘to consider’ is an intentional verb. This explains why we may say that the essences of all things are considered by each of the speculative science,¹⁸ and that there is no real distinction among them since the same things are considered by each of the different sciences: the terms here precede the verbs and thus are read transparently. Now we can enlarge upon this point, and say that it is false that every science considers the essences of all things, or that every science considers all things, for in this case the term follows the verb and so the reason for the imposition of the term is involved (the appellation of a *ratio*). The Mental terms Buridan assigns as the subject of each science are the *rationes* according to which things are considered in a science. Things are considered by metaphysics insofar as they fall under the concept of being, *i. e.* under the *ratio* by which the term ‘being’ is applicable to them; things are considered by physics under the *ratio* by which the term ‘mobile being’ is applicable to them; things are considered by mathematics under the *ratio* by which the term ‘measurable being’ is applicable to them. In

¹⁶ This is Buridan’s way of drawing scope distinctions: a term appears *a parte post* and so in the scope of the verb, or *a parte priori* and outside of the scope of the verb.

¹⁷ Strictly speaking it is incorrect to call these ‘opaque’ and ‘transparent,’ for they are not alternative readings of one and the same sentence but Buridan’s way of regimenting the difference between the logical form of two different sentences; I shall use these terms as convenient abbreviations for distinguishing sentences in which the term appears *a parte post* and *a parte priori*.

¹⁸ Or at least, of all things the essences are considered: fol. 33vb.

the final analysis, this is Buridan's way of capturing the fact that all things are considered by every science, but each from its own point of view.¹⁹

The nature of opacity suggest that while the inference *a parte priori* to *a parte post* holds for at least some ratio (which we shall call the Entailment Principle), the converse entailment, *a parte post* to *a parte priori*, generally fails. But in his *Sophismata* Buridan investigates a particular case in which the latter inference seems to hold, the case of knowledge (*scientia*) or knowing (*scire*). We shall call this the Converse-Entailment Principle. [*Soph.* 4 remark 8; *TS* 3.8.27.] From "Socrates knows *A*" we can, Buridan argues, infer "[There is some] *A* Socrates knows."

Now the verb 'to know' may take either an objectual or a sentential complement.²⁰ The case given above is the objectual version of the Converse-Entailment Principle. In *Soph.* 4 sophism 13 Buridan argues that a sentential version of the Converse-Entailment Principle entailment also holds: from "Socrates knows *A* to be φ " we can infer "[There is some] *A* Socrates knows to be φ ."

This is crucial for Buridan's account of *scientia* and, as mentioned before, is the key element in his distinctive treatment of the distinction between knowing sentences and knowing things signified by the terms of sentences (as opposed to Ockham). One of the arguments Buridan gives is that on any other construal we should have to deny that we have *scientia* of the world, which is the point of disagreement between Buridan and Ockham. Ockham's account of *scientia* leaves us only in the realm of the mental; Buridan's allows us to be directly in contact with items in the world.²¹

Buridan's Converse-Entailment Principle, however, runs into two obvious difficulties: (i) counterintuitive substitution-instances; (ii) lack of existential import, *i. e.* when no *A* exists.

In sophism 14 of *Soph.* 4 Buridan takes up the first difficulty, in the following case: Socrates, who has been studying astronomy, has been locked away in prison so that he cannot see the sky at all. Buridan permits us in this case to pass from "Socrates knows some stars are above the horizon" to "[There are] some stars Socrates knows to be above the horizon." Which stars? Those which are in fact above the horizon, namely (in the example)

¹⁹ This may also explain the abstract character of *scientia*: it deals only in concepts, which may indeed be abstract; so long as the items which fall under the concepts are singular, Buridan's anti-realism is not compromised.

²⁰ Strictly speaking, for Buridan an accusative-infinitive phrase or declarative clause introduced by '*quod*' is not a sentence, but we can ignore this distinction here.

²¹ Note that Buridan is careful only to state the Converse-Entailment Principle for *scire*: it clearly fails for verbs that allow for intentional inexistence.

the constellation of Aries. But this surely seems false, for Socrates cannot see the sky.

Buridan's reply is to insist on the different readings *a parte priori* and *a parte post*. The constellation Aries is indeed what Socrates knows, but only under the complex ratio 'some stars above the horizon,' by the Entailment Principle. This *ratio* will of course latch onto some actual stars, although Socrates does not know which. Socrates, from his astronomical studies, knows that stars are (always) above the horizon; the Converse-Entailment Principle allows us to pass from "Socrates knows some stars to be above the horizon" to "Some stars Socrates knows to be above the horizon," and since substitutivity works *a parte priori* we may infer from the fact that the stars of Aries are above the horizon that "The stars of Aries Socrates knows to be above the horizon." But from this we can only pass to "Socrates knows stars (under some *ratio* or other) to be above the horizon," and the only such *ratio* poor Socrates has at his disposal in prison is the *ratio* 'some stars (or other).' This, Buridan holds, is not counterintuitive but in fact the natural reading of the case.

But this answer might seem to be a cheat.²² It surely trades on the peculiar characteristic of *scire* in that what you know must be so. Yet this is exactly what Buridan has been emphasizing all along, and the Converse-Entailment Principle only works because of the peculiar characteristics of *scire*.

Still, this objection leads us to the second difficulty mentioned above, namely cases in which there is an empty subject-term. Surely God could destroy all zebras; in that case do I no longer know that zebras have stripes? More prosaically, it is obvious that there is not always thunder. What then is the status of my scientia (= — of the conclusion "Thunder is a sound in the clouds"? How can there be the sort of necessity Aristotle required for the demonstrations involved in natural science if one is a good nominalist, holding that in the natural world only contingent mutable particulars exist? If the sentence "Thunder is a sound in the clouds" is necessary, then if I know it by the Converse-Entailment Principle I seem able to conclude that thunder I know to be a sound in the clouds, which is false when the subject-term 'thunder' is empty (a standard belief of mediæval logic).

Buridan's answer is rather subtle.²³ Buridan argues, most notably in

²² Which is exactly what Peter Geach calls it: "A Mediæval Discussion of Intentionality," in *Logic Matters*, University of California Press 1972, 134.

²³ This subtlety is missed in the analysis of the answer offered by T. K. Scott in "Buridan on the Objects of Demonstrative Science," *Speculum* 11 (1965), 654–673.

QNE VI q. 6 501 and *TS* 3.4.6–7 but in other places as well,²⁴ that terms which appear in the sentences of demonstrative *scientia* have ‘natural supposition,’ which he sometimes puts by saying that *scientia* of a sentence ampliates the terms appearing in it to stand for all times.²⁵ Note that this is partly a function of understanding a sentence in a particular way. The same sentence may be ignored, doubted, opined, or known demonstratively; our understanding of a particular utterance or inscription will determine which complex expression in Mental it immediately signifies.

Hence, Buridan says, to have *scientia* of the sentence “Thunder is a sound in the clouds” is for this utterance or inscription to be subordinated to the Mental sentence “Any thunder, whenever it was or is or will be, is or was or will be a sound in the clouds.” The former sentence is an abbreviation (*ad breviliquium*) of the latter (*TS* 3.4.7 and *QNE* VI q. 6 501). The force of the temporal quantifier is to restrict the supposition of ‘thunder’ to all and only those times at which there is thunder. This should not be confused with reading such a sentence as a conditional assertion, as Scott suggests; Buridan specifically rejects such a reading in *QNE* VI q. 6 502. Sentences of natural science are thus to be understood as follows:

Socrates has *scientia* of “Thunder is a sound in the clouds” (a particular utterance or inscription).

Socrates knows that any thunder, whenever it was or is or will be, was or is or will be a sound in the clouds.

The latter sentence expresses the Mental sentence to which the utterance or inscription is subordinated, reflecting Socrates’s *scientia*. The Converse-Entailment Principle then licenses:

Thunder, whenever it was or is or will be, [is that which] Socrates

²⁴ See also *QM* IV q. 8 fol. 19ra and q. 14 fol. 23va, V q. 2 fol. 27va, VI q. 4 fol. 35rb for brief remarks.

²⁵ Although this discussion will be carried out in the technical terms of supposition-theory, such terminology is eliminable: *suppositio* is, for Buridan, the relation of reference, and his point is that terms which appear in the sentences of demonstrative *scientia* do not simply refer to items which exist at the time of the (tensed) verb or copula, as usual, but the referential domain is widened to permit reference to objects of other times as well. ‘Ampliation’ is widening of the normal referential domain of a term, which becomes more ‘ample’ by including more items. This is Buridan’s innovation; while philosophers and logicians had discussed the notion of natural supposition previously, it had a different sense, and Buridan is conscious that he is using an old notion in a new way (*QNE* IV q. 6 501). For further details about natural supposition see Jan Pinborg, “The Summulae Tractatus I, De introductionibus,” in *The Logic of John Buridan* (*op. cit.* n. 15); Paul Spade, “The Semantics of Terms,” in *The Cambridge History of Later Medieval Philosophy* (*op. cit.* n. 6); and the introduction to *Jean Buridan’s Logic* (*op. cit.* n. 5).

knows to have been or to be or to be going to be a sound in the clouds (matching tenses appropriately).

Thus for any instance of thunder Socrates knows it at least under the *ratio* ‘a sound in the clouds’ (matching tenses appropriately). But this removes our original difficulty, since the subject of this last sentence is nonempty; indeed, it is amplified to all and only those times at which there is thunder. We can therefore preserve the necessity of the sentences of demonstrative *scientia* in this fashion. We have ‘necessary’ knowledge of contingent and mutable things which pass in and out of existence, where the necessity in question is the truth of a particular utterance or inscription of which the terms are construed with natural supposition. Now truth at-all-times might not seem enough for necessity; do we not need to require that every possible instance of thunder be a sound in the clouds as well? Buridan does not mention this; we can on his behalf either (i) hold that ampliation to possibles is included in natural supposition; (ii) deny that there are any possibles which are not actual at some time or other. There are problems with each: there is no mention made of (i) in any of the discussions of natural supposition, and Buridan’s explicit use of the temporal quantifier seems to rule it out. But (ii) seems simply false to Buridan’s actual practice, although perhaps he hints at it in *TC* 1.6.9.

A solution which is far better is the following, which I have no textual evidence for (though it seems purely Buridanian in spirit): the claim that such a sentence is necessary is to be read as a composite modal sentence. According to the analysis Buridan offers of composite modals, to say that “Thunder is a sound in the clouds is necessary” is (very roughly) to quantify across sentences, so that some sentence equiform to ‘Thunder is a sound in the clouds’ describes the way the world must be, and the temporal ampliation indicates that this is so for any time at which there is thunder.²⁶ And that is all there is to the vaunted ‘necessity’ of a *scientia*. I suspect this is not accidental: we shall see later that physical principles are indeed not necessary in the divided sense with the ‘strong’ necessity Aristotle required. What the terms supposit for, as we can see by the application of the Converse-Entailment Principle above, are the particular, contingent, mutable things of the world, however. Buridan forcefully insists on his anti-realist interpretation of the Aristotelian paradigm. It is time to examine more carefully what our knowledge amounts to in particular cases.

²⁶ This discussion is couched in terms of ‘the way the world is’ because of Buridan’s distinction between the possible and the possibly-true, which should by equipollence carry over to the necessary and the necessarily-true. See A. N. Prior, “The Possible and the Possibly-True,” reprinted in his *Papers on Logic and Ethics*, Cambridge 1976.

6. Scientific Principles

We shall begin the more detailed examination by considering which sentences can function as the principles employed in *scientia*. Buridan starts his analysis by rejecting the view of Nicolaus of Autrecourt, whose analysis of causality and causal inference led him to hold only the Law of Non-Contradiction to be evident (and so a principle).²⁷ Buridan seems quite annoyed by this view (QM II q. 2 fol. 9vb):

It should be noted that the indemonstrable principles assumed in an art or a science are not merely one or a few but rather there are as many as or more than demonstrable conclusions with the same terms. Hence the opinion of some, believing that nothing can be simply demonstrated except through reduction to the [Law of Non-Contradiction], is absurd, since... any conclusion requires at least two indemonstrable premisses [from which it is deduced].

Buridan is surely right on the orthodox view of Aristotelian science: a syllogism is composed of two premisses. But this is (almost willfully) to miss the main thrust of Nicolaus's criticism, which was directed toward all principles other than the Law of Non-Contradiction, none of which, he held, could pass the Aristotelian requirements for a principle (a basic proposition) of demonstrative science. This, however, will involve us in the justification of principles, which is not yet our topic; it will be treated in §7. Right now we have to discover what kinds of principles there are.

It turns out (QM II q. 2 fol. 9vb) that there are three kinds of principles:

- (1) Principles that are *a priori*
- (2) Singular principles accepted from sense, memory, or *experimentum*
- (3) Universal principles accepted by induction

Each of these calls for further comment.

Ad (1): *Scientia* includes what we would call *a priori* principles, such as the Law of Non-Contradiction; these principles are acquired on the basis of the "natural inclination of the terms" (QM II q. 2 fol. 9vb):

Then there are some principles which ought to be conceded in none of the aforesaid ways, but rather they are conceded according to manifest opinion or by the clear inclination of the terms: for exam-

²⁷ See Nicolaus of Autrecourt, 'Exigit ordo' in *Beitrage zur Geschichte der Philosophie und Theologie des Mittelalters* 6.2, Munster 1908. For more details about Nicolaus and his relation to Buridan, see the classic study by Julius Weinberg, *Nicolaus of Autrecourt: A Study in Fourteenth-Century Thought*, Princeton 1948, and T. K. Scott, "Nicholas of Autrecourt, Buridan and Ockhamism," *Journal of the History of Philosophy* 9 (1971), 15–41.

ple, that every horse is an animal or that all iron is a metal or that nothing cold is hot; the case is similar for the first principle [the Law of Non-Contradiction]. Indeed, they are conceded without any preceding experience and free from any demonstration.

Presumably metaphysics is composed of only such principles. Mathematics is assuredly not, since it contains “many dubious principles,” such as the infinite divisibility of a magnitude, although it is most “certain” in respect of its precise proof-procedure (*QM* I q. 3 fol. 4vb). Sentences which are analytic, that is, true by the meaning of the terms involved, certainly seem to have the sort of necessity required for science; they may not be informative, but are certainly true.

Ad (2): A singular principle taken from sense is “This fire is hot”; a singular principle taken from memory is “The fire I touched yesterday was hot”; a singular principle taken from experimentum is “This fire I am now touching is hot” (fol. 9vb). A singular principle taken from sense is simply a perceptual report, as is a singular principle taken from memory. But a singular principle based on *experimentum* is rather different, though Buridan’s example does not make this clear. The term ‘*experimentum*’ covers all possible perceptual reports, which allows for two main cases: (i) actual perceptual reports; (ii) claims about how the senses would respond in a given situation, which perhaps is only imagined. Note that if we act so as to bring about the given situation of (ii) and lay down minimal requirements of repeatability and the like we have an ‘experiment’ in the modern sense. But as (ii) stands now it is especially appropriate to Buridan’s actual scientific practice, namely the devising of logically possible situations and posing of questions, the mediæval method of thought-experiment.²⁸

Why Buridan wants to call these ‘principles’ is unclear, especially given

²⁸ This method is apparently flawed: why think that we know in advance what would take place in an alternative possible situation? But such an objection may be too facile; most such thought-experiments were couched as predictions of outcomes in cases which we could bring about. For example, in *QCM* II q. 12, 179 Buridan objects to Averroës’s explanation of motion by arguing that this theory has as a consequence the claim that a rock dropped from a tower has the same impact velocity as a rock dropped from a foot—but “it is manifest to the senses that the body which should fall from the high point would be moved much more quickly than that which should fall from the low point, and it would kill a man while the other stone would not hurt him.” Second, the method of thought-experiment is more likely to identify inadequacies in the conceptual framework itself than the modern scientific experiment, which often poses a problem the solution of which is not obvious: do we alter a particular principle, our body of principles, claim that the experiment is not crucial, *etc.*? While we should not want to return to the mediæval method, its virtues should not thereby be ignored.

his views of singular events (*e. g.* eclipses) and the Aristotelian requirement that principles of *scientia* be universal propositions. Perhaps we could say that they are (at least) necessary, due to the ‘immediacy’ of experience and other Aristotelian slogans like *Omne quod est quando est necesse est esse*. But this is a very weak sense of necessity, and they certainly fail to be universal. I suspect a slip here on Buridan’s part: singular principles are not principles at all, but merely provide cases for the covering-laws to cover when we apply our *scientia*.

Ad (3): Physical principles are accepted from induction; they are general or universal in character, stating what happens “always or for the most part”: they specify physical necessity, which is distinct from logical necessity, since they can fail to apply—see *QM* V q. 2 fol. 27va:

There is another necessity which is called ‘natural,’ which is not necessity *simpliciter*, but which would be necessity with all super-natural cases put to one side.

We shall investigate this further in §7. We need not be worried by the proviso “or for the most part”: it is meant to indicate a factual claim about the operation of such causes, not about the nature of the causes; it is meant, in short, to be a claim about the fact that the cause is not normally impeded and hence produces its effect.²⁹

In *QM* VI q. 3 fol. 34vb Buridan discusses eclipses and whether there can be *scientia* of them, as singular events. His comments are illustrative:

I say that nobody has *scientia* of the sentence that on such a day the Moon will be eclipsed, because once the day has gone by the sentence will then and ever after be false, and so is not demonstratively knowable. This is also the case for such a sentence as that this year the Dog Days will be rainy.

Yet nevertheless an astronomer can have *scientia* that when the heavens are in a certain disposition there will be an eclipse for a certain length of time then, or even that there will be a rainy summer later. Hence if the astronomer were to observe (*videat*) by an instrument or consult his astronomical tables that the heavens are in this disposition he can infer that then there will be an eclipse or there will be a rainy summer. But

²⁹ This is why Eileen Serene’s comment (*art. cit.* 516) is misguided: she cites Buridan’s remark in *QM* II q. 2 fol. 9vb that physical principles include the proviso “if an impediment does not occur” and draws the conclusion that physical principles have a built-in escape clause, which is a poor way to deal with skepticism. But Buridan here is making a remark which is (as it were) metalinguistic, not specifying part of the physical principle, which no more compromises the integrity of natural science than the fact that the covering-law must apply for the covering-law model to be applicable.

the major, namely that the heavens are disposed in this way, is not known demonstratively, since it would have been false yesterday if put forward and will be false tomorrow if proposed, and this is because it is singular with respect to ‘today or ‘tomorrow’ or ‘yesterday.’ Hence it is not knowable, and it is just like the case of the doctor who can know that everyone feverish is sick, and so if he sees someone feverish he can properly conclude that the patient is sick.

We have knowledge in such cases, but it is not demonstrative knowledge but rather an odd case of “applied” knowledge. And this seems correct, even though such cases are the very stuff of modern science and indeed of the covering-law model of explanation. This is how the singular principles of (2) are used in *scientia*, in keeping with the remarks above about the use of such principles.

Buridan offers two further points about the nature of physical principles: (i) they are imprecise; (ii) they are abstract.

To take the first point first: physical principles are not, Buridan holds, susceptible to precise quantification which allows of mathematical treatment (and so much the worse for the Mertonian School of Oxford calculators): “It should be noted that we cannot measure natural motions absolutely precisely and punctually, *i. e.* in the manner of mathematical considerations; we cannot know by means of a balance that a pound of wax is equal to a pound of lead, since there could be excess of so small a quantity we could not detect it” (*QSP* IV q. 14 fol. 80va). With respect to the second point, such physical principles are abstract: while discussing Aristotle’s rules for the ratios of motions, Buridan says “it seems to me it must be inferred that these rules are rarely or never found to produce their effect; nonetheless, they are conditional and true, for if the conditions laid down in the rules were to be observed then everything would happen just as the rules say” (*QSP* VII q. 8 fol. 108rb).³⁰ Nor do such rules “descend to singulars,” for this is not the job of speculative science (*QM* II q. 2 fol. 9va).

7. The Justification of Scientific Principles

The use of principles of the first or second sort in *scientia* is warranted in a direct fashion. The first sort, the *a priori* principles, are paradigmatically self-justifying; they are true independently of experience. The second sort, singular principles, are not really ‘principles’ at all, since they do not possess the characteristics requisite for demonstration (though they are the bridge

³⁰ This translation is adapted from William A. Wallace, *Causality and Scientific Explanation* 1, University of Michigan 1972, 107–108.

principles for applied science). The justification of such singular 'principles' would be citing the deliverances of the senses in the actual, remembered, or imagined situation.

Thus far Buridan is in agreement with Nicolaus of Autrecourt. The problematic and difficult case is (*iii*), the justification of physical principles accepted from induction. Nicolaus argued that God, by His absolute power, could falsify any such principle: this is the skeptical challenge Buridan must meet.

Buridan's response is startling: he gives up the question of truth for physical principles, offering instead a theory of warranted assertibility. This is not a mere capitulation to the skeptic, for Buridan hopes to show that with his new analysis of truth the skeptical questions do not and cannot arise.

First, let us describe the mechanics of induction, set forth principally in *QM* I q. 8 and II qq. 1–2. We begin with a singular judgment of sense (fol. 7va); after several such instances we have "consimilar" memories and hence experience. We are thus led to form a singular judgment in a present case; after having touched fires many times in the past, and each time finding them to be hot, when confronted with another fire I form the singular judgment that it is hot. If this continues to happen—Buridan never tells us how many times is enough—and I never meet with a counterinstance (*non in aliquo fuisse instantiam percipit*)³¹ then by its "natural inclination" my mind forms the general proposition "All fire is hot" and assents to it: *per suam inclinationem naturalem. . . consurgit ad consentiendum universali propositioni ut quod omnis ignis est calidus*.³² Of course, this description is no justification at all, but Buridan is not offering a justification here: he is only describing the actual mechanics of induction.³³ Were he to offer this as a justification, he would be committing Locke's genetic fallacy, and Buridan is a far better philosopher than that. In its essentials his story about the actual process of induction is the bare claim that we proceed from

³¹ This suggests that Buridan accepted a strong version of falsification. There is no reason not to think so, as this was the drift of all Aristotelian science.

³² Buridan reiterates this claim in *QM* II q. 2 fol. 9vb: *conceduntur ab intellectu propter naturalem inclinationem intellectus*. Incidentally, "Fire is hot" is a good example of a physical principle which God can suspend; in *Daniel* 3:19–27 Shadrach, Mesach, and Abednego are cast into a fiery furnace and emerge unscathed!

³³ Weinberg therefore misses the point in *Abstraction, Relation, and Induction* (University of Wisconsin Press 1965) when he describes Buridan's account of induction, taking the mechanics of induction to be Buridan's justification of induction, which it manifestly is not (152–153).

single experiences to the general proposition because of (psychological?) hardwiring: it is natural for us to inductively generalize; we are built to do so. This much is indisputably true.

How do we justify inductive principles? Buridan replaces this question with another: what is it to justifiably assent to such a principle? And with this question, Buridan begins to alter the notion of *scientia*. In *QM IV* q. 2 fol. 13va, he explores what it is to have *scientia* of a sentence which is a demonstrative conclusion, and argues that the term '*scientia*' here does not merely supposit for the sentence itself, but supposits for the assent to the sentence, indicating (connoting) that the sentence is demonstrated or demonstrable. This view is "more likely" (*probabilior*) than the view that '*scientia*' merely supposits for the sentence itself, which is (roughly) Ockham's view. Buridan gives us three arguments for his view. (1) Socrates and Plato can each form the same (consimilar) Mental sentence, and perhaps even be aware of the demonstration, but one may accept it and the other reject it. Hence the sentence alone is not *scientia* but rather the assent to such a sentence. (2) Indeed, it is not impossible (*contra* Aristotle) to have contradictory sentences in mind at the same time; logicians, for example, do so when they state the Law of Non-Contradiction. What is impossible is that we assent to contraries or contradictories together, for assent to contraries is a case of contrary assents (see also *QM IV* q. 2 for this point), prohibited by the Law of Non-Contradiction.³⁴ (3) Finally, many arguments are directed not at the conclusion but rather at securing the assent of the one they are addressed to; "it seems that the assent is something superadded to the conclusion."

Buridan's conclusion is direct; he says "if these [arguments] are allowed it seems to me that it should be said that *scientia* or opinion is not the very conclusion but rather it is that assent, having as foundation or proximate subject the demonstrated or probably proved conclusion. And this seems to agree with ordinary usage: we say that there is *scientia* of the conclusion, not that there is *scientia* of the *scientia*."

Note that Buridan here is proposing a theory of what are typically called 'propositional attitudes,' *i. e.* taking *scientia* to be a mental state distinct from, but directed toward, a (Mental) sentence. Note also that when we apply this theory to the case of a principle, not to a conclusion, we find that *scientia* of a principle is merely warranted assent: assent which connotes its

³⁴ This is how Buridan solves a standard puzzle about the Law of Non-Contradiction, namely how sentences can be incompatible if they are construed solely as accidental qualities which inhere in the soul; it seems as though their content is what is incompatible, but there is no obvious way to describe the 'content' of a quality.

justification.

It might be objected that this reformulation overlooks something, namely that the principle we assent to must be true, so that *scientia* is the warranted assent to a true sentence, and hence is knowledge. But Buridan makes no mention of truth in the analysis given above; nor could he, if he is offering a general theory of assent. But perhaps, it will be said, this is exactly why Buridan adds the stricture about connoting that the sentence is demonstrated; surely only truths are demonstrated.

Two responses. First, this account obviously fails for basic propositions of a science, which are not demonstrated. Second, if the interpretation suggested here is correct and Buridan is only offering a theory of warranted assent, we should expect 'truth' to drop out of the picture as an idle wheel in the account of *scientia*. And surprisingly, that is exactly what happens: in *QM* II q. 1 fol. 8vb, when Buridan asks "whether the comprehension of truth is possible for us," he asserts that the truth of a Mental sentence is nothing other than that Mental sentence itself—in other words, what has been called a "disappearance" or "redundancy" theory of truth.

All of this strongly suggests an account of *scientia* which is not justified true belief but merely justified belief—the 'true' being absorbed into the belief. To complete the argument, we need to examine cases where it seems as though justification and 'truth' diverge, and see that Buridan rejects truth as being anything above and beyond the justification itself. The cases in question are universal principles accepted by induction: physical principles.

Buridan investigates the justification of induction in *QM* II q. 1 fol. 8vb–9ra, expanding on an earlier discussion of certainty given in *QM* I q. 3 fol. 4va–vb. He gives a taxonomy of 'certainty' as follows. First, certainty is divided into the firmness of truth and the firmness of assent. The former is further divided into truth *simpliciter* and truth under the common course of nature (CCN-truth). The latter, firmness of assent, is divided into three kinds: that based on natural appearances, that based on an act of will, and that based on appearances. The last of these is divided into evidence *simpliciter* and evidence relatively speaking, which itself has two varieties, namely for moral matters and when taken under the common course of nature (CCN-assent). Let's consider these in more detail.

The first division is between certainty as reflecting the firmness (*firmitas*) of truth and the firmness of assent or adherence (*assensus vel adhaesio*), which is relevant after we pass beyond merely entertaining a true Mental sentence—and we are not interested in this case, for one might be disposed to dissent from it rather than assent to it.

Firmness of truth has two aspects: truth *simpliciter*, which "can in no

case be falsified, as in the sentence ‘God exists,’ and truth *ex suppositione communis cursus naturae*, which characterizes natural *scientia* (fol. 8vb). This division alone might make it seem as though Buridan has simply missed the point. For truth *ex suppositione* might seem to be merely conditional or presuppositional, and then the skeptical question is whether we ever know that the antecedent or the presupposition is fulfilled. But Buridan’s theory of assent shows that he is aware of this problem.

Assent has three main aspects. First, there is assent which is a mere act of the will: through perversity, tenacity, or religious faith we can hold to opinions which are the *minime evidentia*; the articles of faith are a good example.³⁵ This is not justified assent as required for physical principles, though. Second, there can be firmness of assent based on ‘the natural appearances of things,’ which seems to be Buridan’s way of cashing out the immediacy of sensation and perception. This too is not yet relevant to physical principles, although it does ground the singular principles taken from sense.

Finally, there can be firmness of truth in which the assent to a sentence is based on evidence. The evidence itself may be of two kinds: it may be *evidentia simpliciter*, as for example from the nature of sense or intellect a man assents without necessity to some sentence he cannot assent to its opposite. presumably the sentence ‘God exists’ has this sort of evidentness. Secondly, there may only be evidence *secundum quid*, either “on the supposition of the common course of nature,” as mentioned above, or the sort of weaker evidence required for moral judgments. Now the last case is important, because Buridan specifically acknowledges that ‘moral evidence’ may fail to produce the correct judgment “due to the invincible ignorance of some circumstance” (fol. 9ra). But in such cases, as when a judge condemns an innocent man to death on the basis of all the evidence, we say that the moral judgment was justified—and in that sense, ‘true.’ Buridan wants to argue, I suggest, that the same considerations will apply to evidentness *secundum quid* for physical principles.

The relevant difference between physical principles and moral principles, as Buridan mentions, is that in the latter case the value of the judgment depends on whether there is evidence we do not possess (nor could we reasonably be expected to possess it). In the former case Buridan is talking about all of the evidence available to us, whether we are lucky enough to possess it or not. If there is a counterinstance, after all, the principle does

³⁵ Buridan also makes this point in *Summulae de dialectica* VIII-3, the “treatise on demonstration.”

not apply, whether we are aware of the counterinstance or not. But what is the cash-value of 'the common course of nature'?

In firmness of truth and firmness of assent we have to make allowances for supernatural intervention: that is what Buridan means to exclude by the proviso about the common course of nature. He specifically creates a species of truth to capture this: truth under the common course of nature, what we may call CCN-true. Is this truth *tout court*? It is not, for the physical principle may fail to hold if God supernaturally intervenes. But that does not remove its CCN-truth: it merely restates it. Similarly, there is firmness of assent on the assumption of the common course of nature, which we may call CCN-assent. The key thesis in Buridan's exposition is the following: all there is to CCN-truth is CCN-assent. We are justified in holding a physical principle (endorsing it as CCN-true) on the basis of our CCN-assent.

What, then, is CCN-assent? It is assent to a principle based on all the evidence open to us, where 'open to us' does not include knowing whether God is supernaturally intervening. God's intervention is irrelevant to CCN-assent. This is Buridan's point: he does not mean to suggest that the truth of or assent to physical principles is conditional or presuppositional; that would be to give the game up to the skeptic. Rather, there is nothing more to the truth of a physical principle than CCN-truth, and this is nothing but CCN-assent: assent to the principle on the basis of all the evidence open to us. Truth for physical principles just is warranted assertibility, and so the skeptic has no purchase on Buridan. A physical principle may be false simpliciter but CCN-true, and Buridan thinks there is no need to be concerned with the former alternative. Indeed, the physical principle cannot even be said to be false simpliciter, for physical principles are only CCN-true or CCN-false. (Of course, if God informs us of what He has been up to, it is a different matter; but then God's revelations count as evidence open to us.) We do not know the limits of God's power.³⁶ In an odd way, then, physical principles are like moral principles (*QM* II q. 1 fol. 9ra):

It is concluded as a corollary to such cases [moral and physical counterexamples] by certain evil people who want to do away with natural and moral *scientia* that there is no simple evidentness in most of their principles and conclusions, for they could be falsified through supernatural counterexamples. But as was said before, these [moral and physical principles] only require evidence secundum quid, which

³⁶ Can God violate the laws of logic? Buridan refrains from taking any stand in *QM* IV q. 12 fol. 21vb, but in *QM* II q. 2 fol. 9vb he seems bolder: "We do not know; God can do all things and so it should be believed that he can do impossible things."

suffices. Thus Aristotle is correct in [*Metaphysics*] II when he says that mathematical exactness should not be sought in every *scientia*. Just as we speak of the correctness or propriety of a moral judgment, but not of its truth *simpliciter*, so we should speak of the warranted assertibility of a physical principle, not its truth *simpliciter*. Physics and ethics are in this respect on a par.

Consider the following case: a judge rules an item of (putative) evidence inadmissible, because of the way it was procured. If it were admitted as evidence it would exonerate the defendant; however, the rest of the available evidence all weighs against the defendant. What is the correct verdict?

If we take 'correct verdict' to mean the proper legal judgment, then the defendant should be pronounced guilty. If we take 'correct verdict' to mean the proper moral judgment, then the defendant should be pronounced innocent. But if we refuse to split hairs and insist on knowing the correct verdict, period, then I take it the appropriate answer is that there is no such thing as the 'correct verdict, period.' The fact is that our intuitions conflict.

Buridan's suggestion is that physical principles are like proper legal judgments, and that truth *simpliciter* is like the demand for the 'correct verdict, period.' The God's-eye view is like the proper moral judgment. The skeptic runs together the God's-eye view and the demand for truth *simpliciter*. To put the matter on a more abstract level: physical principles are claims which are supported by all the available evidence; the skeptic is suggesting the possibility of evidence which is unavailable in principle should lead us to reject the physical principles. But this is to conflate distinct arenas of judgment, as though there were a body of all evidence, available and unavailable, which would support a single conclusion. Buridan will not allow the skeptic this maneuver.

Buridan's relativization of physical principles to the common course of nature is quite distinct from the claim that the modality of physical principles is relative to God's absolute and ordained power. The latter distinction, though notoriously difficult to spell out, takes possibility to be defined relative to what is logically within the limits of omnipotence alone (God's absolute power), or relative to what is logically within the limits of omnipotence as combined with other divine attributes, such as infinite goodness (God's ordained power). Some mediæval philosophers thought that this distinction could be applied against the skeptic, granting that while God could falsify any principle by the exercise of His absolute power, in fact God would not do so, and so could not by His ordained power. Yet it is certainly not obvious that there is nothing in God's ordained power which prevents Him from

suspending natural laws for purposes consonant with His goodness, and this is the worry addressed by Buridan. The mere modal distinction between absolute and ordained powers is not strong enough to ground the common course of nature, which by definition excludes supernatural intervention. Hence Buridan attacks the skeptical assumptions directly, refusing to admit the relevance of any supernatural intervention to physical principles; logical possibility and physical possibility are quite distinct.

For Buridan, skepticism is a complex matter, a challenge which relies on contentious assumptions he is free to reject. Whether the skeptic can be permanently silenced in Buridanian fashion is another matter, a philosophical problem not restricted to the fourteenth century. I shall be content to say that Buridan has firmly put the ball back in the skeptic's court.

Note that Buridan has not attempted to actually justify any particular physical principle: his argument that CCN-truth is CCN-assent is meant to establish the possibility in principle of justifying particular physical principles. Any such particular justification will be no different from justifying particular legal verdicts—that is, notoriously difficult. In particular, there are two difficulties Buridan's view faces. First, on Buridan's view it is not at all clear how to distinguish genuine physical counterexamples from miraculous intervention. There seems to be no general reason why any and all apparent physical counterexamples could not be written off as divine interference, not relevant to the CCN-assent to the principle. Second, the skeptic has plenty of running room in particular cases, for Buridan has not attempted to distinguish between evidence which is 'available to us' and 'available to me.' Any particular physical principle might be supported on the basis of all the evidence available to me, but not on all the available evidence, and so fail to be even warranted (CCN-true). The skeptic might grant Buridan's general point and argue for skepticism on a case-by-case basis. Nothing Buridan has said addresses this issue; he seemed to be content to establish the theoretical possibility and turn to his investigations as a natural philosopher.

Before we leave the subject we must point out that Buridan does consider physical principles which are not the result of inductive enumeration. In *QM* XII qq. 10–11 and in *QCM* II q. 22 Buridan discusses astronomy, and in particular the theories of eccentrics and epicycles. Principles governing such theoretical entities are not arrived at by enumerative induction, but rather by the hypothetico-deductive method. Buridan seems to grant this; he often speaks of such principles as having their justification in their ability to 'save the appearances' (*possent salvari omnia nobis apparentia*). Yet his discussions make clear that he does not think this is quite sufficient; many

incompatible hypotheses would save the appearances, and it is up to the natural scientist to discover which is correct. And here, I am afraid, he retreats to the conceptual method of thought-experiments as *experimentum*. He seems blissfully unaware that reflecting upon such cases would eventually give way to modern science, and uninterested in the wealth of philosophical difficulties they pose. So much the worse for Buridan; he paid the price for being a man of his time.

8. Conclusion

Buridan has tried to combine his anti-realism and anti-skepticism into a complete and coherent account of *scientia*, knowledge. We have seen the alterations he made in the Aristotelian Paradigm, and, under the pressure of the skeptical current of nominalism, give up truth itself to establish physics. His voyage was interesting, though we may doubt but that he has in the end gone aground on the skeptical shoals. The bold move of replacing truth with CNN-truth for physical principles requires more in the way of defense and explanation. Nicolaus of Autrecourt might simply insist that Buridan has changed the subject, and demand an argument as to why truth *simpliciter* does not apply to physical principles. Surely such principles are *prima facie* true or false. And as for the discussion of truth *secundum quid*, the skeptic can simply grant it for Buridan and continue to ask why truth *simpliciter* does not apply. Buridan does not appear to have any answer to this. Perhaps none can be given. On the other hand, perhaps one can: this is an open question in philosophy, now no less than in the fourteenth century. Given the affinities of contemporary philosophy with Buridan's nominalist approach to science, we may stand to learn a great deal from his philosophical inquiries.