Cleansing the Doors of Perception: Aristotle on Induction

in *Greek Philosophy and Epistemology*, vol. II, ed. Konstantine Boudouris (Athens: International Association for Greek Philosophy, 2001), pp. 204-213

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Abstract: This paper has two objectives. The first is to clarify Aristotle's view of the first principles of the sciences. The second is to stake out a critical position with respect to this view. The paper sketches an alternative to Aristotle's intuitionism based in part on the use of quantitative inductive logics.

Keywords: induction, inductive logic, Aristotle, intuitionism, first principles

1. Introduction

The reference in the title to cleansing the doors of perception is adapted from William Blake.[1] He should be used to it by now. Aldous Huxley borrowed it for his essay, *The Doors of Perception*; so did Jim Morrison for his band, The Doors. But my purposes are different. The idea plays off Aristotle's comparison of truth to a door in a provocative way: "The investigation of the truth is in one way hard, in another easy.... Therefore, since the truth seems to be like the proverbial door, which no one can fail to hit, in this way it is easy, but the fact that we can have a whole truth and not the particular part we aim at shows the difficulty of it" (*Met.* 993a30–b7).[2]

Aristotle may be right that the study of truth is easy in some ways, but I am more impressed with its difficulty. In this paper I argue that the truth is not as easy to find as Aristotle thought, and that the fundamental difficulty lies at the doors of perception. To motivate these claims, I discuss Aristotle's view of the first principles of science in Section 2; then I stake out a critical position with respect to this view in Section 3. Though Aristotle looms large in this paper, the point is not ultimately historical. It is to clarify, in some small way, our own use of induction in the sciences.

2. Aristotle's first principles

How are the first principles of Aristotelian sciences to be obtained? Notoriously, Aristotle offers two separate accounts. The *Posterior Analytics* concludes with the claim that the mental faculty of comprehension (*noûs*) grasps first principles through induction (*epagōgē*). *Topics* I, 2, however, affirms that first principles are known dialectically. How are these two accounts related? Did Aristotle begin with the *Topics* and then, in the *Posterior Analytics*, abandon dialectic for induction? Or, less probably, was it the reverse? Did he start off with induction but forsake it for dialectic? Or—still a third possibility—did he maintain both accounts, regarding them as somehow mutually consistent? I want to attempt an answer to these questions. Suppose we begin by reviewing a few of Aristotle's remarks on induction and dialectic, and that we observe how they are related to his scientific practice.

A key passage on induction appears in *Posterior Analytics* II, 19, where Aristotle describes a complex process of cognition. Though the process is continuous, it has five distinguishable stages. 1) Perception (*aisthēsis)* discriminates among particulars. 2) Memory retains these perceptions. 3) Repeated memories create experience of a universal (*katholou*) common to many memories. 4) Higher universals are inferred. 5) First principles are inferred.

Immediately following this description, Aristotle makes the treatise's culminating claim: comprehension acquires first principles through induction (100b3–17).[3]

Induction, as the *Topics* explains, "is a passage from particulars to universals" (105a13–14).[4] Induction and perception are closely linked, but perhaps not as closely as one might expect. Aristotle treats them as separate sources of premises (*Post. An.* 78a35–36). Even though inductive inferences are ultimately based on perceptions of individuals, they may be drawn more immediately from lower-level universals, that is, generalizations, as in Aristotle's "supposing the skilled pilot is the most effective, and likewise the skilled charioteer, then in general the skilled man is the best at his particular task" (*Top*. 105a14–17).[5] Hence perception is the beginning, but only the beginning, of the inductive process. A complete induction consists of all five stages together.

A parallel description of this five-stage process can be found in the opening lines of the *Metaphysics* (980a29–981a12).[6] It concludes with a crucial example:

> And art [*technē*] arises, when from many notions gained by experience one universal judgment about similar objects is produced. For to have a judgment that when Callias was ill of this disease this did him good, and similarly in the case of Socrates and in many individual cases, is a matter of experience; but to judge that it has done good to all persons of a certain constitution, marked off in one class, when they were ill of this disease, e.g. to phlegmatic or bilious people when burning with fever, —this is a matter of art. (981a6–13)

Aristotle intends this universal judgment as an instance of a first principle of the productive science of medicine. It may startle a student of the *Posterior Analytics*, however, because the same cognitive process that leads to the first principles foremost in the *Posterior Analytics*—those of demonstrative sciences like mathematics, for example—leads to the first principles of sciences of a very different stripe. Aristotle contrasts the exactness of theoretical sciences like mathematics with the inexactness of productive sciences like medicine and practical sciences like ethics. This is a necessary contrast, he claims, because demonstration is of the eternal whereas the productive and practical sciences concern the variable (*Post. An.* 75b22–24, *NE* 1103b35–1104a12).

What we have so far, then, is an account that Aristotle means to be completely general. Regardless of the science, first principles are inductively known. But the results of induction vary with the subject. First principles may be necessary, in which case syllogisms with necessary premises and conclusions can be constructed from them, or they may be for the most part (*epi to polu*), in which case syllogisms drawn from them have premises and conclusions that hold for the most part as well (*Post. An.* I, 30).[7] These syllogisms for the most part are explicitly linked to political science, for example, in the *Nicomachean Ethics* (1094b19–24).

Let us now turn to dialectic. Aristotle explains in the *Topics* that dialectic departs from generally accepted opinions (*endoxa*), which may be those of everyone or a majority or the wise (100b22–23, 104a8–10). He also maintains that the task of securing the first principles of the sciences "belongs properly, or most appropriately, to dialectic" (101b3). How does this square with the inductive account of the *Posterior Analytics*? *Topics* I, 12 provides the key. There Aristotle identifies two species of dialectical argument: induction and syllogism.[8] He would not have regarded the two accounts as inconsistent, therefore, for to say that first principles are known inductively is to imply that they are known dialectically. Granted, the inductive description cuts closer to the bone, but this is what we might expect on developmental grounds if, as is usually supposed, the *Topics* is earlier than the *Analytics*.

While induction and syllogism are comparable as species of dialectic, they nevertheless function at entirely different levels. Induction operates outside syllogism, as it were; it provides the first principles upon which dialectical syllogisms depend. These dialectical syllogisms are plainly the syllogisms for the most part of the *Posterior Analytics*. The necessary syllogisms with

which they are contrasted are also, as we have seen, externally related to induction: induction supplies the first principles that demonstrative syllogisms employ.

How induction as a form of dialectic could lead to necessary first principles is problematic, for dialectic departs from mere generally accepted opinion. That Aristotle believed it could, however, is borne out by his scientific practice. Aristotelian first principles are subdivided into axioms, which are common to all the sciences, and theses, which are not. Theses are subdivided in turn into hypotheses, which assert existence or nonexistence, and definitions, which do not (*Post. An.* 72a15–25). Now Aristotle's prime examples of axioms are the principles of contradiction and excluded middle, and his defense of them in *Metaphysics* Γ, 3–7 is unmistakably dialectical. Aristotle's theses are often presented dialectically through a consideration of the opinions of the wise. In *Physics* I, 2–4, for example, he surveys the opinions of earlier philosophers in order to establish the contraries. A similar survey in *Metaphysics* A, 3–7 introduces the four causes. Another in *De Anima* I, 2–5 prepares Aristotle's own definitions of the soul. *On Generation and Corruption* I contains at least four such surveys, each preparatory to Aristotle's statement of his own view. Even the nondemonstrative science of ethics proceeds the same way; *Nicomachean Ethics* I, 4–6 surveys the opinions of the wise (especially the Platonists) and of the many prior to presenting Aristotle's own definition of happiness. Though these surveys have historical value, Aristotle is not doing history of philosophy. He is hammering out first principles in a dialectical forge. His practice provides ample evidence of belief that though dialectic starts with generally accepted opinion, it need not end there.

Still, if Aristotle relies on dialectic to secure his first principles, has he not parted company with the inductive approach of the *Posterior Analytics*? The answer, I suggest, is no. The dialectical exercises instanced in the preceding paragraph *are* inductive. As we have seen, Aristotelian induction is "a passage from particulars to universals." What Aristotle is doing in these surveys of generally accepted opinion is actually higher-order induction. That is, the groundwork of perception and memory has been done, and Aristotle is working his way up from the experiences and universals of everyone or the many or the wise. In terms of the five-stage process of the *Posterior Analytics*, he is ascending to first principles from the third and fourth stages.

Indeed, the inductive and dialectical accounts of first principles complement each other. The approach of the *Posterior Analytics* is individual and descriptive, while that of the *Topics* is social and critical. I conclude, then, that the two accounts can be reconciled in a single view, and that this single view—evolving, no doubt, but largely coherent—was probably Aristotle's. If we were able to ask him which of the two accounts he favors, the answer, I believe, would be "both."

3. An alternative to Aristotle's intuitionism

Striking a critical balance with respect to Aristotle's views might well serve as propaedeutic to our own attempts to understand induction and the sciences. What could be usefully said? At least two things, it seems to me.

The first is to zero in on two Aristotelian infallibility claims. The first is that the special senses always yield truths (*De An.* 427b13); to see that something is white, for example, is an infallible perception (*De An.* 428b21–22).[9] A second claim concerns comprehension: "Since of the intellectual states by which we grasp truth some are always true and some admit falsehood (e.g. opinion and reasoning—whereas understanding and comprehension are always true), and no kind other than comprehension is more precise than understanding…" (*Post. An.* 100b6–9).[10] The two claims are linked, of course. We have already observed the continuity of perception and comprehension in the five-stage inductive process. Aristotle claims that "no one can learn or understand anything in the absence of perception" (*De An.* 432a7–8), and that "if some perception is wanting, it is necessary for some understanding to be wanting too" (*Post. An.* 81a38–39).

But there is wide, if not universal, agreement that perception is not only sometimes fallible but never infallible. Because of limitations of space, I will merely gesture towards three standard lines of argument for this view. The first is Platonic, extrapolated from the *Theaetetus* (154a). In order to know that my perception of white is not illusory, for example, I would have to check my perception against the perceptions of others. But since perceptions are private and imperfectly communicable, I can never verify that my perceptions are really the same as others; hence I can never know that my perceptions are infallible. The second line of argument is Cartesian, adapted from the First Meditation. Even if I could somehow verify that my perceptions and the perceptions of others are the same, there is no guarantee that an evil genius does not systematically dupe the human race into seeing black as white, say. Finally, the third line is a probabilistic argument due to Shimony (1970). He has shown that anyone who assigns a probability of 1 to any non-tautological statement, e.g., a sense report, is thereby open to a semi-Dutch book. That is, to bet using such probability assignments is to ensure that there is no possible state of affairs in which one can win and some possible state of affairs in which one can lose.

Now infallible comprehension of essential form (what flesh is, e.g.) presupposes infallible perception of sensible form (hot, cold, and the other sensible qualities proper to flesh) (*De An.* 429b15–22, 430b30–32). But if, contrary to Aristotle, perception is always fallible, then so is comprehension. And if comprehension is always fallible, then even its crowning achievements, the first principles of the sciences, are fallible. It follows that the necessary first principles required for demonstration cannot be obtained. For necessary first principles cannot be otherwise (*Post. An.* 74b14–15), but they certainly might be otherwise if they might be false (*EN* 1139b115–25).

Even if we break with Aristotle by severing the link between perception and comprehension, the proliferation of many-valued and paraconsistent logics shows that the axioms of excluded middle and contradiction in their Aristotelian forms might be mistaken. The moral of this story, it seems to me, is evident: fallibilism with respect to the first principles of the sciences.

A second focus for critical attention is Aristotle's two-tiered intuitionism. He relies on it at the extremes: from above, to provide the first principles of the sciences, and from below, to cognize brute particulars. His terminology from below, it should be noted, is not always consistent. Sometimes he gives the job of characterizing particulars to comprehension:

> And comprehension (*noûs*) is concerned with the ultimates in both directions; for both the primary definitions and the ultimates are objects of comprehension and not of argument, and in demonstrations comprehension grasps the unchangeable and primary definitions, while in practical reasonings it grasps the last and contingent fact, i.e. the second proposition. For these are the starting points of that for the sake of which, since the universals are reached from the particulars; of these therefore we must have perception, and this is comprehension. (*EN* 1143a35–b5)

But just a few paragraphs away he assigns the task to a form of perception:

> That practical wisdom (*phronēsis*) is not knowledge is evident; for it is, as has been said, concerned with the ultimate particular fact, since the thing to be done is of this nature. It is opposed, then, to comprehension; for comprehension is of the definitions, for which no reason can be given, while practical wisdom is concerned with the ultimate particular, which is the object not of knowledge but of perception (*aisthēsis*)—not the perception of qualities peculiar to one sense but a perception akin to that by which we perceive that the particular figure before us is a triangle; for in that direction too there will be a limit. But this is rather perception than practical wisdom, though it is another kind of perception. (*EN* 1142a24–31)

Given the continuity of perception and comprehension, these inconsistencies are not seriously debilitating. In particular, they do not affect the present point: call the faculty comprehension or call it perception, it provides direct, noninferential insight into the form implicit

in the particular. In ethics, for example, one just *sees* that one should be angry with a certain person in a certain way for a certain length of time; the decision, as Aristotle says, "rests with perception" (*EN* 1109b23, 1126b5). Similarly, in matters of sensible form, one just *sees* that a certain thing is blue. Suppose we call these seeings "intuitions" in a sense ample enough to finesse the terminological uncertainty concerning comprehension and perception.

Aristotle is disturbingly complacent about these intuitions:

> Hence any one who is to listen intelligently to lectures about what is noble and just and, generally, about the subjects of political science must have been brought up in good habits. For the facts are the starting point, and if they are sufficiently plain to him, he will not need the reason as well; and the man who has been well brought up has or can easily get starting points. (*EN* 1095b5–9)

In fact, he regards intuitions of simple forms like evil and black as infallible (*De An.* 430a26–b23). But this intuitionism from below is, I contend, descriptive at best. It describes the psychological assurance that we sometimes feel in moments of righteous anger or acute vision. The preceding point about fallibility, however, applies here as well: mistakes are possible even in these moments of high intuition. The person of "good habits"—Aristotle himself, for instance—may think it evident that an instance of slavery is just, or one's perception of color may be chemically skewed. The doors of perception must forthwith be cleansed.

Where could we find the critical tools to cleanse a mistaken intuition that something is so? I suggest that we depart from Aristotle's elementary notion of a "this" (*tode ti*) in its primary sense of form (*De An.* 412a8–9). When we attempt to actualize the form implicit in a particular, that is, when we attempt to say what a thing is, how do we proceed? The key notion is what I call *core classification*: rudimentary sentences of the form "δ is E," where "δ" stands for a demonstrative pronoun and "E" for a class term. "This is red" and "That is unjust," when used in context, are examples. How, then, do we core classify? Unless we are actually coining the class term, we core classify by analogy. That is, we classify a particular by noting its similarity to other particulars previously classified by the term.[11]

Analogies may be simply intuited, of course. Animals of no great complexity routinely identify food, predators, and mates at least in part by noting similarities between new features of the landscape and old food, predators, and mates. But these intuitions are fallible; the fox flees from the dog who only wants to play, not kill. Human beings appear to be unique among animals in our critical resources for assessing analogies. Reasons can be given for an analogical insight, and when they are, the result is an argument from analogy.

We have been discussing Aristotle's intuitionism from below, but the link to his intuitionism from above has already been observed in the account of first principles in the *Posterior Analytics*: the intuition of particulars primes the intuition of the inductive generalizations that serve as first principles. Now suppose we join the three following claims: inductive generalizations are based on core classifications of particulars; core classifications of particulars are based on analogies; analogical intuitions are fallible but linguistically assessable. This conjunction places the much-maligned argument from analogy at the very base of empirical knowledge. Arguably, then, the fundamental question of all epistemology is the following: How can we distinguish between good and bad arguments from analogy?

The answer, in principle, is not complex. An argument from analogy is subject to a condition on its content: all its premises must be true. It is also subject to a condition on its form: the conditional probability of the argument's conclusion given its premises must be greater than that of any rival conclusion. Note that both conditions apply to any argument whatsoever, analogical or not. Obviously so, in the case of the condition on content, and the condition on form has been stated generally enough to cover arguments whose form is deductively valid (the conditional probability of their conclusions is 1 while that of their rivals is 0) as well as arguments whose form is inductively strong but not deductively valid (the conditional probability of their

conclusions is less than 1 but greater than that of their rivals). Good arguments from analogy belong to the class of inductively strong arguments.

How, then, might we determine the conditional probability of the conclusion of an argument from analogy given its premises? This is indeed a complex matter, and here we can do little more than refer to the relevant literature. One of the most successful research programs of the twentieth century, in my view, was the quantitative approach to induction adumbrated by Wittgenstein (1922, 5.15–5.156) and Waismann (1930–31) and brought to maturity by Carnap (1952, 1971, 1980). Carnap's work has served as the basis for advances by Hintikka (1966), Pietarinen (1972), Hintikka and Niiniluoto (1976), Kuipers (1978, 1984), Niiniluoto (1981), Spohn (1981), Costantini (1983), Skyrms (1991, 1993), and Festa (1997), among others. The inductive logics in this tradition permit reliable estimates of the conditional probability of a conclusion given its premises in many cases. But analogy has been a sticking point; the predicate symmetry characteristic of many of these logics made it difficult to handle the similarity relations on which analogy is based (Welch 1999). But Kuipers (1984, pp. 68–78) has introduced inductive systems that successfully reflect analogy influences. These systems are unusual, however, in that they are not indifferent to the order in which predicates are instantiated, thereby violating the axiom of individual symmetry upheld by Carnap (1952, p. 14; 1963, p. 975) and others (e.g., Maher 2000, p. 64). Nevertheless, the probabilities obtained from the various orders of instantiating predicates all converge to the same point (Kuipers 1984, p. 76). For those unwilling to give up the axiom of symmetry, steps towards a satisfactory treatment of analogy may be found in the work of Skyrms (1993) and Festa (1997). Admittedly, however, much remains to be done.

In conclusion, I suggest that the way forward is clear even if unmapped. The sciences, in order to really be sciences, must discriminate true inductive generalizations from false pretenders such as stereotypes. Hence the core classifications on which generalizations are based require criticism. But Aristotle's intuitionism is psychologically descriptive at best.[12] To cleanse the doors of perception, we need the right kind of norms: the norms entailed by the overarching requirements of true premises and cogent logical form.

NOTES

1. "If the doors of perception were cleansed, everything would appear to man as it is, infinite. For man has closed himself up, till he sees all things thro the narrow chinks of his cavern" (*The Marriage of Heaven and Hell*).

2. Throughout this paper, the English versions of Aristotle are from the revised Oxford translation in *The Complete Works of Aristotle*, ed. Jonathan Barnes (Princeton, NJ and Chichester, West Sussex: Princeton University Press, 1984). I occasionally depart from that translation to render *aisthēsis* consistently as “perception.”

3. See also *EN* 1139b26–30.

4. This paper will not discuss Aristotle's other sense of induction (*Pr. An.* 68b8–37), which is actually a form of deductive inference.

5. See also the example at *Met.* 1048a36–b9.

6. Cut from the same cloth is Aristotle's description of Socrates' two innovations: inductive arguments (*epaktikous logous*) and universal definition (*horizesthai katholou*). Both, he says, "are concerned with the starting point of science" (*Met.* 1078b27–30). See also Socrates' intellectual biography at *Phaedo* 96b.

7. See also *Post. An.* 75b22–36, 96a8–19.

8. See also *Post. An.* 71a5–6.

9. Aristotle does betray a shade of doubt about this at one point: "Perception of the special objects of sense is never in error or admits the least possible amount of falsehood" (*De An.* 428b18–19).

10. See also the claim that comprehension’s "thinking of the definition in the sense of what it is for something to be [*to ti ēn einai*] is never in error" (*De An.* 430b28–29).

11. This analogy thesis is argued at greater length in John R. Welch, "Ethical Classification and Inductive Inference," unpublished manuscript.

12. The point can be extended to neo-Aristotelian intuitionisms such as that of W. D. Ross.

REFERENCES

Carnap, R.: 1952, *The Continuum of Inductive Methods*, University of Chicago Press, Chicago.

Carnap, R.: 1963, "An Axiom System for Inductive Logic," in P. Schilpp (ed.), *The Philosophy of Rudolf Carnap*, Open Court, La Salle, IL, and Cambridge University Press, London, pp. 973–979.

Carnap, R.: 1971, "A Basic System of Inductive Logic, Part 1," in R. Carnap and R. Jeffrey (eds.), *Studies in Inductive Logic and Probability*, Vol. I, University of California Press, Berkeley, pp. 33–165.

Carnap, R.: 1980, "A Basic System of Inductive Logic, Part 2," in R. Jeffrey (ed.), *Studies in Inductive Logic and Probability*, Vol. II, University of California Press, Berkeley, pp. 7–155.

Costantini, D.: 1983, "Analogy by Similarity," *Erkenntnis* 20, 103–114.

Festa, R.: 1997, "Analogy and Exchangeability in Predictive Inferences," *Erkenntnis* 45, 229–252.

Hintikka, J.: 1966, "A Two-Dimensional Continuum of Inductive Methods," in J. Hintikka and P. Suppes (eds.), *Aspects of Inductive Logic*, North-Holland, Amsterdam, pp. 113–132.

Hintikka, J. and Niiniluoto, I.: 1976, "An Axiomatic Foundation for the Logic of Inductive Generalization," in M. Przełęcki, K. Szaniawski, and R. Wójcicki (eds.), *Formal Methods in the Methodology of Empirical Sciences*, D. Reidel, Dordrecht, and Ossolineum, Wrocław, pp. 57–81.

Kuipers, T.: 1978, "On the Generalization of the Continuum of Inductive Methods to Universal Hypotheses," *Synthese* 37, 260–72.

Kuipers, T.: 1984, "Two Types of Inductive Analogy by Similarity," *Erkenntnis* 21, 63–87.

Maher, P.: 2000, "Probabilities for Two Properties," *Erkenntnis* 52, 63–91.

Niiniluoto, I.: 1981, "Analogy and Inductive Logic," *Erkenntnis* 16, 1–34.

Pietarinen, J.: 1972, *Lawlikeness, Analogy, and Inductive Logic*, North-Holland, Amsterdam.

Shimony, A.: 1970, "Scientific Inference," in Robert Colodny (ed.), *The Nature and Function of Scientific Theories*, University of Pittsburgh Press, Pittsburgh, pp. 79–172.

Skyrms, B.: 1991, "Carnapian Inductive Logic for Markov Chains," *Erkenntnis* 35, 439–460.

Skyrms, B.: 1993, "Analogy by Similarity in Hyper-Carnapian Inductive Logic," in J. Earman, A. Janis, G. Massey, and N. Rescher (eds.), *Philosophical Problems of the Internal and External Worlds: Essays on the Philosophy of Adolf Grünbaum*, University of Pittsburgh Press, Pittsburgh, pp. 273–282.

Spohn, W.: 1981, "Analogy and Inductive Logic: A Note on Niiniluoto," *Erkenntnis* 16, 35–52.

Waismann, F.: 1930–31, "Logische Analyse des Wahrscheinlichkeitsbegriffs," *Erkenntnis* 1, 228–248. English trans. "A Logical Analysis of the Concept of Probability," in F. Waismann, *Philosophical Papers*, D. Reidel, Dordrecht, 1977, pp. 4–21.

Welch, J.: 1999, "Singular Analogy and Quantitative Inductive Logics," *Theoria* 14, 207–247.

Wittgenstein, L.: 1922, *Tractatus Logico-Philosophicus*, Routledge & Kegan Paul, London.