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Induction: Perennial Value of the Aristotelian Perspective

A well thumbed Logic in use through most of the 20th century is that of H.W.B. Joseph. First published in 1906 at 608 pages, it became the prototype of many a logic textbook written for classroom use. Joseph opens a chapter devoted to the problem of induction with the observation. "The history of the word Induction is still to be written, but it is certain that it has shifted its meaning in the course of time and that much misunderstanding has arisen thereby." Volumes have been written in the last hundred years, but the conflict between the empiricist and the Aristotelian remains the same. Joseph shows clearly what Aristotle in the Posterior Analytics understood by induction. "Aristotle," he tells us, "gives the name induction to the formal process of inference by which we conclude a proposition to hold universally of some class, or logical whole, because an enumeration shows it to hold for every part of that whole." This may be called induction by complete enumeration or perfect induction. Aristotle shows how it might be thrown into the form of an inductive syllogism. He points out that our knowledge of scientific principles springs historically out of our experience of particular facts; though its certainty rests ultimately on an act of intellectual insight. He gives the name "induction" to the process in which particulars of our experience suggest to us the principles which they exemplify, but this is not a formal process from premises to conclusion. It is not the enumeration which leads us to assent to the universal, but a kind of intellectual penetration.

In Joseph's account, Aristotle goes on to show "where (presumably in default of the necessary insight and assurance from our intellect) we may look for reasons for accepting or rejecting any principles which a science puts forward. He does not give to this procedure, which is of a formal logical kind, the name of "induction" but calls it "dialectic." What he says on this subject is of importance from the standpoint of scientific method and comes close to what modern writers understand by induction. There is no doubt that for Aristotle our knowledge of general principles comes from our experience of particular facts and that we arrive at those principles by induction. Yet the only formal logical process which Aristotle described under the name of induction is that of perfect induction, which clearly neither is nor can be the process by which the sciences establish their laws or general principles. The kinds of reasoning processes or arguments which they really do employ, so far as they appeal merely to the evidence of our experience, are of a different sort

The strength of Aristotle's treatment of induction became an issue only in modernity, notably after Locke and Hume. Medieval schoolmen and their contemporary exponents generally consider inductive reasoning unproblematic. The schoolmen referred to induction as an argument from experience. Albert the Great (1206-1280), for example, writes that our senses teach us the obvious truth about the nature of wine—that it intoxicates—and that our intellect grasps this truth with certainty that cannot be doubted. Modern logicians misunderstand this basic truth when they reduce it to no more than an invalid syllogism. Induction, from an Aristotelian perspective, as Joseph shows, is not mere enumeration. Statistical models of induction miss the point when they reduce it to a mechanical process of enumerating cases. Such models fail to appreciate the cognitive leap, the intellectual discernment that produces the intelligible universal. One does not have to examine all instances of copper to understand that copper conducts electricity, conducts heat, and is malleable. The inductive insight is not mere enumeration, a statistical summary, or an endless enumeration. At some point the intellect recognizes that there is more in the sense report than the senses themselves are able to appreciate. Mere multiplication of instances serves no purpose.

One of the best expositions and defense of the perennial value of the Aristotelian perspective since Joseph is found in three works, which may be read in tandem, of Jacques Maritain. Maritain dismisses perfect induction as the purely verbal and sterile form which modern commentators have the naïveté to regard as the only induction known to the ancients. Using his

example, we don't have to examine every vertebrate to know what a vertebrate is. We can speak of "vertebrate" as common to man, horse, and crocodile. "It is not from the parts of a collective whole nor from the point of view of a distributed whole or a universal properly so called that we must consider induction if we are to understand it, for induction consists in attributing to an intelligible universal, disengaged, so to speak, by abstraction, a predicate verified by some of the individuals or some of the parts in which the universal is realized. This operation is legitimate when the enumeration of individuals is sufficient and it really furthers knowledge. For to know that every metal conducts electricity is not the same thing as to know that silver, copper are conductors of electricity; it is to know that there is some necessary connection (even though we do not perceive it in itself) between the property and the nature of metal—it is to possess— however obscurely and imperfectly it is nevertheless to possess—a truth de jure." At play here is the distinction between what the scholastics call the proper object of the senses (sensible properties, color, shape, magnitude, odor, etc.) and that of the intellect (a spontaneous insight into the essence or nature of the thing under consideration). We will address this at length in our lecture on the principle of substance.

Maritain has his own way of expressing this insight. He writes, "induction by incomplete enumeration does not make us pass from some to all but from some to every. We should avoid saying "all metal conducts electricity," and instead say, "metals conduct electricity." It is the intellect's grasp of the nature of metal that enables it to attribute the same predicate to each individual.

Induction has the double function of inference and proof. When considered as an argument or proof, inductions admits of a certain zone of probability. It is, in fact, neither an inference properly so called nor an argument nor proof: it merely leads the mind to a connection of terms whose intelligible necessity it perceives immediately, for example the principle of identity or the principle of causality. Maritain points out that complete induction is a true inference, a true argumentation by which the mind acquires new knowledge. "If modern authors have denied this, it is 1) because as a result of nominalist prejudice they have failed to recognize the nature and value of the universal and thereby the entire process of human knowledge, and 2) because they have understood induction only from the point of view of the parts of a collective whole." It is one thing to know that Peter and Paul are mortals and another to know that man is mortal. By the universal truth which concerns the nature or quiddity common to the enumerated parts, we implicitly possess the raison d'être of the considered property."

Maritain calls attention to a distinction between what belongs to logic itself and what belong to epistemology or metaphysics. It belongs to metaphysics to discuss nominalism and realism and the controversies concerning the nature of science and ordinary knowledge. The discussion of the first principles of thought and being and the order in which they are known to us is also a part of metaphysics. This we will do in subsequent lectures.

As a personalist, Edith Stein approached the topic from the reverse problem of differentiating or accounting for the individual given the universal. In her habilitationschrift, written under the direction of Edmund Husserl and published posthumously as Finite and Eternal Being, acknowledging a common human nature, she tackles the problem of individuation. A person is not simply an exemplification of a common human nature. A person is not like all others with the human form. A person has a level of un-repeatability and dignity that the classic Aristotelian position did not emphasize. This leads Stein into an extended discussion of the principle of individuation. Her position may be described as uniquely her own, neither that of the well-known position of Aguinas nor that of Scotus, who took an entirely different tack. She speaks of "a common human form" where Aquinas would speak of "a common human nature." Although influenced by Thomas in much of her work, she has a distinctive metaphysical conception of being and essence. She wants to give an account of how there can be many instances of the same type which differ not only numerically but also qualitatively. She does this by positing a form in addition to the common human form, not exactly Scotus's formal principle of individuation, i.e. the principle of haecceitas, but closer to Scotus than Aquinas's signate matter. "Stein's primary concern in positing individual forms," Sarah Bordon Sharkey explains in her excellent book on Stein "is not individuation (as such in the case of Scotus's haecceitas), the paradigm for being a universal, or identity, but rather uniqueness." To fully understand Stein's position, we would have

to review Husserl's theory of parts and wholes as presented in his Logical Investigations III, something beyond our present enquiry.

Louis Groarke, in his An Aristotelian Account of Induction, develops Maritain's thesis, offering vet another telling critique of the empiricist's account of induction and the empiricist's notion of substance. Like Etienne Gilson and Maritain upon whom he draws, Groarke is conscious of the historical setting of philosophical analysis and debate. He is convinced that no historical idea arrives on the scene without some kind of antecedent. Descartes may have set out to create a new philosophy, both natural and metaphysical, to take the place of Aristotle and St. Thomas, yet Jorge Secada, in his careful study of Descartes, finds it necessary to give his book the subtitle, the scholastic origins of modern philosophy. After Bacon, the praise of induction was taken to be a sign of enlightenment. Today popular science writers repeat the all-too-familiar tale about the triumph of modern science over earlier natural philosophy, and the largely uneducated public accepts the story because it lacks the philosophical sophistication to wrestle itself free of the reigning orthodoxy. In fact, those who did the most to advance the sciences did not refute or even repudiate ancient notions concerning the object of science and the nature of scientific explanation; they merely shifted discourse from consideration of the nature or essence of things to that which can be measured, declining to integrate the scientific tableau of the new physics with that of philosophy and common sense.

Pierre Gassendi (1592-1655) is not a household name, but in his own day he was engaged in one way or another with the leading intellectual figures of his period. He corresponded with scores of his illustrious contemporaries, notably with Descartes, Galileo, Kepler, Hobbes, Campenella, and Christina of Sweden. Like others at the threshold of modernity he was confronted with the problem we have been addressing. He deserves to be remembered, if for no other reason than his cautionary dictum, "It is not permitted to transfer into Physics something abstractly demonstrated in Geometry." Gassendi clearly stands at the threshold of modernity, anticipating the British empiricists by more than a century. It is Descartes and his artificially created "mind/body problem" that stimulated Gassendi to address the age-old problem of universals and the relation between sense and intellectual knowledge. In his criticism of Descartes, he writes, "When you say that you are simply a thing that thinks, you mention an operation that everyone was already aware of-but you say nothing about the substance carrying out this operation, what sort of substance is it, what it consists in, how it organizes itself in order to carry out its different functions." Gassendi's own understanding of nature leads him to a mechanism, reminiscent of Epicurus's atomism. Having failed to grasp the fact that much of the moral philosophy he was antecedently committed to could be defended with the metaphysics of Aristotle, he seized upon the philosophy of Epicurus to ground both a theory of knowledge and the inherited moral principles to which he was committed. As a consequence, accounting for the incorporeal, i.e., the existence of God, free will, an incorporeal human soul and immortality. always remained a problem. Gassendi's difficulty shows clearly that the implications of one's solution to the problem of individuation for ethical theory cannot be overlooked.

Groarke points out that with a textual knowledge of Aristotelian metaphysics the problem of induction disappears or solves itself. Defending Aristotle against the charge of naïve realism, he is convinced that modern logicians ignore at their peril what medieval philosophers had to say about induction. Hume may have been the first to raise the skeptical doubts about inductive reasoning, but Groarke finds it strange that the problem was overlooked by his predecessors for nearly two millennia. He argues that Locke and Hume and their empiricist followers never attempted a fair understanding of earlier perspectives. There is no textual evidence that Hume had a significant knowledge of Aristotle. In the Inquiry Concerning Human Understanding (1739), Hume mentions Aristotle twice, once to emphasize his "utterly decayed" reputation and once in a general reference to the four elements. By the time later authors such as Kant and Mill appear on the scene, mainstream philosophy had already lost sight of the original understanding of induction.

If we go back to the Aristotelian texts themselves, Groarke reminds us, we find that Aristotle distinguishes between two different ways of knowing, deduction in which the intellect moves from previously established propositions to a conclusion that follows necessarily, and induction in which the intellect moves from observance of particular instances to general claims about the

nature of the thing under discussion. Induction moves from the particular to the universal whereas deduction involves inference from previously established data. "Scientific induction," writes Groarke, is for Aristotle a matter of what must be the case; it is the capacity of insight (not argument) that allows us to make logical sense of observation Confronted with repeated instances of a phenomenon, human reason arrives at a universal principle, and then goes on to use this universal principle in scientific argument." "Induction is the mental ability to some how jump from the experience of a particular to concepts, rules and principles covering a wide variety of cases. We can, then, define Aristotelian induction in two different ways. Induction is, as traditionally understood, an inference from particular to the universal; but it is also in its most basic form, an inference from sense perception to knowledge. We begin in perception and we end up with words or symbols, with propositions made out of some kind of language, with verbal or linguistic claims that ultimately affirm what is true, in a general way, about the world." Thus we have two different ways of knowing, induction in which the intellect moves from previously established propositions to a conclusion that follows necessarily and induction in which the intellect moves from the observance of particular instances about the nature or essence of the kind of thing in question.

As the Scholastics insisted, it is necessary to keep in mind a distinction between the order of nature and the order of experience. In the order of nature, the intelligible nature, the essence, is prior to the sensible fact. To us, the particular sensible is known first, and the intelligible principle by which the sensible is explained is known afterwards. Induction proceeds from what is first in the order of experience to what is first in the order of nature; from the apprehension of the sensible facts to the apprehension of general principles out of which we subsequently construct the sciences. Without sense experience there is no knowledge of intelligible principles. The process of obtaining knowledge out of sense experience is induction. But there is a difference between apprehension and understanding. Apart from knowing the fact itself, we understand why planets move in ellipses, why some materials burn, why salt dissolves in water only when we have a physical theory that provides a causal explanation. Only by resorting to the principles governing the structure of molecules, by alluding to the atomic structure of salt and water, and the laws governing their action, can we understand combustion and solubility. To understand such natural processes as oxidizing and dissolving requires one to understand the underlying causal mechanisms at work. No one will ever see a K-meson or neutrino, but they are among the important non-observable posited in physical theory that enable us to explain a wide range of phenomena. In short, understanding requires an appeal to causal mechanisms largely unseen. The same is analogously true in the social sciences where, as in the physical sciences, we need to identify causal mechanisms at work. Peter Manicas, writing from an Aristotelian perspective, addresses the problem of explanation in the social sciences in his A Realist Philosophy of Science: Explanation and Understanding. Manicas proves to be a compelling critic of David Hume and the positivism of the Vienna Circle and by implication their understanding of induction. He defends the thesis that the fundamental goal of both the natural and social sciences is not prediction and control but rather the understanding of the processes that jointly produce the contingent outcomes of experience. Scientific knowledge, he maintains, consists primarily in knowledge of the internal structures of persisting things and materials and secondarily in knowledge of the statistics of events or the behavior of such things and materials. Scientific understanding occurs when causal analysis enables us to explain how patterns discerned amidst the flux of events are produced by the persisting natures and constitution of things. Manicas makes a distinction between "scientific explanation" and "understanding." Understanding is achieved when explanation includes a well-confirmed theory about the generative mechanism responsible for the phenomena under investigation. Phenomena that are unintelligible in terms of themselves beg to be explained causally. A successful theoretical explanation consists of a representation of the structure of the enduring system in which the events under consideration occur. This is accomplished when the mechanism responsible for its generation is identified. Drawing heavily on Rom Harré's Principles of Scientific Thinking (1970) in which Harré develops an account of explanation in the natural sciences, Manicas analogously employs Harré's thesis as he describes what he call the "ontological status" of the social sciences. Understanding in the social sciences, Manicas argues, is achieved when, as in the natural sciences, we can exhibit a

causal mechanism responsible for the phenomenon in question. He does not deny that there are important differences between the scientific study of nature and the scientific study of society. "In our world, most events—birth growth, rain, fires earthquakes, depressions, revolutions—are the products of a complex nexus of causes of many kinds, conjunctively at work. It is for this reason that the natural sciences, instead of seeking to explain concrete events, more modestly seek to understand the mechanisms and processes of nature." Without doubt, a social mechanism can be theorized which provides an explanation of why working-class kids get working-class jobs. Typically, suggests Manicas, this would involve identifying their place in society, their beliefs, and their view of the world. Generative social mechanisms in the social sciences are always historically situated. Thus to understand concrete events, such as the collapse of a regime, a depression, or a dramatic increase in divorce, in addition to a pertinent general mechanism, one also needs an historical narrative. "In these cases, explanation takes the form of a narrative that identifies the critical social mechanism and links the sequential to the contingent but causally pertinent acts of persons."

Plato had it right; there is no science of the particular. To explain some event, some actual outcome, one needs to go back in time and identify sequentially the pertinent causes that produce that outcome. To understand Western culture, one needs to examine the classical and Christian origins of that culture and its development through time. To understand Islam is to examine the life and teachings of the Prophet, the Hadiths, and the history of Islamic conquest. "This will require, as Manicas insists, "a narrative which links critical actions and events with ongoing social processes grasped in terms of social mechanisms." In history there are no laws or sets of conditions from which one can make deterministic calculations. An explanation of any event requires the identification of the causal mechanisms as work in the social order. Understanding comes when we have a well-informed theory about the relevant generative mechanism.

I trust that this lecture with the above historical excursions has not only clarified Aristotle's treatment of induction but has shown that any resolution to the problem of induction, be it from the perspective of Wittgenstein's positivism, Edith Stein's personalism, or Gassendi's atomism, is one that has implications for the way we view many other things, notably, scientific explanation. But the implications are not limited to the natural sciences for they influence our understanding of human nature and the social order in its moral and cultural dimensions.