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Concepts of Scientific Method from Aristotle to Newton

In this paper, I shall not try to present any results concerning the history of philosophy or concerning the history of philosophers' ideas about the scientific method in the middle ages. Instead, I shall comment on the conceptual frameworks which have been used, or can be used, in such historical studies. It seems to me that our understanding of what actually happened in the middle ages can be greatly enhanced by a suitable conceptual framework in which the specific historical problems can find their appropriate niche. I shall also suggest that in the study of the history of the scientific method, as in so many other walks of philosophical scholarship, the best way of finding the right framework (in the sense of the historically relevant and useful framework) is to go back to the main Greek philosophers, especially to Aristotle, and to try to reach a deeper understand of their ideas. Their philosophy was the most important backdrop of medieval thought, which often can be looked upon as a gradual transition from Greek ideas to ours. In other respects, too, will an appropriate map of the conceptual situation help to fit different actual historical developments together as pieces of a larger overall picture.

In this spirit, I am led to ask: How do we twentieth-century thinkers view the scientific process, and how do our ideas differ from Aristotle's ideas in this respect? This question might seem to be too general and ambiguous to admit of a clear response, but in reality there is a clear and yet informative answer to it. A twentieth-century philosopher is likely to think of scientific inquiry as consisting of making observations (and gathering other kinds of empirical evidence) and then of using them as a stepping-stone to general explanatory theories. The step form data to theories is sometimes called a (species of) scientific inference. It is generally agreed that this so-called inference cannot be deductive. The main watershed between different overall conceptions of science is the question whether there is a nondeductive kind of inference, usually called inductive inference, to mediate the step from observations

to general theories or whether this step is in principle a matter of hypothesis. According to the latter idea, we cannot infer theories or other general truths from phenomena, but we can test them by comparing their deductive conclusions with observations. Thus we obtain two of the main types of modern models of scientific inquiry: the inductivist model and the hypothetico-deductive model. Although these two models do not quite enjoy any longer the monopoly they used to have among philosophers of science, they are being widely used tacitly or explicitly by historians of philosophy as a part of their conceptual framework.[1]

The basic idea of the Aristotelian conception of scientific inquiry can also be indicated very simply. Aristotle conceives of scientific inquiry literally as inquiry, that is, a questioning procedure. This is shown amply by the *Topics*, among other things. One precedent for such a procedure were the Socratic questioning games practiced in the Academy.[2]

Originally, even deductive inferences were simply special kinds of moves in these questioning games, viz. answers that every rational person would have to give, given his earlier admissions. Aristotle soon realized the special role of such preordained answers or admissions and tried to systematize them in his syllogistic logic. He even tried to make syllogisms the only vehicle of putting the first principles of a science to use for the purpose of explaining various phenomena. But even then the road to these first principles remained a dialectical one.

The interrogative or erotetic concept of inquiry is thus amply in evidence in Aristotle. In a more traditional terminology, it would be called the dialectic method. I am avoiding this label, however, because on the long way to twentieth-century philosophy it has acquired all sorts of misleading associations.

It is fairly clear that something like the interrogative model of science remained influential in the middle ages. For instance, the various

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[1] Their restrictive character is shown by the difficulty of fitting major historical figures into either pidgeonhole. Was Newton an inductivist or a hypothetico-deductivist? Neither shoe fits very well. And the same question can be raised about the medievals.

What is needed is a wider and more realistic conceptual framework for understanding the actual history of philosophical, scientific, and theological thought. That is what I shall try to provide here for the history of the scientific method, just as I have (with several others) tried to provide a new framework for studying the history of the concept of being. That earlier attempt is documented in Simo Knuuttila and Jaakko Hintikka, editors, *The Logic of Being: Historical Studies*, Synthese Historical Library, D. Reidel, Dordrecht, 1986.

[2] See here my paper, "The Fallacy of Fallacies", *Argumentation* vol. 1 (1987), pp. 211-238, and the literature referred to there.

commentaries on Aristotle freely use Aristotle's interrogatively loaded terminology of "admissions", "acceptances by the learner", etc.

This fact is enough to put one facet of medieval thought into a new light. If there indeed was a relevant element of interrogative knowledge-seeking in medieval epistemology and philosophy of science, it is to be expected that the logic of such interrogative procedures should have been studied in so many words. This expectation is fulfilled by the important but incompletely understood *obligationes* tradition.[3] Whatever detailed problems there is about the interpretation of these question-answer dialogues, in their standard form (*antiqua responsio*) they were not, and could not have been, a form of counterfactual deductive reasoning, as has been claimed. For in them one was not examining what follows logically from the initial *positum* or what is inconsistent with it, but rather what follows logically from, or is inconsistent with, the *positum* plus the responder's earlier admissions. This is in fact characteristic of interrogative or "erotetic" knowledge-seeking. Admittedly, later in the fourteenth century obligation-games were given a more deductive twist by some logicians. But this merely illustrates my recommendation of viewing medieval thought as a transition from the Greek to the modern viewpoint.

Admittedly, at first sight the *obligationes* might not seem to have a great deal to do with conceptions of scientific method. However, their close link with the *sophismata* provides a bridge, for problems concerning knowledge-seeking and science were frequently dealt with in the form of sophismata in logic, theology, and natural philosophy, and in this context the obligations terminology was largely employed.

In general, obligation-games illustrate several features of interrogative knowledge-seeking. We can study this kind of knowledge-seeking by means of what I have called the interrogative model of inquiry.[4] This codification of the dialectical conception of knowledge-

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[3] Here the work of Simo Knuuttila and his associates promises to be decisive. I am here relying on their results. See, e.g., Simo Knuuttila and Mikko Yrjönsuuri, "Norm and Action in Obligational Disputations" in O. Pluta, ed., *Die Philosophie im 14. und 15. Jahrhundert*, B.R. Grüner, Amsterdam 1988, pp. 191-202.

[4] The work on this model is largely still in progress. For interim expositions, cf., e.g., my "Knowledge Representation and the Interrogative Model of Inquiry", forthcoming in a volume of new papers on epistemology, edited by Keith Lehrer and Marjorie Clay; Jaakko Hintikka and Merrill B. Hintikka, "Sherlock Holmes Confronts Modern Logic", in E.M. Barth and J.L. Martens, eds., *Argumentation: Approaches to Theory Formation*, Benjamins, Amsterdam, 1982, pp. 55-76; and "The Logic of Science as a Model-Oriented

seeking is the main conceptual framework I am recommending to the historians of scientific method.

The interrogative model seems at first sight to be simplicity itself. In it, an idealized inquirer starts from a given initial premise T. The inquirer may put questions to a source of information. Depending on the intended application, we may call this source of information "the oracle" or nature. The inquirer may draw deductive conclusions from T together with the answers. The aim of the game (or the inquirer's aim) is to prove a given conclusion C or (in another variant of the model) to answer a question "B or not-B?" Normally, the presupposition of a question must have been established before the question may be asked.

How does this model, applied to scientific inquiry, differ from the received models of science? It turns out to be more flexible than its rivals in several respects.

For one thing, the Oracle's answers need not be observations. In some of the most interesting variants of the model, controlled experiments are conceived of as a scientist's questions to nature. But the oracle's answers may instead be intuitions of innate ideas or, as in Aristotle, well-established general opinions, *endoxa*.[5] They need not even be all true, just as *endoxa* sometimes are deceptive. But all that happens then is that the inquirer has to ask further questions to establish the veracity of the oracle's particular answers.

One especially important corollary of this wider conception of what nature can tell us or what we can otherwise establish interrogatively is the following: An important parameter in the interrogative model is the logical complexity of the answers that the oracle can provide to the inquirer. In the received models of science, both in the inductivist and in the hypothetico-deductive model, it is assumed that nature (who in the game of science plays the role of the oracle) can only provide particular (i.e., quantifier free) propositions as answers to the inquirer's questions. In the wider model, there is no longer any reason to accept this "Atomistic Postulate", as I have called it. And if the Atomistic Postulate is not assumed, the rationale of both of these models collapses. For then

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Logic", in P. Asquith and P. Kitcher, eds., *PSA 1984*, vol. 1, Philosophy of Science Association, East Lansing, 1984, pp. 177-185. See also the work referred to in other notes.

5 For the concept of *endoxa* and for their role in Aristotle's argumentation, see. G.E.L. Owen, "Tithenai ta Phainomena", in S. Mansion, ed., *Aristote et les problèmes de méthode*, Louvain, 1961, and. cf. my "The Fallacy of Fallacies", op. cit.

there is no reason to conclude that general theories could not be arrived at deductively from nature's answers to the inquirer's questions or, as Newton puts it, could not be deduced from the phenomena.[6]

Now there are at least two historically important ways in which a scientist can be thought of as being able to obtain general truths as immediate (non-inferential) answers to his or her questions.

The first way is post-medieval. It is the way of controlled experimentation. For the typical outcome of a successful controlled experiment is to find a dependence between two variables, the controlled and the observed one. The codification of such an "answer" is no longer a quantifier-free proposition. It has at least one existential quantifier dependent on a universal one.[7] This was essentially Newton's way.[8]

The other way is Aristotle's. It is deeply rooted in his psychology of thinking according to which to think of X is for one's soul to take on the form of X. This is as genuine a realization of the form as any external one. And if so, any other form Y which necessarily accompanies X will also be present in the soul. Thus any necessary connection between forms can be ascertained simply by thinking about them, according to this Aristotelian psychology (and metaphysics) of thinking.[9]

This means that for Aristotle general truths can be seen immediately in one's own soul, of course after suitable preparation. In terms of the interrogative model, this means that the oracle is assumed to give an Aristotelian scientist general answers, and not only particular ones. In the light of what was said earlier, it is therefore small wonder that neither the inductivist nor the hypothetico-deductive model of science played any appreciable role in medieval philosophy.

This does not mean, however, that the Aristotelian idea of direct access to general truths was universally accepted in the middle ages. As soon as scientific inference was conceptualized as involving a step from

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6 Cf. note 4 above.

7 See here my paper, "What Is the Logic of Experimental Inquiry?", *Synthese* vol. 74 (1988), pp. 173-190.

8 See here Jaakko Hintikka and James Garrison, "Newton's Methodology and the Interrogative Logic of Inquiry", forthcoming in the proceedings of the April 1987 symposium on Newton in Jerusalem.

9 This peculiarity Aristotelian psychology of thought is so striking that it is barely been acknowledge in its full strangeness (strangeness from our twentieth-century viewpoint, that is to say). For indications of it, cf. my paper "Aristotelian Infinity", *Philosophical Review* vol. 75 (1966), pp. 197-219.

particulars to a general truth, it became clear that such a step was not unproblematic, and could not be thought of as nature's direct answer to a scientist's question. In the middle ages, the rise of nominalism seems to mark an important watershed in this respect. This is only to be expected in view of Aristotle's idea of the realization of universal concepts in the form of "forms" in the human soul as a source of scientific truths. Indeed, this Aristotelian background helps us to understand why the rejection of universals was as crucial a development in medieval thought as it in fact was. This helps us to understand the impact of nominalism in general. For instance, nominalism cannot be construed as a skeptical philosophy, as several speakers at this very congress will emphasize. Its impact is seen by comparison with Aristotle's methodology which in effect means giving up, at least partly, the idea that nature can give us *general* answers to suitable questions by means of a realization of the relevant forms in one's mind.

Did this mean a radical change in philosophers' idea of the scientific process? The interrogative model suggests an interesting answer, which is *no*. For the interrogative model shows that you can often compensate for the effects of an additional restriction on the oracle's (nature's) answers by strengthening the initial theoretical assumption T.[10] In fact, logicians know that even if answers to questions are restricted to (negated or unnegated) atomic propositions, there can be theories T which jointly with nature's answers to questions enable the inquirer to establish *any* true proposition. (These are the theories that are known as *model-complete* ones.)

These observations throw highly interesting light on developments in the medieval period. The very same philosophers who began to think of scientific inference as a passage from particular observations to general truths were also among the first ones to evoke prior general propositions to back them up. Duns Scotus is an especially interesting case in point. He writes as follows:[11]

> As for what is known by experience, I have this to say. Even though a person does not experience every single individual, but

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[10] Cf. here my "The Logic of Science as Model-Oriented Logic", op. cit.
In general, the possibility of partial trade off between strong assumptions as to what is answerable and strong a priori premises is an extremely interesting fact which can throw light on several other historical phenomena.

[11] Duns Scotus, *Opus Oxoniense*, i, d.3, q.4, translated in Wolter, *Duns Scotus: Philosophical Writings*, p. 109.

> only a great many, nor does he experience them at all times, but on frequently, still he knows infallibly that it is always this way and holds for all instances. He knows this in virtue of this proposition reposing in his soul: "Whatever occurs in a great many instances by a cause that is not free, is the natural effect of that cause." This proposition is known to the intellect even if the terms are derived from erring senses, because a cause that does not act freely cannot in most instances produce an effect that is the very opposite of what it is ordained by its form to produce.

This quotation is interesting in that it illustrates what for a thinker like Duns Scotus was the alternative to the idea that nature can answer questions concerning universals. Even though nature doesn't do so *apud Scotum*, the intellect knows certain completely general truths like the regularity of nature with a certainty that is not derived from sense-experience. They are therefore of the character of initial premises of the scientific enterprise rather than answers (new facts) contributed by nature.

What is important here is that this novelty does not turn Duns Scotus away from the interrogative conception of inquiry. What it does is to shift the focus from nature's answers to initial theoretical premises. One symptom of this is what Duns Scotus says in so many words in the quoted passage, viz., that the results based on the principle of the regularity of nature are infallible, even though they are based only on a sample of the individuals covered by the generalization. In this respect, I can say, they are just like the results of an interrogative inquiry. Thus Duns Scotus does not anticipate Hume's doubts about induction nor even the twentieth-century conception of induction, even though one recent author refers in this context to Duns Scotus's "inductive evidence".[12] Admittedly, soon afterwards Duns Scotus says that in this way we can only reach "the very lowest degree of scientific knowledge".[13] But this inferior degree does not mean a lower level of certainty, for the principle of the regularity of nature is said to remove in such cases all "uncertainty and infallibility".

Thus it is in principle misguided to see in medieval thinkers like Duns Scotus anticipation of Hume's problems or even anticipations of the hypothetico-deductive or the inductivist models of science. These models came about only when the skeptical ideas found two different inroads into

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12 See N. Kretzmann, A. Kenny and J. Pinborg, eds., *The Cambridge History of Later Medieval Philosophy*, Cambridge University Press, Cambridge, 1982, p. 511.

13 Op. cit., i, d.3, q.5; Wolter, p. 119.

the interrogative conception of scientific inquiry. It was not enough to restrict nature's answers to negated or unnegated atomic ones. One also has to eliminate in principle all nontrivial initial premises. It is for this reason why is was crucially important for modern empiricist philosophers like Locke and Hume to attack the doctrine of innate ideas.

The same observation explains why Newton's overall conception of the structure of science bears striking resemblances to Aristotle in spite of its mathematical character.[14] For according to Newton nature can yield general answers to a scientist's questions, of course not answers concerning necessary connections between "forms" as in Aristotle but answers taking the form of functional dependence between variables, typically obtained through a controlled experiment. No wonder Newton, too, believed that general truths can be deduced from phenomena.

It is of interest to see a little bit more closely what is involved in the abandonment of the Aristotelian idea of direct access to general truths. One corollary to the Aristotelian theory of thinking as a realization of forms in the soul is that whatever follows as a matter of the nature of things in question, that is, as a matter of their essential forms, can be established in thought. There is therefore no distinction in Aristotle between logical and natural ("formal") necessity. This conclusion, which has of course been misunderstood time and again, is shown to be a genuine Aristotelian doctrine in my monograph on Aristotle's theory of modality.[15] Another corollary is that whoever does realize the premises clearly and distinctly in his or her mind, cannot avoid drawing the conclusion. Full-fledged *akrasia* is as impossible in logic as it is in rational action (i.e., in a practical syllogism).[16] All these Aristotelian views have their echoes in medieval thought.

Of course, in order to be able to see what necessarily accompanies a form one must first realize fully the form in one's mind. Hence the crucial task for an Aristotelian scientist is not inference from particulars to general truths, but the formation of general concepts ("forms"). Accordingly, the first premises of an Aristotelian science are definitions,

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14 See Hintikka and Garrison, op. cit. The view we reject is represented, e.g., by I. Bernard Cohen, *The Newtonian Revolution*, Cambridge University Press, Cambridge, 1980.

15 Jaakko Hintikka (with Unto Remes and Simo Knuuttila), *Aristotle on Modality and Determinism* (Acta Philosophica Fennica, vol. 29, no. 1), Societas Philosophica Fennica, Helsinki, 1977.

16 See here my "Aristotle's Incontinent Logician", *Ajatus* vol. 37 (1978), pp. 48-65.

and the way to reach them is the dialectial process which leads up to the definition of a concept (i.e., a full grasp of its essential "form").[17]

All this is part and parcel of what I meant by saying that for Aristotle questions concerning general propositions were (directly) answerable. To give up this answerability assumption can therefore take the form of giving up the identification of logical (metaphysical) necessity and natural necessity. In so far as this natural necessity is construed as nomic necessity, the step away from Aristotle took the form of denying the identification of unrestricted generality and metaphysical (conceptual) necessity. As Knuuttila and others have spelled out, this step was taken most resolutely by Duns Scotus.[18]

Now we can see that this step was not an isolated change in scholastic philosophers' ideas about necessity and other modal concepts. It affected their outlook on the entire structure of the scientific search of knowledge.

These general observations can be illustrated by applying them to the history of one particular concept, that of induction. There exists a useful study of the history of this concept by Julius Weinberg, but unfortunately he assumes throughout his essay something essentially tantamount to the twentieth-century notion of induction as an inference from particulars to general truths.[19]

At first sight, the story of induction within an interrogative framework might look rather like the "curious incident of the dog in the night-time" in Sherlock Holmes: the dog didn't do anything. Likewise, there does not seem to be any niche for the notion of induction in the interrogative conception of scientific investigation. Even if we relax our model and allow for answers by nature that are true only with a certain probability (and hence can be false), the result is not the inductivist model of science but its mirror image.[20] In inductive logic, we study uncertain (nondeductive) inferences from data that are typically assumed to be unproblematic. In the loosened interrogative model we are studying

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17 Cf. "The Fallacy of Fallacies", op. cit.

18 Cf. Knuuttila's own contribution to Simo Knuuttila, ed., *Reforging the Great Chain of Being*, Synthese Historical Library, D. Reidel, Dordrecht, 1981.

19 Julius Weinberg, *Abstraction, Relation, and Induction: Three Essays in the History of Thought*, The University of Wisconsin Press, Madison and Milwaukee, 1965.

20 See here my paper, "The Interrogative Approach to Inquiry and Probabilistic Inference", *Erkenntnis* vol. 26 (1987), pp. 429-442.

deductive (and hence certain) inferences from uncertain answers by nature.

This negative finding is nevertheless itself quite remarkable, just as its counterpart was in Conan Doyle. It is indeed remarkable how little the medievals had to say about induction in anything like the twentieth-century acceptance of the term.

There is more to be said of this concept, however. Even if the twentieth-century notion of induction is an uninvited guest in the house of interrogative inquiry, there is a historically important namesake notion that arises naturally from the idea of scientific inquiry.[21]

This can be seen as follows: Even if nature's answers can be general truths, they can be partial. For instance, in an Aristotelian search for a definition of pride or magnanimity (*megalopsychia*, cf. *An. Post.* B 13), we can directly find out only what characterizes each of a number of subclasses of pride. Likewise, an experimental scientist can find what functional dependence obtains between the variables he or she is interested in over a number of intervals of values of the controlled variable. The experimentally established dependence can even be different over the different intervals. Such general but restricted answers lead to the problem of reconciling these partial answers with each other. Thus Aristotle writes:

> I mean, e.g., if we were to seek what pride is we should inquire, in the case of some proud men we know, what one thing they all have as such. E.g. if Alcibiades is proud, and Achilles and Ajax, what one thing do they all [have]? Intolerance of insults; for one made war, one waxed wroth, and the other killed himself. Again in the case of others, e.g. Lysander and Socrates. Well, if here it is being indifferent to good and bad fortune, I take these two things and inquire what both indifference to fortune and not brooking dishonour have that is the same. And if there is nothing, then there will be two sorts of pride.

This reconciliation procedure, I have shown elsewhere, is precisely what Aristotle elsewhere calls *epagoge* or induction.[22] What I did not know when I wrote my earlier paper was that essentially this interpretation of Aristotle's concept of induction was fairly common among subsequent Aristotelians. Thus Aquinas assimilates to each other induction

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21 See here my paper, "The Concept of Induction in the Light of the Interrogative Model of Inquiry", forthcoming in the proceedings of the Pittsburgh Colloquium in the Philosophy of Science.

22 In "Aristotelian Induction", *Revue Internationale de Philosophie*, vol. 34 (1980), pp. 422-439.

and the method of looking for definition by means of the method of division. "... the same thing happens in the method of division as happens in the method of induction."[23] Here the method of division is "used in obtaining the *quod quid* of a thing". The context makes it clear that Aquinas is thinking of an interrogative search for definitions. This is shown by statements like the following:[24]

> For one who induces through singulars to the universal does not demosntrate or syllogize from necessity. For when something is proved syllogistically, it is not necessary to make further inquiry concerning the conclusion *or ask that the conclusion be conceded*; what is necessary is that the conclusion is true, if the premises laid down are true. [Emphasis added.]

However, Aquinas mistakenly thinks that the search for definitions described in *An. Post.* B 13 (by means of magnanimity example) is intended by Aristotle to be a method different from division and alternative to it. It is nevertheless significant that, in discussing the famous last chapter of *An. Post.* B, Aquinas assimilates induction and the search for definitions along the lines of B 13 to each other, and even refers to one of the examples employed there.

There identity of the two apparently different processes of definition-seeking (seeking for the *quod quid* of a thing) and induction throws some light on the history of the notion of induction. For instance, we can see in what sense Aristotelian induction must be complete: the different kinds of *megalopsychia* whose definitions have to be reconciled with each other must collectively exhaust the entire field of all instances of magnanimity. This means at one and the same time to exhaust different subclasses of magnanimity and all the particular instances of magnanimity. Of course, in Aristotle the real action in induction lies in the reconciliation of the definitions of the subspecies, not just in the exhaustion of all instances.

This shows how thin the line is from Aristotelian induction to the modern conception. This line was repeatedly transgressed as early as in the middle ages.

What is the inductive reconciliation process like? An answer to this question is facilitated by a comparison with the quantitative version of the extension and reconciliation problem. In this problem, different

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23 Thomas Aquinas, *Commentary on the Posterior Analytics of Aristotle*, Magi Books, Albany, N.Y., 1970, p. 177.

24 Thomas Aquinas, loc. cit.

partial functions with exclusive ranges of definition are to be subsumed under one single comprehensive functional dependence. I have shown elsewhere that this kind of reconciliation problem occurs often in the history of science and at crucial junctions in the development of science.[25]

It is easily seen that the reconciliation cannot be subject to simple rules. It involves experimentation with the mathematical expressions of the different functions to be reconciled with each other, and hence has a definite element of conceptual analysis to it. It represents a type of scientific reasoning, including the use of mathematics in science, that has not been discussed very much by philosophers.

Here the similarity between the reconciliation problem in modern science and Aristotelian induction is particularly close. For, as the *megalopsychia* example shows Aristotle understood inductive search of definitions to contain a heavy dose of conceptual analysis and even conceptual reorganization, including the partial rejection of some of the relevant *endoxa*. One is tempted to say that Aristotelian induction is merely a qualitative version of the modern reconciliation process.

Here a couple of challenging tasks open both to systematic and to historical research. One is to try to understand what goes into the inductive reconciliation process, both in its quantitative and its qualitative forms. Another problem is to understand the development of the concept of induction in its Aristotelian sense into an integral (though not always explicitly recognized) part of the methodology of modern science. I have argued that the functional extrapolation and reconciliation task is what Newton meant by induction. But where he got his ideas from and, more generally, what happened to the notion between Aristotle and Newton largely remains to be investigated.

Certain things can nevertheless be said. It is unmistakable that the modern conception of induction began to rear its ugly head in the fourteenth century. Such writers as Ockham, pseudo-Scotus etc. discuss induction unmistakably as a step from particular cases to a general law that falls short of necessity. This is for instance stated explicitly by pseudo-Scotus who says that incomplete induction cannot provide

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25 See op. cit., note 21 above.

necessity, only evidence.[26] This is a far cry from the Aristotelian idea of induction sketched earlier.

In a wider perspective, an especially interesting point seems to be a connection between this change in philosophers' concept of induction and the rise of nominalism. This connection is shown by the Aristotelian background mentioned above, and it helps us to understand why nominalism meant such a break with earlier ideas of human knowledge-seeking. A nominalist could not conceptualize thinking as a realization of a form in one's mind and therefore could not assume that necessary connections between forms could be seen simply by realizing them in one's mind. A nominalist, in brief, could not assume that nature answered general questions, at least not directly, only particular ones. This helps us to appreciate the impact of nominalism in general.

This is an instructive example of how observations of the kind proposed here can throw light on major issues in the history of philosophical thought.

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26 *Super Pr. Anal.* II, 9, 8.