7-1996

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July 1996

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In his Ancient Formal Logic, Professor Joseph Bochenski finds Aristotle's description of syllogisms based upon hypotheses to be "difficult to understand." Noting that we do not have the treatise which Aristotle promised to write, Bochenski laments the fact that the Prior Analytics, where it is treated most explicitly, "is either corrupted or (which is more probable) was hastily written and contains logical errors." (1)

Charles Sanders Peirce wrestled with the same difficult text when he attempted to establish the Aristotelian roots of his theory of abductive or hypothetical reasoning. However, Peirce opted for the explanation that the fault was with the corrupted text, not with Aristotle's exposition. Peirce interpreted the text of Book II, Chapter 25 thus:

> Accordingly, when he opens the next chapter with the word Ἀπαγωγή a word evidently chosen to form a pendant to Ἐπαγωγή, we feel sure that this is what he is coming to. In the excessively abridged and obscure style of the Analytics he begins as follows: "Abduction, Ἀπαγωγή, is when it is well known that the major term is true of the middle, and that the middle is true of the last is not known, yet is antecedently more credible than the conclusion." He should have added "which conclusion we find to be a fact." but he overlooks that, in his wish to add the clause, "and if moreover the middles between the middle and the minor term be few; for thus it will be decidedly nearer to a thorough comprehension of the matter, ἐπιστήμη." (7.249) (2)

Later in this essay, the details of Peirce's condemnation of Apellicon for tampering with the text will be examined. Suffice it to say at the beginning that Peirce's explanation of his own efforts to form a hypothesis about Aristotle's position was itself a most instructive demonstration of exactly what Peirce was trying to clarify in his theory. He was proposing a radical abduction about the roots of abduction.

According to Douglas Anderson, Peirce, in 1905, retracted his efforts to show that his theory fit the overall scheme of Aristotle's logical work and that he admitted that his interpretation was "at best highly doubtful." (3) It will be shown here that when Peirce changed his mind on the matter he simply clarified and amplified the concept of abduction. In his earliest treatment he considered abduction within the requirement of formal logic, being concerned to show how abduction related to and differed from deduction and induction. Later, as he expanded on the logic of discovery as an ongoing process, he concentrated on the unique characteristics of abduction as the source of all new ideas and the foundation of pragmatism. Paul Weiss authoratively notes the centrality of abduction in Peirce's total scheme and his preeminent position in the history of the debate over creative reasoning:

> Under such titles as abduction, hypothesis, retroduction and presumption, C.S. Peirce struggles over the years to lay bare the logic by which we get new ideas. He was, I think, more perceptive and bolder, and traced the problem into more crannies than anyone before or since. He took abduction to the very essence of pragmatism, saw that it was essential to history, and that it was a necessary part of perception, memory and science. He thought it had a bearing on the proof of God and that it was presupposed by all induction. (4)

The critical turning point in Peirce's thought came with the realization that abduction was not simply a variant form of induction, but that it was an irreducibly and radically different kind of reasoning, because "probability proper had nothing to do with the validity of Abduction." (2.102) This correction came in 1902.

I

Before exploring Peirce's perception of the Prior Analytics it would be revealing to examine closely his illustration of abduction as a form of syllogistic reasoning. Had Peirce returned to this illustration later in developing his theory, he might have appeared

more consistent. He was obviously quite careful in constructing this illustration, so it warrants some reflection. He offered it in 1878 (2.623):

DEDUCTION

Rule - All the beans from this bag are white.

Case - These beans are from this bag.

Result - These beans are [certainly] white.

INDUCTION

Case - These beans are from this bag.

Result - These beans are white.

Rule - All the beans from this bag are [probably] white.

HYPOTHESIS [ABDUCTION]

Rule - All the beans from this bag are white.

Result - These beans are white.

Case - These beans are [possibly] from this bag.

The modifiers, certainly, probably and possibly, are added in brackets to make explicit how each inference carries its own modality. Peirce readily admits that: "As a general rule, hypothesis is a weak kind of argument. It often inclines our judgment so slightly towards its conclusion that we cannot say that we believe the latter to be true; we only surmise that it may be so." (2.624) The subject of a hypothetical proposition is

> a possibility, or possible case, or possible state of things. In its primitive sense, that which is possible is a hypothesis which in a given state of information is not known, and certainly cannot be inferred, to be false. (2.247)

Peirce created the imaginary circumstances in which he thought that the source of the white beans might be discoverable.

> "Suppose I enter a room and there find a number of bags containing different kinds of beans. On the table there is a handful of white beans, and after some searching, I find one of the bags contains white beans only. I can at once infer a probability, or as a fair guess, that this handful was taken out of this bag..." (2.623)

Note the juxtaposition of "probability" and "fair guess." In time Peirce would realize that the "fair guess" was about a possibility and that the word "probability" created a confusing overlap with induction.

Simple as this illustration appears to be, it involves a complex set of assumptions and perceptions, including the recognition that the objects of curiosity are actually beans, that each bag contains one type of bean and that color is, at least initially, a more significant feature than size, taste, texture or any other characteristics. In the formation of the hypothesis, the color is the perceived fact that calls for attention. In the testing of the hypothesis, all other factors (size, taste, etc.) come into play. Peirce represents the "fair guess" as the only apparently rational possibility for further inquiry.

The illustration invites some reflection on the relationship between the theory of abduction and Peirce's pragmatism. One might wonder why the observer cares to inquire about the beans in the first place. Of course, if he is hungry and the beans are edible, and the fact that they came from a particular bag helps in deciding whether to eat them, the question is a useful one. In that sense the hypothesis is practical. However, this is not the practicality that defines pragmatism as a rule of inquiry:

> If pragmatism is the doctrine that every conception is a conception of conceivable practical effects, it makes conception reach beyond the practical. It allows any

> flight of imagination, provided this imagination ultimately alights upon a possible practical effect..." (5.196)

The practicality that guides pragmatism is the imagined action that advances inquiry. If one proposed that the handful of beans and the bag were on the same table because the law of gravity kept them there, this hypothesis does not lead to any further understanding about what accounts for the beans being in any one place rather than another, nor does it open up possibilities of finding out whether the beans are safe to eat. The "fair guess" is a good guess because there is something an inquirer can do about it. For example, one can imagine asking others if they knew about the situation, tasting the beans, giving some to the dog to see what happens. Peirce consistently emphasizes that abduction and pragmatism have to do with conceivable action, i.e., with our conduct as searchers for understanding, primarily, not as searchers of food or fortune.

One might take the hint from Peirce and imagine that the observer discovers that it is impossible to find out whether the white beans came from a certain bag, but, in the process of asking others, comparing taste, texture and size, the hypothesis grew weaker until the dog ate some of the beans from the bag and died. This surprising turn of events might call for another obvious hypothesis or question: Are the beans outside the bag just as dangerous as the ones inside the bag? However, without the initial "fair guess," nothing would have been learned at all, so that the first hypothesis has value, not because it is true, but because without it there would be no new ideas. The original hypothesis might be quickly and easily dismissed if some witness came forth who knew for a fact that the beans were from somewhere else or that, upon further examination, the two sets of beans shared only one characteristic, the color white, and differed in all other respect.

The best hypothesis, according to Peirce, "is the one which can be most readily

refuted if false." (1.120) This is the core of his doctrine of fallibilism. One might add that the best hypothesis is not only fallible, but it is the guess which when rejected, leads to a reassessment of the situation and the formulation of new hypotheses when warranted. The strength of a hypothesis is derived from "...a certain insight, not strong enough to be oftener right than wrong, but strong enough not to be overwhelmingly more often wrong than right..." (5.173)

II

It appears that this early illustration of the irreducible forms of inference contains, at least implicitly, the most important indicators of Peirce's more fully developed doctrine on abductive and hypothetical reasoning. An even more fruitful examination of his theory is possible with regard to his interpretation of the Prior Analytics, II, 25.

In 1891-92 Peirce first gave voice to his suspicion that the text of the Prior Analytics was misleading because the text was corrupted precisely at the place where Aristotle dealt with reduction or abduction. He writes:

> There are in science three fundamentally different kinds of reasoning, Deduction (called by Aristotle συναγωγή or [sic!] αναγωγή), Induction (Aristotle's and Plato's ἐπαγωγή), and Reduction (Aristotle's ἀπαγωγή, but misunderstood because of corrupt text, and as misunderstood usually translated abduction.)" (1.65)

There is no question in Peirce's mind that these essential differences are what Aristotle had in mind. W.D. Ross describes abduction in Aristotle as "a type of argument which might be said to be semi-demonstrative, semi-dialectical, inasmuch as it has a major premise which is known, and a minor premise for which the moment is only admitted." (5) As has been pointed out, Peirce is aware of the transitory force of abduction and is sure that this is consistent with his reading of Aristotle.

Ten years later, Peirce returns to the issue in an extensive treatment aptly entitled The Logic of Drawing History from Ancient Documents in which he takes up the textual criticism as an example of the use of hypothetical reasoning. In the very beginning of the treatise, he establishes the important difference between the process of framing or forming the hypothesis (abduction) and the process of testing the hypothesis(induction). One frames the hypothesis by "tracing out the experiential consequences of the hypothesis" and tests it "by comparison with facts not taken into account in the formation of the hypothesis." (7.163) Clearly, formation and testing are distinct operations, yet organically inseparable. If a hypothesis were not testable, one would have no reason to form it or articulate it, but whether it tests well or badly, does not argue against its being logically arrived at as a possibility.

It should not be surprising that Peirce never claimed that his speculation about Aristotle's text was certain. In fact, he expressed a wide variety of inclinations about it, which has led to accusations of inconsistency. At one point in his discussion, Peirce explored the details of the historical account of Apellicon's tampering with the Prior Analytics to the point of disturbing the sense of the whole treatment. Peirce concludes that his interpretation of events is "so natural, and it ought to be so easily refuted if it is not true, that I am strongly inclined in spite of the jeers of all the great German critics, to admit it on probation." (7.235) Peirce obviously finds nothing contradictory among such terms as "natural" and "strongly inclined" on the one hand and "on probation" on the other. Peirce is anxious to test his assumptions against the available facts of history, which, he believes confirm the villainy of Apellicon, "marked by extreme carelessness and

utter want of conscience, though we are told that [the work's] stupidity was its most striking characteristic." (7.242) This indictment, imposed with such conviction, is followed immediately with the admission that "At any rate, some of the phenomena to which our hypothesis points as probable..." are hardly certain.

After Peirce enumerates the major "blunders" found in the text, he acknowledges the most powerful persuasion in the formulation of his hypothesis:

> Certainly, he would not be Aristotle, to have overlooked that question [whether the minor premise of such a syllogism is not sometimes inferred from its other two propositions as data]: it would no sooner be asked than he would perceive that such inferences are very common. The two examples alleged to be Aristotle's are, for Peirce, totally out of character: "Nothing could be more utterly unlike Aristotle's usual examples, which bring up in vivid aptness actual reasonings well known to his scholars." (7.249)

It is quite obvious that Peirce's hypothesis is formed out of the long and deep study of Aristotle in Greek. It is not induction which leads Peirce to the formulation; it is the continuity of experience. Once formulated, the hypothesis is to be checked against all the available facts, including the nefarious activities of Apellicon, and the habit of Aristotle to write on average seventy lines to a page and that the altered word occurs on a line exactly where one would expect it. Somewhere in the remnants of antiquity there may be one fact that destroys Peirce's thesis, but its original credibility is justified by the abiding insight Peirce has into the habits of Aristotle's mind. Thus, it is understandable that Peirce goes so far as to declare:

> I think, then, that my interpretation of the passage, considering its being what the current of thought demand considering how the word 'Απαγωγή balances 'Επαγωγή and considering that it renders both the examples their real historic forms, comes within a tolerably close approach to certainty.(7.253)

Even this level of confidence does not diminish the fallibility of the abduction.

In the same year, 1901, Peirce reflected again upon the way that Apellicon subverted the sense of the Prior Analytics, II, 25, by substituting a single wrong word and making Aristotle's imperfect description even more difficult to fathom. Here he characterizes abduction as "the problematic theory which induction verifies." (2.776) Peirce further clarifies the "problematic" nature of abduction, explaining that the hypothesis which often arises from "some conception with which the mind is already stored" is

> frequently utterly wrong itself... for it may be that the features of the phenomena which it aims to explain have no rational explanation at all. Its only justification is that its method is the only way in which there can be any hope of attaining a rational explanation. (2.777)

In 1902 Peirce levels his severe reprimand at Apellicon once more and observes: "At any rate, even if my conjecture is wrong, and the text must stand as it is, still Aristotle, in that chapter on Abduction, was in that case groping for the mode of an inference which I call by the otherwise useless name of Abduction..." (5.144) In yet another context Peirce says that he "fully accepts the usual story about Aristotle's writing lying some centuries perdus..." and condemns the extravagances of high criticism for rejecting the story and rejecting the authenticity of Aristotle's work. (2.37, note)

In what appears to be his last reflection (1905) on the Aristotelian foundation of his concept of abduction, Peirce confesses that the theory is "doubtful." His point is not quite so emphatic, however, as Anderson makes it out to be in his paraphrase: "...at best highly doubtful." In the very same sentence in which he expresses doubt, Peirce completed his thought by reiterating that abduction "... consists in examining a mass of facts and in allowing these facts to suggest a theory. In this way we gain new ideas; but

there is no force in the reasoning." (8.209) This is, of course, the nature of dialectical reasoning: the opposite conclusion always remains possible.

It would be consistent with Peirce's earlier descriptions of abduction to recognize that even a good hypothesis might be dismissed or replaced as the result of inductive examination. Later critics have argued that the formation of hypotheses is either guided by induction from the beginning or they are no more reliable than random conjecture which lacks reliability until tested by induction. The opponents of abduction maintain that, either way, abduction adds nothing worthwhile to induction, which is the only logical method for eliminating error. According to Peter Skagestad (6), the necessity of error-elimination, later popularized by Karl Popper until superseded by Quine's revival of Duhem's underdetermination thesis, had already been discovered by Peirce. In the pre-inductive formation of a hypothesis, the basis for reliability and the selection of one guess over another lies in the affinity between the human mind as part of nature and as maturing in the experience of nature, with nature itself, and this includes the natural community of fellow inquirers.

In his early sample of the handful of white beans and in his sustained assumption about the text of the Prior Analytics, Peirce trusts in a condition that precedes the formation of the hypothesis: one allows the facts to suggest the theory. In the case of the beans, common sense responds to the surprising coincidence that there is a bag full of white beans nearby. There appears to be no other provocative possibility to be curious about. With regard to the Aristotelian text, Peirce was guided by many years of study of Aristotle in the Greek and by a belief in unrelenting questioning. He was convinced that

he and Aristotle were searching for the same thing. Anderson aptly notes that both Peirce and Aristotle describe abduction as "a type of lived reasoning which is on a par with and not ancillary to deduction." (7)

The radical hypothesis upon which all theorizing is based is that generality and continuity do indeed exist and are inescapable in any and all inquiries. Having no experience of nature which is more disorderly than orderly, the only "fair guess," for Peirce, would be that nature would continue to behave itself as it unfolds its endless possibilities. This point is well made by Patricia Turrisi. (8) Against this assumption of continuity, one can always detect exceptions and variations: without it, one can decipher nothing. In this regard, Peirce was profoundly influenced by the vision of Kant:

> The law of reason which requires us to seek for this unity is a necessary law, since without it we should have no reason at all, and without reason no coherent employment of the understanding, and in the absence of this no sufficient criterion of empirical truth. In order, therefore, to secure an empirical criterion we have no option save to presuppose the systematic unity of nature as objectively valid and necessary. The Critic of Pure Reason, ... A 651.

This is the kind of reasoning Peirce applies in his speculations about the Prior Analytics. If there is continuity in Aristotle's thinking as a general rule, it makes more sense to Peirce to assume that Aristotle was "groping for the mode of inference" which Peirce was also trying to formulate.

Among others, Bas van Fraassen rejects such Peircean optimism as empirically inadequate because it rests on an unobservable world. (9) Stathis Psillos counters this criticism and, without mentioning Peirce, gives expression to an important Peircean insight:

> Generally, avoiding ignorance is as important as avoiding error. So the challenging task is not to avoid error at the price of remaining ignorant but to find a compromise between avoiding error--that is making one's beliefs as secure as possible, and avoiding ignorance--that is acquiring warranted beliefs about more things. (10)

Of course there are risks either way. However, the greatest risk is to reject the possibility of a fruitful hypothesis. Only deduction is risk free, because it belongs to an ideal world in which nothing genuinely new takes place. Hence Peirce is willing to risk disagreement with the German critics of Aristotle's text if such disagreement keeps open the possibility of finding further illumination about where new ideas come from in an evolving universe. (6.475)

It was characteristic of Professor Bochenski to be scrupulously precise in his analysis of specific philosophical problems and in the exposition of the thoughts of other philosophers. One can only imagine what his views of C.S. Peirce's system would be had he had an opportunity to examine his work in toto. Peirce was a different kind of philosophical personality. He seemed to delight in taking risks--in concept and in language. Particularly, his doctrines of abduction and pragmatism were not simply attempts to describe the logic of discovery; they were a deeply felt conviction about his own intellectual life. His "fair guess" about the text of the Prior Analytics bears this out.

NOTES

1. Bochenski, Joseph M. Ancient Formal Logic. Amsterdam: North-Holland Publishing Co., 1968, p.65.

2. Peirce, Charles Sanders. Collected Papers. Eds. Charles Hartshorne, Paul Weiss and Arthur Burks. Cambridge: Harvard University Press, 1931-58. All references are to volume and paragraph numbers.

3. Anderson, Douglas. "The Evolution of Peirce's Concept of Abduction." Transactions of the C.S. Peirce Society. Spring 1986, vol. 22, no.2, p.146.

4. Weiss, Paul. "The Logic of the Creative Process". Studies in the Philosophy of C.S. Peirce. First Series, Eds. Philip Weiner and Frederick Young. Cambridge: Harvard University Press, 1952, p. 166.

5. Ross, William D. Aristotle's Prior and Posterior Analytics. Oxford: Clarendon Press, 1965, p. 490.

6. Skagestad, Peter. The Road of Inquiry in Charles Peirce's Pragmatic Realism. New York: Columbia University Press, 1981, p.187.

7. Anderson, Douglas. Creativity and the Philosophy of C.S. Peirce. Boston: Martinus Nijhoff, 1987, p.15.

8. Turrisi, Patricia. "Peirce's Logic of Discovery: Abduction and the Universal Categories" Transactions of the C.S. Peirce Society. Fall, 1990, vol. 26, no. 4, p. 465.

9. Van Fraassen, Bas. The Scientific Image. New York: Oxford University Press, 1980, pp. 71-72.

10. Psillos, Stathis. "On Van Fraassen's Critique of Abductive Reasoning." The Philosophical Quarterly. January 1996, vol. 46, no. 182, p.43.

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