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PEIRCE'S THEORY OF ABDUCTION

ARTHUR W. BURKS

One task of logic, Peirce held, is to classify arguments so as to determine the validity of each kind. His own classification is interesting because it includes a novel type of argument (called abduction¹) in addition to the two traditionally recognized types (induction and deduction). It is the purpose of this paper to discuss what Peirce thought to be sufficiently distinctive about abduction to warrant calling it a new kind of argument. But since one finds in his writings on abduction a number of different views it is first necessary to make a few remarks concerning the unity of Peirce's thought.

The variation to be found in his views on abduction is, of course, typical of Peirce's writings. It is fashionable today to conclude from the fact that Peirce's writings are fragmentary that his thought was likewise fragmentary. Now it is true that Peirce was frustrated in his ambition to create a unified system. But the lack of unity in his thought has been greatly overemphasized because of a failure to recognize three facts: first, that his logic is foundational to the rest of his philosophy, and hence that his three categories are basic to all his thought; second, that in the scientific spirit Peirce pursued the implications of different hypotheses (and as a consequence varied his terminology from paper to paper); and third, that there was a temporal development in his thought.

The last point is particularly important for an understanding of Peirce's varied writings on abduction. Roughly speaking, Peirce's thought falls into two periods.² In the early period Peirce treated inference, and hence abduction, as an evidencing process. The distinction he drew between induction and abduction corresponds to that between the descriptive, summarizing part of science and the explanatory, theoretical part: induction is an inference from a sample to a whole, while abduction is an inference from a body of data to an explaining hypothesis. In his later period Peirce widened the concept of inference to include methodological processes as well as evidencing processes: induction is the method of testing hypotheses, and abduction includes the method of discovering them.³ This development was a part of Peirce's attempt at system building. During his later period Peirce took the original ideas (pragmatism, synechism, abduction, etc.) discovered in the first period of his thought and attempted to use them as the basis of a grand philosophic system. To this end he worked out a

¹ In his early writings Peirce called this type of argument hypothesis; later he called it abduction, and sometimes retrodution or presumption. For the sake of simplicity "abduction" will be the term used throughout this paper.

² The year 1891—which is the date at which he left his government post and retired to his home at Milford, Pennsylvania—marks the beginning of a transitional decade dividing the two periods.

³ The distinction drawn in the first period between induction and abduction was kept in a modified form in the later period as the distinction between quantitative and qualitative inductions.

classification of the sciences, reinterpreted the categories in a more metaphysical fashion,⁴ and extended the scope of logic.⁵ Abduction was related to his other doctrines, such as pragmatism and tychism, and treated as a method of discovering new ideas rather than as a mode of argument.⁶

The question immediately arises: can there be a *logic* of discovery? For are not discovery and invention the work of genius, and hence the proper subject matter of psychology rather than of logic? Can the process of arriving at an hypothesis (rather than of justifying it) be called inference or argument? Peirce does not lack historical precedent for such a view, of course, for induction has often been regarded, not as an evidencing process, but as a logic of discovery. Such a position requires justification, however, so we shall consider the grounds Peirce had for advancing it before we consider the content of his logic of abduction.

There are two ways to consider this question, an external approach and an internal approach. An external criticism holds that the discovery of an inference is clearly not an inference, and hence that Peirce is merely confused.⁷ The internal approach asks the question: do Peirce's conception of logic and his theory of inference justify his calling the discovery of an hypothesis an inference? We shall examine Peirce's work from this point of view.

One might expect Peirce's view to flow out of a confusion of logic and psychology, or out of a theory which held them to be inseparable. But he very clearly separates logic from psychology: psychology, he frequently says, is a study of how we do think and is irrelevant to logic, which is a study of how we *ought* to think. It is true that in his discussions of abduction Peirce often speaks of man's "insight into the laws of nature," his "guessing-instinct," his natural tendency to guess right; ". . . all human knowledge, up to the highest flights of science, is but the development of our inborn aminal instincts" (2.754). Thus he says that abduction "is really an appeal to instinct" (1.630), and that the "simpler" hypothesis is the one that instinct suggests (6.416). Of course if these statements were taken literally, one could not speak meaningfully of the logic of abduction, for unless the process of abduction has a rationale of some sort it cannot have a logic. However, Peirce's statements that abduction rests upon man's instinct

⁴ In the early period Peirce regarded his three categories as a classification of signs rather than of things; any relation or reference to a correlate was a Second, while only meanings or representations were Thirds. In his later period Peirce extended the scope of the categories, interpreting them as possible kinds of being, rather than as kinds of thoughts; thus Secondness becomes the idea of dyadicity in experience, the idea of compulsion and brute force, and Thirdness becomes the category of rationality, objective value, and law.

⁵ What Peirce called logic in his first period he subdivided into phenomenology, esthetics, ethics, and logic in the later period.

⁶ This seems also to have been the purpose of another branch of logic, called by Peirce formal rhetoric, speculative rhetoric, objective logic, and methodetic.

⁷ Thus Mr. R. B. Braithwaite says that "Peirce only differs from the orthodox account [of scientific procedure] in classifying the thinking of the hypothesis as itself a form of ampliative reasoning, and this difference is, I think, merely a verbal one, namely, that of whether 'an act of *insight* . . .' (5.181) is or is not called reasoning."

"Review of *Collected Papers*," *Mind* 43 (1934) 510.

for truth are intended as an explanation of how it is that we have any knowledge whatsoever; for since there are an infinite number of hypotheses which might be proposed for the solution of any problem, a completely behavioristic explanation of knowledge in terms of trial and error learning must fail. A distinction Peirce draws between one's *logica utens* and one's *logica docens* is relevant at this point. The *logica utens* of a reasoner is the undeveloped theory of logic that he uses as a basis of his reasoning. After careful and systematic study of the process of reasoning one arrives at a *logica docens*, which is an improved and scientific theory of logic. Though Peirce never applies this distinction to abduction, it strengthens his position to do so and to say that man's natural insight into truth is a *logica utens* which can be developed by abductive logic. It follows that it is the task of logic to bring into critical consciousness one's instinctive habits.

What, now, do one's reasoning habits have to do with logic? The answer to this question is to be found in Peirce's analysis of belief. As a pragmatist Peirce held that a belief is a conscious habit of action: ". . . what we think is to be interpreted in terms of what we are prepared to do" (5.35). Similarly, he held that genuine doubt comes about when an actually functioning habit is interrupted. Until a belief-habit is actually interrupted there is nothing which can be subjected to scientific investigation. "Every inquiry whatsoever takes its rise in the observation. . . of some surprising phenomenon, some experience which either disappoints an expectation, or breaks in upon some habit of expectation. . . ." (6.469). Once a belief-habit is interrupted the aim is to arrive at a new belief-habit which will prove to be stable, that is, one that would "lead to the avoidance of all surprise and to the establishment of a habit of positive expectation that shall not be disappointed" (5.197). Peirce calls the activity of resolving genuine doubt and arriving at stable belief-habits inquiry.

Hence in his second period Peirce conceived of the three kinds of reasoning (abduction, deduction, and induction) as three stages of inquiry. All three are based upon the idea of an hypothesis. Abduction *invents* or proposes hypotheses; it is the initial proposal of an hypothesis because it accounts for the facts.⁸ Deduction *explicates* hypotheses, deducing from them necessary consequences by means of which they may be tested. Induction *tests* or establishes hypotheses; as a believer in the frequency theory of probability Peirce used the phrase "evaluates them." "Abduction is the process of forming an explanatory hypothesis. It is the only logical operation which introduces any new idea; for induction does nothing but determine a value, and deduction merely evolves the necessary consequences of a pure hypothesis" (5.171).

Though Peirce's conception of logic as a study of habits of inquiry leaves room for the view that abductive discovery may be inference, it is actually in his theory of reasoning as normative that we find a positive justification for such a position.⁹

⁸ It is worth noting that on this view abduction is no longer to be classed along with induction as over against deduction, for a logic of discovery is as pertinent to mathematics as to science.

⁹ Peirce himself never pointed this connection out, but it is an historical fact that he did not adopt the view that the discovery of an hypothesis is reasoning until he had conceived

Reasoning, according to Peirce in his later period, is thinking which is deliberate and consciously controlled. "A proof or genuine argument is a mental process which is open to logical criticism" (2.26). A man is reasoning when he deliberately and consciously adopts a conclusion because he sees that it follows from the premises in accordance with a method or leading principle which he approves and which he consciously sees is applicable to the particular case. If the premises merely *cause* (in the sense of efficient causality) him to accept the conclusion he is not reasoning, since such causality is not under his control. The beliefs of a man may succeed one another in such a fashion that the successor of a proposition is a logical consequence of it. But the man is not reasoning, according to Peirce, since he is not conscious of that relation. An instinctive or habitual reaction cannot be an inference. "If one does not at all know how one's belief comes about, it cannot be called even by the name of inference" (6.497). A man is not reasoning until he deliberately approves and consciously applies his habits of thought. Thus inference is "the conscious and controlled adoption of a belief as a consequence of other knowledge" (2.442). Hence, on Peirce's view, logic is the study of how one cognition ought to determine another cognition. It is clear that on the basis of this definition of reasoning the discovery of an hypothesis could be an inference, since it could be the deliberate determination of one cognition (the hypothesis) from another cognition (the data of the problem).

An interesting application of this conception of reasoning is Peirce's view that a perceptual judgment is not an inference. Such judgments involve interpretation because they go beyond the given; for this reason some thinkers call them perceptual *inferences*. On this view we experience the sense datum, and infer the existence of the object it represents. But a perceptual judgment is not an inference, Peirce argues, since it lacks that essential feature of inference—the property of being under our conscious control. "...a perceptual judgment is a judgment absolutely forced upon my acceptance...by a process which I am utterly unable to control and consequently am unable to criticize" (5.157).

The view that reasoning is controlled thinking is alien to the prevailing temper of our time. We can throw some light on how Peirce arrived at it by considering his reflections on logical machines. Peirce was aware of the possibility of building into a machine relations that are the basis of some mathematical inferences.¹⁰ Though not all inference is computational, it is certainly true that numerical computation is inferential in the sense that its results follow deductively from its data. But if you call this reasoning, then it would seem that nature reasons whenever it operates in accordance with mathematical principles. "Any apparatus whatever used for experimentation would be, on the same principle, a logical machine. A steam-engine would be working out, at every revolution, its problem

of reasoning as normative; for his conceptions of logic as a normative science and of abduction as a logic of discovery were both advanced during his later period. See a paper by the author, "Peirce's Conception of Logic as a Normative Science," *The Philosophical Review*, 52 (1943) 187-193.

¹⁰ "Logical Machines," *American Journal of Psychology*, 1 (1887) 165-170.

in thermodynamics . . ." (2.58). "A decapitated frog almost reasons. The habit that is in his cerebellum serves as a major premiss. The excitation of a drop of acid is his minor premiss. And his conclusion is the act of wiping it away" (6.286).

A computing machine starting from correct premises can arrive at correct conclusions. In what respects, then, does such a machine fail to infer? In the first place, the procedure of a machine does not have the element of conscious approval and control; it cannot certify the validity of its own inferences. Secondly, a computing machine lacks originality.¹¹

A machine can solve only the kind of problems for which it has been constructed; it cannot formulate these problems nor the principles embodied in it by means of which it solves them. Thus according to Peirce's normative definition of inference a computing machine fails to infer in two respects, conscious approval and originality, both of which are essential to abductive reasoning.

Let us consider next the rules of abductive reasoning, that is, the principles to be used in deliberately and consciously proceeding from the data of a problematic situation to a tentative solution. Though abduction has "a perfectly definite logical form", it is by its very nature "very little hampered by logical rules" (5.188), since if it were much subject to known principles it would not be discovery but the application of knowledge (already attained) to a specific situation. However, since abduction belongs to the programmatic part of Peirce's system, one finds only a few suggestions as to the content of the logic of abduction in his writings. He discusses questions of the economy of investigation, such as the problem of which of many hypotheses should be tested first, and comes to the conclusion that in general we should test the simpler hypothesis before the complex ones. In fact, it may be economical to begin with the least plausible of a set of hypotheses if it happens that its truth status may be determined much more easily than can that of the others. On the other hand, it may be best to try "the hypothesis which suggests an experiment whose different possible results appear to be, as nearly as possible, equally likely" (2.786), since such an hypothesis would be a decisive one. In an article on scientific method in Baldwin's *Dictionary of Philosophy and Psychology*¹² he analyzes the steps to be taken in solving a problem, suggesting that analogies between related fields should be carefully studied as sources of suggestions and warning that one should not give up an hypothesis too soon as Newton did when he first considered his gravitational theory. One principle he might have mentioned is that of systematically considering and organizing the various possible solutions of a problem.

Since Peirce attempted to incorporate pragmatism into abduction, something can be learned from his discussions of pragmatism. He refers to pragmatism as

¹¹ *Ibid.*, pp. 168-169. Peirce also argues that the memory capacity of such a machine is limited, whereas that of a human reasoner is unlimited, if the possibility of recording on paper is admitted. Though this was true of the machines available in Peirce's time, it is not true of the computing machines built today. See the article by the present writer, "Super Electronic Computing Machine," *Electronic Industries* 5 (July, 1946) 62-67.

¹² "Scientific Method," Vol. II, pp. 500-503, by Peirce and James Mark Baldwin.

the logic of abduction and means by this that it is a logical doctrine to be used in determining the admissibility of hypotheses. For pragmatism is a criterion of meaning—it states that an hypothesis has meaning if and only if it has empirical or practical consequences, and that the sum total of those consequences is its total meaning. Pragmatism is thus a maxim of analysis; it is none other than the maxim of science, since a scientist would admit no hypothesis that fails to have empirical consequences. “Any hypothesis . . . may be admissible . . . provided it be capable of experimental verification, and only insofar as it is capable of such verification” (5.197). Thus the principle rule of abduction is that “its conclusion should be such that definite consequences can be plentifully deduced from it of a kind which can be checked by observation” (2.786).

In terms of pragmatism we can see what it means to say that an hypothesis “explains” the facts. For no hypothesis can be admitted unless it accounts for some or all of the facts. An hypothesis must explain or account for the facts in the sense that they can be deduced from it. An explanation which has recourse to a Maxwellian demon or that says “it is so because God made it so” has no conceivable consequences that can be tested, and hence does not explain the facts. Thus Peirce rejects the Abbé Gratry’s explanation of the inductive leap as being a miracle by saying that it is not an explanation “because an explanantion should tell *how* a thing is done . . .” (2.690). It follows from this principle that no reasoning can result in the conclusion that something is by nature inexplicable. “. . . nothing justifies [an abductive] inference except its affording an explanation of the facts. It is, however, no explanation at all of a fact to pronounce it *inexplicable*. That, therefore, is a conclusion which no reasoning can ever justify or excuse” (1.139).

Thus pragmatism “is nothing else than . . . the logic of abduction. That is, pragmatism proposes a certain maxim which, if sound, must render needless any further rule as to the admissibility of hypotheses to rank as hypotheses, that is to say, as explanations of phenomena held as hopeful suggestions; and, furthermore, this is *all* that the maxim of pragmatism really pretends to do, at least so far as it is confined to logic, and is not understood as a proposition in psychology” (5.196).

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