

Peirce and the Autonomy of Abductive Reasoning

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ABSTRACT. Essential to Peirce's distinction among three kinds of reasoning, deduction, induction and abduction, is the claim that each is correlated to a unique species of validity irreducible to that of the others. In particular, abductive validity cannot be analyzed in either deductive or inductive terms, a consequence of considerable importance for the logical and epistemological scrutiny of scientific methods. But when the full structure of abductive argumentation -- as viewed by the mature Peirce - is clarified, every inferential step in the process can be seen to dissolve into familiar forms of deductive and inductive reasoning. Specifically, the final stage is a special type of practical inference which, if correct, is deductively valid, while the creative phase, surprisingly, is not inferential at all. In neither is abduction a type of inference to the best explanation. The result is a major reassessment of the relevance of Peirce's views to contemporary methodological studies.

1. THE PROBLEM

Discussions of scientific discovery and justification commonly refer to C. S. Peirce's threefold distinction among the basic kinds of reasoning: *abduction* is the process of both generating hypotheses and selecting some for further pursuit, *deduction* draws out their testable consequences, while *induction* evaluates them (*CP* 5.171, 6.468-477).¹ Besides this difference of roles in the process of scientific inquiry, Peirce added that reasoning within each kind utilizes distinctive methods or forms, and that there are diverse senses in which these methods can be described as valid or as legitimate means of extending our knowledge. The latter is at the core of his contention that each kind of reasoning is irreducible to the other two, specifically, that abduction is an autonomous branch of logic.

While there is widespread agreement about the need to distinguish between inductive and deductive correctness, there is less concerning the autonomy of abduction, even when one follows Peirce in refusing to label all ampliative reasoning as "inductive." The issue is not whether there *are* the three kinds of reasoning Peirce delineated, each with its characteristic aims and methods, nor whether abductive procedures constitute a proper phase of scientific inquiry. The question of autonomy, as here understood, concerns the alleged irreducibility of abductive correctness, for insofar as abduction is a characteristic method of either discovery (Hanson 1958,

Thagard 1988) or explanation (Achinstein 1972, Boyd 1984), it is this claim that carries a truly significant logical and epistemological import in the study of scientific method.² How did Peirce defend the autonomy of abduction? A common assumption is that abduction is unique in its generative capacity (CP 5.171), yet Peirce complicated matters by describing a twofold process of both discovery and pre-testing preference:

The first starting of a hypothesis and the entertaining of it, whether as a simple interrogation or with any degree of confidence, is an inferential step which I propose to call *abduction*. This will include a preference for any one hypothesis over others which would equally explain the facts. (CP 6.525)

In which phase does the irreducibility of abduction lie, in discovery or preference? Either choice raises problems; despite the conceptual distinctions, it is difficult to demarcate the reasoning involved in hypothesis-preference from the deductive and inductive strategies used to evaluate hypotheses (Thagard 1981, p. 258), and there is serious doubt that Peirce developed a distinctive *logic* of discovery (Laudan 1980, p. 174; Foss 1984, p. 30; Brown 1988, p. 404). From whence, then, autonomy?

To avoid debating a position Peirce himself did not hold, the issue must be addressed with reference to his overall views on inference and validity. But when this is done, there remains little to secure the autonomy of abduction, since a close analysis of his writings reveals,

- (A) valid abductive reasoning does not sanction inference to a novel hypothesis (specifically, abduction is not inference *to* the best explanation);
- (B) the initial conceiving of a novel hypothesis is not the product of an *inferential* transition;
- (C) both discovery and preference embody special sorts *to practical* reasoning which justify, not belief, but adoption of a course of action;
- (D) every inferential phase of the abductive process can be analyzed in terms of inductive or deductive methods;
- (E) there is no abductive correctness that cannot be reduced to deductive or inductive validity.³

If these hold, as I shall argue they do, then "abductive" methods for generating and preferring hypotheses fail to be autonomous from either a logical or an epistemological point of view.

The result is significant, and not only out of concern for historical accuracy. Peirce's ideas about method have had a substantial impact upon the contemporary philosophy of science, and a proper assessment of their relevance demands clarity about their precise nature and strengths. If claims (A)-(E) are correct, then the *inferential* procedures characterizing abductive discovery do

not transcend deductive or inductive methods (Pera 1980, 1987, Zahar 1983), while the *heuristic* strategies that do are not rules of inference. As regards preference, abduction does not provide a unique means for conferring evidence, and there is doubt that Peirce took it as evidential reasoning at all; evidence and hypothesis-confirmation are a matter for the joint operation of deduction and induction. In particular, abduction is *not* inference to the best explanation, in which case its relevance does not depend upon the plausibility of that, admittedly controversial, mode of reasoning (see note 2).

Apart from impact, Peirce's theory of abduction carries an independent interest, and not just for the reasons usually given, i.e., that discovery involves rational processes, or that abductive reasoning is distinct from deduction and induction. If the following interpretation is accurate, then the study of scientific method ought not be exhausted by scrutiny of evidential, intra-theoretical, and inter-theoretical relations among propositions; it must also concern itself with the *conduct* of inquiry and, consequently, with procedures for evaluating inferences to practical directives. It is the *practical* character of abductive reasoning, specifically, its inference *from* a "best explanation" *to* a directive, that makes Peirce's account of scientific method both novel and instructive.

2. INFERENCE AND VALIDITY

According to Peirce, an inference is "the conscious and controlled adoption of a belief as a consequence of other knowledge," (CP 2.442, 2.144, 5.109) which "consists in the thought that the inferred conclusion is true because *in any analogous case* an analogous conclusion *would be* true" (CP 5.130). Its aim is "to find out, from the consideration of matters and things already known, something else that we had not known before" (MS 628:4), thus, to increase our grasp of truth. The occurrences of 'as a consequence of' and 'because' in these passages not only indicate a premise-conclusion relation, but carry a *causal* significance since inference "produces" or "creates" a belief in the mind of the reasoner (CP 2.148). A *belief*, in turn, is described as a "holding for true," or "any kind of holding for true or acceptance of a representation" (NEM 4, 39-40), and "to say we really believe in the truth of any proposition is no more than to say we have a controlling disposition to behave as if it were true" (MS 652:15).⁴

These characterizations pose a problem, for Peirce also contended that abduction is not a matter for belief (CP 5.589), that belief is out of place in science (CP 5.60, 1.635), and that non-truth-valued items like questions can follow logically from antecedent information (MS 293:37). Conveniently, he also spoke of inference in terms of acceptance, a broader type of "favorable attitude towards" a proposition with which positive belief was sometimes contrasted (MS 873:23). While not productive of a full-fledged belief, an abduction still results in a type of acceptance, though it is another matter to determine what particular modes of acceptance there are. Recourse to this broader notion is essential in achieving a general definition of inference, though it cannot yet be ruled out that all acceptance is ultimately belief of one sort or another (CP 7.102).

Three steps are essential to any inference: colligation, observation, and judgment (MS 595:35). Inference begins with *colligation*, the conjoining of distinct propositions and asserting the whole

(CP 2.442-3, 5.579). One then deliberately contemplates the colligated data (MS 595:30, CP 7.555) which, in turn, results in an observation that some proposition *C* will hold if the single colligated premise *P* does. Next follows a *judgment* which embodies first, an acceptance that what is observed in the premise yields, by following a rule, the proposition *C* and, second, an acceptance of *C* itself (CP 7.459, 2.444, 1.606). Control is exercised over colligating, contemplating, and both phases of judgment, but not over the observing (CP 7.555).

Because it is controlled, an inference can be subjected to rules or norms indicating what one would be warranted in accepting. Since norms are appropriate only in relation to ends (CP 5.594), then following the appropriate inference rules helps us to realize the end of reasoning, namely, acquisition of truth, a goal which we are justified in both presuming can be reached and, therefore, in pursuing (MS L75:271). An inference is *valid* if it is conducive to such acquisition, more precisely, if it follows a method (norm) which (i) it professes to follow, and (ii) has the truth-producing virtue it is supposed to have, i.e., *qua* being an inferential method of one of the three elementary kinds (CP 2.780).⁵ In this way, Peirce effectively extended the concept of validity beyond both the deductive ideal of truth-preservation and the inductive standard of likelihood, to that of *truth-productivity*. We must do so if we hope to expand our grasp of truth, he thought, for deductive and inductive reasoning are insufficient in their generative capacities.

There are three ways in which inferential methods can be truth producing: a method is deductively valid insofar as it invariably (necessary deduction), or very probably (probable deduction), yields truth from truth: inductively valid if by following it we approximate to the truth in the long run, and abductively valid insofar as it leads to truth if truth can be attained at all (CP 2.781, 5.161). Analogously, one might refer to the *assurance* that a given method is truth-producing:

the distinction that is undoubtedly of highest importance . . . is that which consists in the *nature of the assurance* being different. (MS L231:56)

Two dimensions of assurance are invoked at this point; *security* and *uberty*. Security is a measure of the confidence that we are avoiding falsehood in the inferential transition, while uberty reflects the productiveness in knowledge gained, i.e., that we are increasing our grasp of truth. While we lose in security in moving from deduction to induction and, again, in going to abduction, we gain in uberty at each step (CP 8.384-8).⁶

Yet these distinctions do not, by themselves, establish the autonomy of abduction. The matter cannot be settled by agreeing that there are inferences, inferential patterns, or methods of reasoning which are abductively valid. Perhaps *all* "logically good" inferences or inference methods are, since abductive goodness is but the weakest assurance of having reached truth. What must be shown is that there are some modes of valid inference which can be justified *only* abductively, for unless there are, Peirce's claim to have unearthed an irreducibly third mode of reasoning cannot be substantiated. The claim for autonomy requires a supporting existence proof.

3. DISCOVERY, PREFERENCE, AND ABDUCTIVE FORM

Recalling that Peirce understood 'abduction' to encompass logical-mechanisms for both generating hypotheses and selecting certain of them for further examination, let us speak of "abductive-discovery" and "abductive-preference" respectively.

He supplied different models of abductive form, the most characteristic being that presented in his 1903 lectures on Pragmatism:

(F1) (1) The surprising fact, C , is observed;

(2) If H were true, C would be a matter of course.

Hence,

(3) There is reason to suspect that H is true.⁷

At one level of abstraction, the premises accurately portray scientific procedure; research typically begins with a problem (puzzling or surprising phenomenon) and aims at a solution in terms of an explanatory hypothesis. Yet, from the standpoint of valid reasoning (F1) is problematic. There are any number of "wild" hypotheses that would explain why I am now reading this paper, but that alone does not provide reason to think that any particular one is true (Achinstein 1970, p. 92). More is required to legitimately conclude, select, or make plausible a hypothesis than what (F1) reveals and, if anything, the "logic" of abduction should bring this out.

Peirce did offer more. Keenly aware that there are numerous hypotheses which would explain any given fact were they true (*CP* 5.591), he viewed it as a "serious problem" whether a given hypothesis should be entertained at all (*CP* 6.524). Using the label of 'economy' (*MS* L75:284, *CP* 7.218-23), he claimed that the abductive inference to hypothesis H is justifiable only if H is economical, or, better, more economical than competing hypotheses. If so, an accurate rendition of abductive form needs a further premise, viz.,

(F2) (1) Some surprising fact C is observed.

(2) If H were true then C would be a matter of course.

(3) H is more economical than the envisioned competitors.

Hence,

(4) There is reason to suspect that H is true.

This form qualifies as a type of inference to the best explanation (Achinstein 1980, p. 126) but, as such, is more suitable as a format for abductive-preference than abductive-discovery. Not only

does the hypothesis itself fail to be the conclusion, it appears twice in the premises, once as an antecedent and once as a subject of predication. Given Peirce's causal account of inference, conception of *H* could not originate as a *product* of an (F2)-inference (or, for that matter, of an (F1)-inference), nor can the reasoner's transition from its premises to its conclusion be the moment of creative insight (Frankfurt 1958, 594). This is especially apparent given the added premise, for the reasoner could not legitimately accept it without a considerable familiarity with the hypothesis.⁸

4. ABDUCTIVE-DISCOVERY AND THE GENERATION OF THE PREMISES

(F2) represents a later stage of abductive thinking; before selecting a hypothesis one must first come up with the surprising fact, formulate explanatory conditionals, and assess rival explanations. Noting that Peirce took *scientific* abduction to include *all* the operations whereby theories are engendered (CP 5.590), we will first inquire whether the autonomy of abduction is to be located in its earlier stages,

Abductive thinking begins by juxtaposing the unfamiliar with the familiar (MS L75:286-7, CP 7.188). The claim that a phenomenon is *surprising* is intelligible only against a body of background expectations, for an isolated fact, not contrary to what is expected, calls for no explanation at all (CP 7.192-201). The *judgment* that a phenomenon is surprising is subsequent to the observation that it is contrary or improbable given what is expected (MS L75:177, CP 2.776, 7.188-200), hence, in need of explanation. But this judgment itself results from an inference to a novel proposition, viz., it represents a "discovery" with which scientific knowledge begins (CP 7.188).

What *kind* of reasoning is involved? Colligation *qua* conjoining, is deductive. Observation of what is contrary or improbable given what is expected, comes by focusing upon the relations between premises and conclusion. To "see" that P is contrary to Q or improbable given Q, is to realize that either implies or makes likely $\sim P$, in which case the observation underlying a judgment of contrariety is exactly the sort that typifies deduction. Hence, the inference that the phenomenon *is* surprising, in want of explanation, appears to be deductive.

It is upon judging that the surprising fact C would be explained by a novel hypothesis H that the more familiar phase of creative thinking emerges. A breach of expectation stimulates a demand for explanation (CP 7.191) which, if successful, results in acceptance of an explanatory conditional. However, it is doubtful that Peirce held the initial *conceiving* of H *qua* antecedent to arise as a result of inference. He wrote that the abductive suggestion comes to us "like a flash," of its being an act of "instinctive insight" tending to make us guess correctly nature's laws (CP 5.604, 5.181), of abduction itself as being "neither more nor less than guessing" (MS 692:24), and of a guessing as being an instinctive power (CP 6.491, 7.48). On the other hand, he emphasized that one guesses on the basis of other information (MS 692:27-36, 595:37); we separate "reasonable" guesses from poor ones (MS 873.11), and given that there are "trillions" of possible hypotheses to explain given facts, we need the operation of rational constraints warding us away from idle and fruitless guesses (CP 5.172, 5.591, 7.38). Hypotheses are not generated

fortuitously; guessing is an inferential process, as such, under our control and not a purely instinctive affair (*MS* 475:20, *CP* 7.48, 6.476).⁹

Peirce attempted to resolve this tension between instinct and control in his 1903 Pragmatism lectures where he distinguished between emergence of the novel hypothesis and inferential acceptance of its explanatory role. He claimed that the initial awareness of the hypothesis comes with the observation of the colligated whole by means of an uncontrolled insight into the world of ideas, i.e., into what he called "Third-ness" as given in perception (*CP* 5.150-212, 7.198). The novel conceiving of any instance of premise (2) of (F2), for example, is *caused* by prior cognitions, its content is "suggested" by the facts, but not everything suggested is *inferred* from cognition of the facts:

There are, as I am prepared to maintain, operations of the mind which are logically exactly analogous to inferences excepting only that they are unconscious and therefore uncontrollable and therefore not subject to criticism. (*CP* 5.108)

However, while such operations are "associational suggestions of belief," not "inferences" (*CP* 5.441, *MS* 1134), they can still be rule-governed methods of originating hypotheses. Though Peirce offered little by way of a *logica docens* in this regard, he was very much concerned with heuristics of discovery (*CP* 2.105-7, *NEM* 4:196), as evidenced by his account of theorematic reasoning, his insistence on the "diagrammatic" character of mathematical thinking (*NEM* 4:46-9), and his emphasis upon analogical thinking in the expansion of knowledge:

Nothing unknown can ever become known except through its analogy with other things known. Therefore, do not attempt to explain phenomena isolated and disconnected with common experience. (*MS* L75:286)

An explanatory conditional, for example, might be generated by applications of the following Newtonian rule; a surprising fact *C* is like another fact *C'* which is explained by hypothesis *H'*; thus, an *H'*-like hypothesis *H* might explain *C*. As with other sorts of heuristic strategies, use of this rule can stimulate those novel conceptions which, in turn, spawn new inferences and the development of theories.¹⁰

According to this view, heuristic strategies are not rules of *inference* appropriate to controlled reasoning after novel conceptions have occurred, for inference requires seeing that the conclusion is justified (*MS* 293: 7-8). While they *are* rules governing transitions from one conception to another, they are typically stated in terms of what to "look for," how to "express" something (Langley et al., 1987, p. 53), what to "combine" or "find" (Thagard 1988, p. 202), not what to "infer." They are aids in locating novel ideas, strategies for discovery, hence, *practical* directives, but not formulae specifying what we are entitled to accept. Nor do they correspond to principles for conferring epistemic warrant, in which case their epistemological significance is of a different order from that characterizing valid inference forms. In strict Peircean terms, the emergence of hypotheses is not a matter of *inference* and, therefore, not a matter of a unique form of inference.¹¹

As indicated in Section 2, an inference occurs only when the reasoner exercises self-control in judging that the conclusion is acceptable on the basis of the information one began with. In itself, such self-control is purely "inhibitory" and "originates nothing" (*CP* 5.194), that is, the creative moment lies with the instinctive observation that given what one already knows, *H* will explain *C*. The correlated guess, the "deliberate acceptance" (*MS* 451:18), is the reasoned adoption of the explanatory conditional, hence, it is a result of inference.

This acceptance can be justified deductively; the very phrase "as a matter of course" in premise (2) indicates a degree of intuitiveness, a point underscored by the fact that explanatory conditionals convey a connection of necessity or high probability (*CP* 8.231 and 7.36). This claim is strengthened by Peirce's contention that once a hypothesis has been identified, it is a matter of deduction to establish further conditionals in which the hypothesis is the antecedent and predictions are the consequents (*CP* 7.115n and *MS* 473:9-10). Ideally, among these predictions will be those whose very "incredibility" makes their consequents similar to the surprising fact *C*, in which case the inferential acceptance of the explanatory conditional results by a *deductive* transition from the background assumptions.

Concerning the third premise of (F2), finally, several considerations must be taken into account before a hypothesis may be "chosen" for further examination (*CP* 7.219). Obviously, it must be explanatory if true and testable (*CP* 7.220), but under the heading of 'economy' Peirce also included (a) the cost (in time, money, and effort) of testing the hypothesis (*CP* 6.533, 7.230); (b) the intrinsic value of the hypothesis in terms of its "naturalness and "likelihood" (*CP* 7.223); (c) the fact that the hypothesis can be readily broken down into its elements and studied (*MS* 692:33); (d) the hypothesis' simplicity (i.e., that it is more readily apprehended, more facile, more natural or instinctive) (*MS* L75:286, *CP* 6.532, 6.477); (e) the breadth of the hypothesis or the scope of its predictions (*MS* L75:241; 457:37); (f) the ease with which the hypothesis can be falsified (*MS* L75.-285); (g) the testability of the hypothesis by means of severe tests based on "incredible" predictions; and (h) the hypothesis' analogy with familiar knowledge (*MS* 873:16).

The evaluations that emerge are *comparative*, often phrased in terms of *preference*, in which case a judgment of economy is itself comparative, as already suggested (*CP* 7.220-231, 2.786, *NEM* 4.37-8, *MS* L75:285-6, and *MS* 475.37). The underlying inferences are best scrutinized by means of the standard logic of preference in which deductive considerations abound, especially in eliminating hypotheses by means of disjunctive syllogisms (*CP* 7.37). But the reasoning to the premises of any such deduction are likely to be inductive, in the mode of qualitative inductions (*CP* 2.759, 7.209-217). How do we know, for instance, if *H* is more cheaply testable than *H'*? We consider the kind of hypothesis that *H* is, and based on our familiarity with past testing procedures, we reason inductively that *H* is the kind of hypothesis that could be examined more cheaply, more quickly, etc. Similar inductive considerations would permeate decisions based upon the other criteria as well.

Having argued that the reasoning used in *generating* the premises of (F2) is either deductive or inductive, there are grounds for concluding that the alleged irreducibility of abduction cannot be found therein. In particular, it cannot be anchored in the process of abductive-discovery. Accordingly, our examination of autonomy must return to abductive-preference.

5. THE PROPER FORM OF ABDUCTIVE-PREFERENCE

A more rigorous scrutiny of (F2) is needed to ascertain whether a unique kind of reasoning is manifested in abductive-preference. There is an initial problem in that its conclusion is still too strong if interpreted as conferring a high degree of probability to the hypothesis *H*, and too weak if the probability is low. At any rate, probability is not the quality which abduction aims at securing:

By its very definition abduction leads to a hypothesis which is entirely foreign to the data. To assert the truth of its conclusion ever so dubiously would be too much. (MS 692:26, and see CP 2.102)

Exploring other conclusion-types, Peirce came to favor the view that abductive-preference allows, at best, an inference to the "plausibility" of the hypothesis:

By Plausible, I mean that a theory that has not yet been subjected to any test, although more or less surprising phenomena have occurred which it would explain if it were true, is in itself of such a character as to recommend it for further examination or, if it be *highly* plausible, justify us in seriously inclining toward belief in it, as long as the phenomena be inexplicable otherwise (CP 2.662)

Thus, a hypothesis is plausible if it is both explanatory and of a character to recommend it for further examination (hence, testable, though untested), noting that plausibility comes in degrees (see also CP 8.223, 6.469, 6.480-8). If it is plausibility, not truth, that we mean to establish in hypothesis-preference, then the abductive conclusion should be "*H* is plausible" (MS 652:16, Thagard 1981). This is fine so long as the comparative nature of judgments of economy is reflected, i.e., the warranted judgment is that *H* has a higher degree of plausibility, hence, more to recommend it, because it is more economical. Making this explicit yields the following form:

- (F3) (1) Some surprising fact *C* is observed.
- (2) If *H* were true then *C* would be a matter of course.
- (3) *H* is more economical than its envisioned competitors.
- Hence,
- (4) *H* is more plausible than its envisioned competitors.¹²

Given what Peirce meant by 'plausible', this form of abduction-preference is more faithful to his statement that the purpose of abduction is "to recommend a course of action" (MS 637.5).

But a striking feature of (F3) and the variant whose conclusion is "*H* is plausible," is that they seem *deductively* valid; how could *H* fail to be more plausible if it is explanatory, testable, and

more economical than its competitors (Achinstein 1970, p. 101)? One of Peirce's strategies for determining the presence of deductive validity is to ask whether the relevant leading principle is necessarily true, in this case,

(LI) If H is the most economical explanation of surprising phenomenon C , then H is more plausible than any of its competitors.

Given Peirce's definitions, this conditional appears to be a necessary truth. Being the most economical explanation, H is obviously explanatory, testable, and therefore -- assuming considerations of economy to be the proper basis for deciding the pre-testing merit of a hypothesis -- to be recommended for further examination. Even when H has comparatively little to recommend it, if there are no better competitors we are nonetheless justified in putting it to test. In short, the judgment seems irresistible that insofar as (F3) is a valid pattern at all, it is *deductively* valid.

It does not follow that it is permissible to deductively infer H itself from the (F3)-premises; no standard deductive (or inductive) canons sanction such a conclusion. Yet, an inference to H might have been what Peirce had in mind in insisting that abductive validity is unique, and, if so, (F3) would not be what he envisioned as the proper form of abductive-preference after all. This possibility must now be explored.

6. ABDUCTIVELY INFERRING THE HYPOTHESIS

Peirce frequently spoke of a hypothesis *itself* being "adopted" as a result of an abduction, albeit "problematically" (CP 2.777) or "on probation" (MS 873:22). A special mode of acceptance is operative here (MS 638:5), a "probationary" mode which, falling short of belief in the hypothesis (CP 5.60, 5.589) is still a favorable attitude towards it (MS 873.23). It is the third and least assured of attitudes sanctioned by the basic types of reasoning; full belief or positive assertion is warranted in deduction (MS 473:17-18), provisional acceptance in induction (CP 2.731; 5.591), and probational adoption in abduction. As such, the correct pattern of abductive-preference might well be the following extension of (F3):

(F4) (1) Some surprising fact C is observed.

(2) If H were true then C would be a matter of course.

(3) H is more economical than the envisioned competitors.

Hence,

(4) H is more plausible than its envisioned competitors.

Hence, probationally,

(5) *H*.

Judging from appearances, we have returned to a type of inference to the "best" explanatory hypothesis, and, with it, to a form that is not readily classified as deductive or inductive. For Peirce, the qualifier 'probationally' indicates that justification belongs not to the sort of acceptance warranted by valid deductive or inductive reasoning, but to probational adoption only, where the latter is the acceptance which culminates the entire abductive process. That (F4) is not a valid deductive or inductive schema is also suggested by the fact that instances of the leading principle,

If *H* is more plausible than its envisioned competitors then *H*.

not only lack necessity but are typically false. The same is true of any conditional linking the premises of (F4) to the probability of *H*, for there is no assurance of approximating truth in the long run by its means. On the surface, then, it would appear that *insofar as* (F4) is a "valid" at all, its validity is of some third sort, perhaps an irreducible "abductive" validity.

Have we our desired existence proof? No, not until we clarify what sort of "acceptance" probational adoption might be. While Peirce was reluctant to say that abduction results in *belief*, he wrote that probational adoption involves some sort of favor extended to the hypothesis. Perhaps the attitude stands to plausibility as belief does to truth, i.e., it is to hold *H* to have, not truth, but a comparatively high degree of plausibility (*CP* 2.776). This is one way to interpret his claim that a hypothesis "... is accepted only problematically, that is to say, as meriting an inductive examination" (*CP* 2.786), or, again, the following passage:

It is one act of inference to adopt a hypothesis on probation. Such an act may be called an *abduction*. It is an act of the same kind, when a hypothesis is merely suggested as possibly worth consideration. For even then some degree of favor is extended to it. But when, in consequence of having found that a good many predictions based on the hypothesis have been verified, a man begins to have a positive *belief in* it, that is an act of inference of a totally different kind: it is an induction, or reasoning from a sample. (*MS* 873.23)¹³

Given the normative character of plausibility, accordingly, accepting a hypothesis as plausible is not to believe, rather, that it ought to be pursued. The problem to be faced, however, is that if this were so, then the transition from (4) to (5) in (F4) would be redundant inasmuch as it would duplicate what one is already warranted in doing in moving to step (4). The result would be to bring us back to (F3) and a straightforward deductive construal of abduction.

Keeping probational adoption of *H* distinct from the beliefs that *H* that *H* is plausible, or that *H* ought to be pursued, leaves the possibility that it is a practical attitude of willingness, resolve (*CP* 5.538), or resolution (*CP* 1.592) to submit *H* to further test. This would amount to a more literal reading of his previously-noted claim that the purpose of an abduction is to "recommend a course of action," that is, endorsing a recommendation to examine *H* is, just that, a

“recommending,” yielding a clear sense in which the abductively extended “favor” is distinct from belief. Recommending or resolving to examine *H*, though an explicit “endorsing” of a line of conduct (*CP* 5.538), is, at the same time, a favorable attitude towards *H* itself - not the “controlled and contented” disposition to act that belief in *H* would be (*NEM* 4.249), only a readiness to submit *H* to testing, an attitude not accorded other rejected hypotheses.

There is still a difficulty; if abductive-preference is a special type of practical reasoning, which culminates not in an acceptance of *H per se*, but in an endorsement of a course of action, then there is no distinction between *probationally adopting H* and *recommending a further examination of H*. Whatever warrant is conferred by the premises of (F4), accordingly, reduces to the warrant for a decision, and, in strict terms, the proper conclusion is not *H*, but a claim recommending *H* for further examination. Therefore, abduction confers no epistemic warrant upon the assertability of *H*, and (F4) turns out to be a misleading representation of pre-testing selection.

This somber assessment of (F4) is based on the inability to find a straightforward doxastic interpretation of probational adoption within Peirce's writings. It can be supported, however, by appeal to his pragmatic criteria for identifying conceptions, for these dampen even further prospects of demarcating acceptance on probation from practical resolve. Belief in a proposition establishes behavioral habits and anchors expectations about one's responses to its presumed consequences in a way that a mere decision to test it does not. An investigator might have good grounds for thinking *H* to be worth testing, yet have very good inductive grounds for being skeptical of *H*'s success, hence, be justified in granting *it* very little favor, even to the point of believing its negation instead. Abductive-preference favors bold, though unlikely, conjectures, and inductive warrant is no measure of the plausibility it confers.

Admittedly, Peirce's texts are not decisive; the foregoing is itself a “hypothesis” as to what he might have meant. The proper conclusion might be that he lacked a clear and consistent picture of what is to be inferred in an abduction, or, for that matter, a clear distinction between belief and other practical attitudes.

7. ABDUCTION-PREFERENCE AS PRACTICAL INFERENCE

If (F4) fails, yet (F3) offers little hope for the thesis of autonomy, what other form of abductive-preference can we look to? Perhaps Peirce's insistence that abduction aims at recommending a course of action deserves a closer look. For instance, how is a recommendation sanctioned once we have established that *H* is more plausible than its competitors? From his definition of plausibility, we would immediately have,

- (a) There is reason to suppose that *H* is worth examining further.

But this falls short of an explicit directive; if a plausible theory has a character to “recommend it for further examination,” what is needed is something stronger than a claim that there is “some” reason, or “*prima fade*” grounds for so doing (Curd 1980, p. 214, and Achinstein 1987, p. 433).

To capture the sense in which the hypothesis "merits" inductive examination (*CP* 2.786, 8.223), a normative is more forceful:

(b) One ought, insofar as one desires an explanation of *C*, to examine *H* further.

or, alternatively,

(c) It is permitted, insofar as one desires an explanation of *C*, to examine *H* further.

Given the end of gaining truth, either of these is a proper manner of asserting justification for hypothesis pursuit, since "ought" has no meaning except relative to an end (*CP* 5.594).

Although normatives like (b) or (c) can be used to *support* a practical directive, e.g., a recommendation, neither is *identical* to a directive. To make explicit the sense in which an abduction "recommends," something like the following must be sanctioned:

(d) *H* is recommended for further examination.

or, more carefully,

(e) It is recommended, for one who desires an explanation of *C*, to further examine *H*.

Obviously a recommendation is not a truth-valued declarative (Castaneda 1975, Belnap 1990); in particular, (e) must not be confused with a declarative report to the effect that someone or other has recommended that *H* be further examined. Again, a recommendation can be phrased interrogatively, and since Peirce often claimed that the hypothesis should be asserted only as an "interrogation," implying by this that the hypothesis merits testing (*MS* 692:26), the abductive conclusion might be,

(f) Why not pursue *H*?

addressed to oneself or others. Or, phrasing the hypothesis itself interrogatively (say, through the appropriate "wh-movements" of the grammarians), practical import can also be conveyed by,

(g) *H*

together with appropriate stress. *Each of (d)-(g) are suitable Peircean forms of practical directives*, though, adhering to the letter of what was said about the aim of scientific abduction, the schematic (e) will be treated as canonical.

A strict reading of Peirce suggests that abductive-preference requires an explicitly "practical" inferential pattern formed by adding to (F3) a second practically-oriented conclusion. What we come up with is an argument form that qualifies not as inference *to* a best explanation. But, as inference *from* the fact that a certain hypothesis is the best explanation to a directive:

(F5) (1) Some surprising fact *C* is observed.

(2) If *H* were true then *C* would be a matter of course.

(3) *H* is more economical than its envisioned competitors.

Hence,

(4) *H* is more plausible than its envisioned competitors.

Hence,

(5) It is recommended, for one who desires an explanation of *C*, to further examine *H*.

To capture the normative aspect of plausibility, the actual chain of reasoning might also include either (b) or (c) between steps (4) and (5). Perhaps Peirce had something close to (F5) in mind when he wrote that abduction "commits us to nothing. It merely causes a hypothesis to be set down upon our docket of cases to be tried" (*CP* 5.602). The phrases "to be set down" and "to be tried" more closely reflect a decision concerning future action, thus, a *resolve* about how to act. To this extent, abductive-preference is a species of practical reasoning.¹⁴

8. ON THE VALIDITY OF (F5)

Before investigating how (F5) is valid, if at all, we must reconsider the Peirce's notion of validity. Because he defined it in terms of *truth-productivity*, there is no obvious format for validating inferences to apparently non-truth-valued items such as recommendations, imperatives, interrogatives, and the like. One might attempt to analyze (F5)-validity by appeal to the truth-values of the performance propositions correlated to the inferred recommendations, noting that propositions can be questioned, commanded or recommended (*NEM* 4:248). Yet, this approach affords little hope; the conclusions of *valid* ampliative inferences can be false when their premises are true, and in particular, a recommendation can be appropriate given the information supplied by the premises even though its corresponding performance proposition is not only false but incapable of being inductively justified. How else might (F5) be brought within the realm of valid inferences?

A generalization upon the notion of truth-productivity is required, and there are at least two ways to achieve it, neither of which require the (F5)-conclusion to be truth-valued or dependent upon the truth of a correlated proposition. The first generalizes the idea of *productivity* by relying on a strict reading of Peirce's "justification" for abductive inference. Thus, we cannot hope to attain rational explanations, reach truth, or know anything of positive fact without abduction, that is, unless we both generate hypotheses and select certain of them for further testing (*CP* 2.777-786, 5.603, 5.17, 7.219). The reason (F5)-inferences are valid is not that their conclusions are true if their premises are -- the truth "produced" is never that of the conclusion's -- but because

accepting their conclusions is the only way we can uncover the truth of any of the preferred hypotheses which happen to be true.

There are two drawbacks of this approach, however. In the first place, it leaves unanswered the question about what the semantic value of the (F5)-conclusion itself is. While directives are not truth-valued, presumably those that can be "validly" derived from true premises of an (F5) sort differ in semantic status from the undesirable recommendations of *unexplanatory* or *least economical* hypotheses. Secondly, it sacrifices a uniform account of abductive validity. Abductive thinking extends beyond the search for plausible explanatory theories, indeed, every decision represents a hypothesis about what is best to do in the circumstances (see Note 3). Insofar as such thinking is justifiable, abductive inferences to directives having nothing to do with the search for truth must be allowed, and there seems no way to construe their validity in terms of truth production.

The second interpretation restricts relevant production to the (F5)-conclusion while preserving a uniform perspective on abductive correctness. It does so by generalizing upon the idea of truth, yet retaining Peirce's formula that an inference is valid "if it possesses the sort of strength that it professes and tends toward the establishment of the conclusion in the way in which it pretends to do this" (*CP* 5.192). Thus, a method can also be valid if it has the virtue of *establishing* conceptions having a (semantic) value other than truth, viz., a question or recommendation can be said to be *legitimate* or *appropriate* given the information in the premises, and just as "*P*" follows necessarily from "*P* is true," so a recommendation "*R*" follows necessarily from "*R* is appropriate." A condition fixing appropriateness is as follows:

(L2) A recommendation to further examine *H* is *appropriate* for one who desires an explanation of *C* iff one is permitted (or, one ought), so far as an explanation for *C* is desired, to examine *H* further.

That is, truth of a qualified normative necessarily determines the appropriateness of a corresponding directive and, consequently, supports the directive itself. Considerations about which recommendation is appropriate *all things being considered* might yield a different judgment if overriding normatives sanction a different recommendation; examining *H* might be appropriate given certain ends but not other, even higher, ends.¹⁵ Also, the workability of (L2) requires that there be some means of determining when a normative is true and when one is overriding, illustrating that a scrutiny of scientific methods cannot be separated from normative and practical concerns. Peirce's teleological basis for normative truth yields a rough, though flexible, formula for fixing normative truth and overridingness, and preserves the realist assumption that whether *H* ought to be examined further is an objective matter insofar as *H* advances the pursuit of truth. Retained is the distinction among the three sorts of validity; deductive validity guarantees passage from truth to a "preferred" semantic value, whether truth or appropriateness, inductive validity yields the preferred value in the long run, while abductive validity secures the preferred value if anything does.

I am claiming that a uniform treatment of abductive reasoning requires the broadened conception of validity characterized in this second interpretation. But it carries a price. The very problem that plagued (F3) resurfaces: why isn't (F5) *deductively* valid? If *H* is the most plausible

hypothesis, there can be no doubt but that one who desires an explanation of *C* is permitted, *qua* investigator, to examine it further, for the move from step (4) to (5) in (F5) seems an iron-clad guarantee of securing the preferred semantic value of appropriateness. This follows directly from (L2) and the normative component in Peirce's construal of plausibility. Through their combined effect, (4) necessitates the claim that the recommendation to further examine *H* is appropriate, and from this, in turn, the recommendation itself necessarily follows. By transitivity of the deductive linkage, therefore, the inference from (4) to (5) is itself a matter of necessity. Since (5) just is the ultimate conclusion of (F5), the latter is a deductively valid form.

At this juncture, each of the claims A-E listed in Section I has been defended. If the argumentation is cogent, then Peirce's writings provide no grounds for the existence of an irreducibly third type of argument correctness. This by no means denies the significance of his discussion nor undermines the role of abductive reasoning in scientific inquiry. The proper conclusion is that the value of Peirce's account does not derive from the alleged autonomy of abduction, rather, from its emphasis upon the overtly practical phases of scientific reasoning.¹⁶

NOTES

1. See *CP* 5.146 where the claim of irreducibility is made. Peirce denied that there was any need to recognize a fourth category of reasoning. In 1911 he wrote, I have constantly been on the alert for a fourth kind of reasoning, and have yet never found the least vestige of any. . . I think myself entitled to presume, for the present, that there is no such fourth form. (*MS* 856:6-9) He stressed that argument by analogy is a mixture of the three elementary kinds (*CF* 2.733, 7.98) while other familiar types of argumentation, e.g., statistical deduction or qualitative induction, are species of deduction and induction respectively. All references to Peirce's writings are from the *Collected Papers of Charles Sanders Peirce*, Harstshorne, C., Weiss, P., and Burks, A., (eds.), (Harvard University: Cambridge, 1931-58): *The New Elements of Mathematics*, Eisele, C. (ed.), (Mouton: The Hague, 1976); and the Houghton Library Peirce manuscripts numbered in accordance with the R. Robin's *Annotated Catalogue of the Papers of Charles S. Peirce* (Massachusetts, 1967), with the page numbers being those of Ketner's. These are abbreviated, respectively, by '*CP*', '*NEM*', and '*MS*'.

2. I will not address the claim that a logic of discovery is autonomous in that there is no sharp distinction among the methods or reasons employed in selecting hypotheses for further test and those used in evaluating hypotheses (see Thagard 1981, and also Nickles 1985, p. 183, who attributes to Peirce this form of what he calls the "divorce thesis"). Moreover, the Peircean irreducibility thesis is distinct from variants of what Nickles calls the "per se thesis," viz., that methods of generation *per se* are capable of conferring justification upon a hypothesis in a way different from recognized deductive and inductive procedures (Nickles 1985, p. 183). There is an interpretation of Peircean abduction that does imply the *per se* thesis, namely, as a type of inference to the best explanation (see Sections 3, 5 and 6). But this is not a correct interpretation of his mature view (Section 7), and if I am correct, abduction is not saddled with the controversy that surrounds inference to the best explanation (Harman 1965, 1986, Boyd 1984, Van Fraassen 1989). Nor is the irreducibility claim - that there are *correct* modes of abductive reasoning which are neither deductively nor inductively valid - wedded to a construal of abduction as inference to an explanatory hypothesis. Peirce emphasized that abductive validity has nothing to do with probability (*CP* 2.102), though, increasingly, he refused to characterize even inductive validity in terms of probability (*CP* 2.781, 5.170; *MS* 293:20, 652:12), writing that induction "lends no definite probability to its conclusion" (*CP* 2.780), and "does not render its conclusion any more *probable* than it was before" (*MS* 475:8). By 1910 he labeled induction "verisimilar" or "likely" reasoning while abduction was dubbed "plausible reasoning" (*MS* 652:13-16).

3. Focus will be upon Peirce's post-1900 writings on abduction, for in 1898 he acknowledged that he had previously confused abduction (also called 'hypothesis,' 'retroduction' and 'presumption') with a species of probable inference (*NEM* 4:183 and see *CP* 2.102), and in 1910 wrote,

. . . the division of the elementary kinds of reasoning into three heads was made by me in my first lectures and was published in 1869 in Harris's *Journal of Speculative Philosophy*. I still consider that it had a sound basis. Only in almost everything I printed before the beginning of the this century I more or less mixed up Hypothesis and Induction (*CP* 8.227).

In his later writings, Peirce is increasingly clear that abductive thinking extends beyond the confines of scientific discovery, with "scientific retrodution" being but one species of a generic type of reasoning (*MS* 637:5-6). Thus, we are constantly engaged in creative thinking at some rudimentary level insofar as we seek solutions to problems, e.g., whenever we are thinking of what to do (Lieb 1988), what to say, or how to interpret and describe what we observe (*MS* 692:27-8). We are continually searching for "action-guiding" hypotheses in a manner similar to which the scientist is looking for explanatory mechanisms to guide research, though under differing time constraints (*MS* 637:5).

4. See also, CP 7.536, 2.444, 2.773, 4.53-5, 7.459, and *MS* L231:56). Every inference involves an acceptance of a conclusion which, though caused by an acceptance of the premises together with the reasoner's application of a general method or inference pattern, is rule-governed. The rule, in turn, is reflected in a *leading principle* of the inference (CP 2.588-9) forming part of an agent's *logica utens*(CP 2.186, 5.108, 5.130). For Peirce, a belief is a habit according to which one would act certain ways in given circumstances, specifically, according to the expected logical consequences of the proposition believed. Moreover, a belief is described as a habit one is aware of, satisfied with, does not struggle against, and which can be acquired merely by imagining situations and the behavior they call for (*MS* 873:24-26). See CP 5.538-45 where the connection to expectations is emphasized, and CP 1.645-6 where the relation to action is explicit. In CP 5.538-9, Peirce distinguished practical from theoretical belief, then preceded to rank the latter as a species of the former.

5. See also CP 2.153, 5.191, 7.444, *MS* 692:5, *MS* 628:4. In places, Peirce distinguished validity from *strength* (CP 5.192, 2.780) allowing that one argument can be stronger than another though both are valid, e.g., an induction based on more instances, a deduction with a more probable conclusion, or an abduction whose hypothesis has fewer competitors. In CP 5.192, he defined validity in terms of strength, writing that an argument is valid "if it possesses the sort of strength it professes and tends toward the establishment of the conclusion in the way in which it pretends to do this." However, he did not define strength, and in subsequent discussions the indicated measure of abductive strength is built into the proper form of abductively selecting hypotheses for further pursuit (Sections 3 and 4).

6. Peirce also argued that the three types of reasoning are differently *justified*, noting that "we are always justified in presuming, for the purposes of conduct, that our sole end may be reached" (*MS* L75:271 and compare *MS* 634:9-10), though here the emphasis is not so much upon the method as upon *use* of the method. Justification for inferring by way of a valid deductive method is justified because one is never led away from truth, and use of a valid inductive method is justified because its conclusion "is reached by a method which, steadily persisted in, must lead to true knowledge in the long run of cases of its application" (CP 7.207, 2.725-40). Peirce offered at least three distinct yet related justifications of abduction: (a) The human mind, having evolved under the influence of natural laws, has a "natural tendency" (instinct) to think as nature is (*MS* 876:5). Man's mind is attuned to the truth of things in order to discover what he has discovered (CP 6.476). (b) By sampling many abductions, we see that the results of reasoning abductively are beneficial (*MS* 637:6-9, CP 2.270; 2.786), for humans would not have survived without having knowledge and this requires abductive thinking (CP 5.603, *NEM* 4:320). (c) Abduction is

the only hope of attaining a rational explanation (*CP* 2.777, 5.145), of regulating future conduct rationally (*CP* 2.270), of attaining our purposes of reaching truth (*CP* 2.786) or of comprehending the universe (*MS* L75:272). Unless we reason abductively we cannot know anything of positive fact (*MS* 475:43, *CP* 5.603, 5.171, 7.219). At one point Peirce argued that all justification rests on deduction, insofar as abductive procedures can be justified inductively (*CP* 2.786) and inductive procedures rest upon deduction (*CP* 5.170). This is no reduction of validity-types: it is the *practice* of abductive reasoning that depends on inductive and deductive justifications, not the *validity* of the forms.

7. See *CP* 5.189-191. Conclusion indicators like 'hence', 'therefore', etc. must be understood as having both a causal and normative force in depicting inferences, indicating not only a transition from some acceptings (beliefs) to another, but that the speaker finds the inference permissible. In displaying inference forms, however, they serve only the latter function. See Harman 1986, pp. 1-10, for more on the distinction between reasoning and argument. (F1) is the focus of concern in Hanson 1958, pp. 85-90, and has tended to dominate the discussion of Peircean abduction ever since (though see Note 8 below). It is significant that by 1911, Peirce wrote; "I do not, at present, feel quite convinced that any logical form can be assigned that will cover all 'Retroductions'. For what I mean by a Retroduction is simply a conjecture which arises in the mind." (*MS* L231:55).

8. This fact undermines certain attempts to preserve (F2) as an originaive mode of inference. In considering a form similar to (F2), Peter Achinstein asks us to consider a *thought* that one might have to the effect that a hypothesis *H* is plausible because *H* provides an explanation given evidence and background information. It is possible, he writes, that I have this thought without having been previously acquainted with *H*, hence, that I first became acquainted with it in the course of making an inference to its plausibility (Achinstein 1970, p. 98, and see Blachowicz 1989, pp. 450-1 who concurs with Achinstein). The latter clause is correct, but the former violates Peirce's vision that we are reasoning to the plausibility of *H* *from* information about *H*, namely, that *H* not only explains what we want explained, but is a more economical explanation than its competitors. Hence, while it may be true to say that *we first* come to be acquainted with *H* "in the course of making an inference" to *H*'s plausibility, it does not follow that the first acquaintance with *H* *results* from an inferential transition. Instead, the inference presupposes our acceptance of various attributions to *H*. Addressing this issue, Douglas Anderson cautions against confusing "logical" with "temporal" priority: while the conditional premise containing *H* is logically prior to the conclusion, this does not mean that it is arrived at temporally prior to the conclusion, for the premise and conclusion may be "simultaneously arrived at." Thus, Peirce's canonical form in which the hypothesis already appears in the premises of abductive inferences does not preclude the latter from being "insightful and originaive" (Anderson 1986, p. 157). Anderson adds that "Peirce does not hold the ideas of insight and inference to be mutually exclusive with respect to abduction," citing the fact that Peirce described abduction as both instinctual and inferential within the span of a single lecture (p. 155). The hypothesis is not arrived at independently of its explanatory role, but Anderson overlooks Peirce's view that inference generates acceptance of the conclusion only if there is a causal *and* temporal relation in the movement from premise to conclusion.

An inference is a passage from one belief to another: but not every such passage is an inference... In inference one belief not only follows *after* another, but follows *from* it. (*CP* 4.53, Peirce's emphasis)

The plausibility of claiming "simultaneous" awareness of premises and conclusion fades even more dramatically when it is understood that a judgment of comparative economy must itself be based upon a fairly extensive acquaintance with the hypothesis' merits (*CP* 7.218-232). Hence, if *H* occurs as an antecedent of a premise of an (F2)-inference, then *that* inference cannot be the causal process that generated the first thought of *H*. The more reasonable conjecture, therefore, is that (F2) is the canonical form for abductive-preference, not discovery.

9. In discussing his paradigm example of abduction, Kepler's discovery of elliptical orbits, Peirce suggested that accepting the conditional premise is itself the product of inference (*CP* 2.96,1.72-4).

10. Not every case of belief causing belief is inference, even if it occurs by following a rule (*CP* .53, *MS* 293:7-8), e.g., the inference-like "associational suggestions of belief." See also *CP* 7.202, 2.776, and 5.171. In discussing the Associational psychologists Peirce wrote:

The action by which, an association having once been established, that act by which in accordance with it, one idea calls up another they called *suggestion*. I shall use this terminology . . . (*MS* 318:38).

Suggestion is treated as a genus of which inference is only a species (*CP* 7.443, 1.606), and it must be noted that he defined 'abduction' as the first *adoption* of a novel hypothesis (*CP* 7.202, 6.525), not as the first *conceiving* of it. While every inference is tacitly rule-governed, the agent's initial "irresistible" acceptance of it may be tempered by subsequent evaluation of it by the norms of reasoning one accepts (*CP* 1.606) Thus, we can distinguish among (i) initially conceiving that one might reason in a certain manner (the creative observation), (ii) actually inferring in that manner (guessing), and (iii) evaluating the reconstructed inference (cf., Achinstein 1980, p. 121 and Curd 1980, p. 203). I have also discussed these issues in Kapitan 1990.

11. Langley et al 1987, p. 14, classifies the heuristic procedures of hypothesis generation as "inductive" since they search for general theories from *finite data*, though it points out that Newton's derivation of the inverse square law of universal gravitation was a deductive process that utilized an algebraic heuristic (pp. 54-7). Zahar 1983 champions the deductivist approach to hypothesis discovery, viewing the theoretical innovations of Maxwell's and Einstein's as well as that of Newton's as embodying deductive processes. Pera 1980, 1987, on the other hand, finds the invention of hypotheses to be inductive, though, equating inductive with ampliative, he does not view discovery in terms of establishing an explanatory conditional. Inductive systems of discovery are also discussed in Zytchow and Simon 1988. Achinstein 1980 distinguishes between rules codifying heuristic strategies and inference rules in terms of *generating and justifying* rules (p. 121).

12. See Achinstein 1970, pp. 93-4 and Curd 1980, p. 214 for analogous forms. The notion of plausibility has been variously interpreted. According to Thagard 1981, p. 249, Thomas Goudge felt the conclusion of an abduction to be a statement of the form "it is plausible to entertain *H*" with plausibility being a mode of acceptance (*CP* 8.222). Thagard, however, finds plausibility to be a property of propositions, a reading more solidly grounded in the texts *CP* 8.223, 2.662, 6.469-476 and *MS* 652:16.

13. See Frankfurt 1958, p. 595 who similarly talks of "adopting" hypotheses inasmuch as they are taken to deserve further consideration.

14. This reading of Peirce goes against a common understanding of abduction as a type of inference to the best explanation, but is closer to the interpretation offered in Hanson 1965, p. 64, and Curd 1980, p. 214, which take the abductive conclusion to be something like (a). It is also analogous to the independent account of retrodution developed in Achinstein 1987, which, nonetheless, shares the common understanding of Peirce's view.. Achinstein claims that a "more guarded" claim, viz., that a theory *T* is worth considering further, is the sort of conclusion sanctioned by the mere explanatory success of *T*" (pp. 423-5), and cites James Clerk Maxwell as a precursor of this view (p. 412). With the conclusion of (F5), we move a step beyond the evaluative mode represented by (a) to the more *practical* inference patterns culminating in directives, familiar in studies of practical reasoning (see Castaneda 1975 and the papers in Raz 1978).

15. A thorough discussion of the deductive character of practical reasoning and of the rationale and grounds for assigning semantic values to imperatives, intentions and the like is offered in Castaneda 1975. His method of assigning semantic values to practical directives is more complicated than what (L2) conveys, though it can be suitably adapted to the reasoning involved in abductive-preference. I have expressed misgivings about his explication of overridingness however (Kapitan 1984).

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MS. – Manuscript collection in the Houghton Library, Harvard University.

NEH – *The New Elements of Mathematics*, edited by Carolyn Eisele. Mouton: the Hague, 4 vols. in 5 books.

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