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Abductive, presumptive and plausible arguments

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Abstract: Current practice in logic increasingly accords recognition to abductive, presumptive or plausible arguments, in addition to deductive and inductive arguments. But there is uncertainty about what these terms exactly mean, what the differences between them are (if any), and how they relate. By examining some analyses of these terms and some of the history of the subject (including the views of Peirce and Carneades), this paper sets out considerations leading to a set of definitions, discusses the relationship of these three forms of argument to argumentation schemes and sets out a new argumentation scheme for abductive argument.

Resume: De plus en plus on reconnaît dans la pratique courante de la logique un troisième type d'argument qui s'identifie par divers adjectifs, «*abductif*», «*presomptif*», «*plausible*», et qui se distingue des arguments deductifs et inductifs. Mais la signification de ces mots, les différences (s'il y en a) et les rapports entre eux ne sont pas clairs. Un examen de quelques analyses importantes de ces termes et de l'histoire de ce type d'argument nous mènera à considérer un ensemble de définitions. On discutera des relations entre ces trois types d'argument et des schémas argumentatifs, et on proposera un nouveau schéma argumentatif pour représenter les arguments abductifs.

Keywords: argumentation scheme, inference to the best explanation, defeasible argument, scientific evidence, legal evidence, hypothesis, argument from sign, probative weight, expert opinion evidence, plausibility.

Three kinds of inference-abductive argument, presumptive argument and plausible argument-are often confused. And it is not too surprising that they are confused. They seem to be quite similar in representing a kind of uncertain and tentative reasoning that is very common in everyday thinking, as well as in special contexts like legal argumentation and scientific hypothesis construction. And although there is quite a bit of writing on all three types of argument in logic, artificial intelligence, philosophy of science and cognitive science, there seems at this point to be no widely agreed upon systematic theory that clearly distinguishes between (or among) the three in any precise way. Another related notion in the same category is inference to the best explanation, now widely taken (see below) to be the same as abductive argument. The purpose of this paper is to survey how these related terms are used in the literature, to determine what the main differences are between (or among) them, and to draw out a basis for making a clear

distinction between (or among) them that should help to explain and clarify these differences. Based on this survey and analysis, tentative definitions of all these related concepts will be proposed. The definitions are not meant to be the final word that closes off all discussion of the matter. They are put forward as tentative hypotheses meant to clarify the discussion and move it forward constructively and openly.

The current convention is typically to postulate three kinds of argument - deductive, inductive, and the variously named third category-abductive, presumptive, or plausibilistic.¹ This convention poses an important question for logic textbooks, and for logic generally as a field that should include treatment of arguments in the third category. Should one of these variously named types fit in as the third kind of inference contrasting to the other two? Or should all of them fit into that category? Or should some subset of them fit? Or should some of them be nested under others as subcategories? The situation is complicated, and the terminology is unsettled. Many logic textbooks either don't recognize the third category at all, or show uncertainty about what to call it. Recent work in argumentation theory has studied forms of argument fitting into the third category. These forms are called argumentation schemes. The arguments fitting the schemes appear to be neither deductive or inductive. Could they be classified as abductive, or is that the wrong word? These questions are perplexing, but seem to be very important, not only for logic and computer science, but for many other fields, like law, where these arguments are so commonly used as evidence. By offering tentative definitions, it is hoped to throw light on these important questions. It will be shown that all three concepts in the cluster need to be defined, analyzed and evaluated dialectically- that is, with reference to the sequence of questions and answers in the context of dialogue in which they were used in a given case.

1. **Abductive Inference**

Abductive inference is a notion that has become familiar to most of us, but the notion is a relative newcomer as something that is widely known or accepted in logic. There seems to be quite a bit of uncertainty about exactly how the notion should be exactly defined. It is thought that the American philosopher Charles Saunders Peirce was the originator of the notion of abduction. But that too is somewhat uncertain, in my opinion, even though Peirce's work on abduction is strikingly original and deep.² A paper by Harman (1965) is also often assumed to be an origin of the notion of abduction in philosophy. However, Harman's paper makes no specific mention of Peirce's work on abduction. Perhaps Peirce's work had not been "rediscovered" in 1965. Although many readers of this paper may have only a fuzzy notion about what abduction is, or is taken to be, they can be expected to have very firm opinions on how to define deductive and inductive inference.³ Hence, the best way of introducing the notion is to begin by using a simple example to contrast abductive inference with deductive and inductive inference.

The best place to begin is to describe what are usually taken to be the success criteria for all three types of inference.⁴ In a deductively valid inference, it is impossible for the premises to be true and the conclusion false. In an inductively strong inference, it is improbable (to some degree) that the conclusion is false given that the premises are true. In an abductively weighty inference, it is implausible that the premises are true and the conclusion is false. The abductive type of inference tends to be the weakest of the three kinds. A conclusion drawn by abductive inference is an intelligent guess. But it is still a guess, because it is tied to an incomplete body of evidence. As new evidence comes in, the guess could be shown to be wrong. Logicians have tended to be not very welcoming in allowing abductive inference as part of logic, because logic is supposed to be an exact science, and abductive inference appears to be inexact. Certainly it is not final. It can be described as a form of guessing. It is subject to being overturned by further evidence in a case. It would seem to be more fallible and conjectural than the other two types of inference.

A nice illustration of the three-way distinction can be given by citing an example used in a recent paper of Preyer and Mans (1999, p. 12).

Deductive Reasoning: Suppose a bag contains only red marbles, and you take one out. You may infer by deductive reasoning that the marble is red.

Inductive Reasoning: Suppose you do not know the color of the marbles in the bag, and you take one out and it is red. You may infer by inductive reasoning that all the marbles in the bag are red.

Abductive Reasoning: Suppose you find a red marble in the vicinity of a bag of red marbles. You may infer by abductive reasoning that the marble is from the bag.

This illustration indicates how abductive reasoning is different from deductive and inductive reasoning. Of course, deductive and inductive reasoning is already quite familiar to us, and it has been extensively analyzed in logic and statistics. But abductive reasoning appears to be mysterious. To some it might appear that it is a special kind of inductive reasoning. But as Woods (1999, p. 118) pointed out, Peirce did not think so. Peirce (1992, p. 142) wrote, "There is no probability about it. It is a mere suggestion which we tentatively adopt." Peirce also used the terms 'hypothesis' and 'best explanation' in describing abductive reasoning, as shown below.

Abductive reasoning is a kind of guessing by a process of forming a plausible hypothesis that explains a given set of facts or data. As Preyer and Mans (1999, p. 12) point out, in this case the hypothesis, 'The marble is from the bag' could "serve as part of the explanation for the fact that a red marble lies on the floor". This account gives a clue about the nature of abductive reasoning, as being a distinctive kind of reasoning in itself, different from deductive and inductive reasoning. Consider the example, and how the conclusion is derived from the given

data. I see the red marble on the floor. I see it is near the bag. I know that the bag contains red marbles. I then construct the hypothesis, or guess, that the red marble on the floor came from the bag. How? Well, the red marble didn't just appear on the floor. It came from somewhere. There is no other obvious source, let's say. Although there is no hard evidence it came from the bag, that hypothesis appears to be the only plausible explanation that offers itself. There are no other hypotheses that are more plausible. The explanation concerns the source of the marble. It could have gotten where it is by coming out of the bag, and somehow (we do not know how) arriving at its present location on the floor. What is significant in the given case is not only the known facts, but also the boundaries of what are known. There is the bare room, the bag of red marbles, and the single red marble on the floor near the bag. No other relevant facts of the case are known. From this set of data, one explanation of the given location of the marble stands out.

Abductive inference has often been equated with inference to the best explanation. Harman (1965, pp. 88-89) wrote that "inference to the best explanation corresponds approximately to what others have called abduction ". According to Harman, various kinds of reasoning can be shown to be instances of inference to the best explanation. One kind of case he cited is that of a detective who puts the evidence together to arrive at the conclusion that the butler did it, in a murder case (p.89). Another kind of case is that of a scientist inferring the existence of atoms and other subatomic particles (p. 89). Another is the kind of case of witness testimony in which we infer that the witness is telling the truth (p. 89). Harman explicates the latter use of reasoning as an inference to the best explanation as follows (p. 89). Our confidence in his testimony is supported by the failure of there to be any other plausible explanation than that he actually did witness the situation he describes. Hence we draw the conclusion, by inference, that he is telling the truth of the matter. It is interesting to note that two of the three kinds of cases cited by Harman show the fundamental importance of abductive inference in legal argumentation.

As a species of inference to the best explanation, abductive inference can be defined as having three stages. First, it begins from a set of premises that report observed findings or facts - the known evidence in a given case. Second, it searches around among various explanations that can be given for these facts. Third, it selects out the so-called "best" explanation and draws a conclusion that the selected explanation is acceptable as a hypothesis. The sequence of reasoning in the red marble case could be represented schematically as follows.

Positive Data: the red marble is on the floor, near the bag of red marbles.

Hypothesis: the red marble came from the bag.

Negative Data: no other relevant facts suggest any other plausible hypothesis that would explain where the red marble came from.

Conclusion: the hypothesis that the red marble came from the bag is the best guess.

The best guess is just an assumption, or presumption. It could be overturned by new information that suggests otherwise. But given what is known and what is not known about the facts of the case, that hypothesis is the best guess, or the most plausible one. There are lots of other possible explanations. Somebody could have put the marble there to make it appear that it came from the bag, for example. But in the absence of any relevant known facts of this sort, the hypothesis that the marble came from the bag is the only explanation that is given any plausibility by the actual facts of the case. Abductive inference is defeasible, meaning that the conclusion is only a hypothesis that is subject to retraction if further investigation of the facts in the case shows that another of the alternative explanations is "better".

Abduction is often portrayed as a kind of 'backwards' reasoning, because it starts from the known facts and probes backwards into the reasons or explanations for these facts. The etymological derivation of the term is from the Latin *ab* (from) and *duco* (lead). If you have a given knowledge base, then by abduction you are taking one proposition in the knowledge base, and trying to trace its derivation from prior propositions in the knowledge base. Knowledge-based reasoning is both common and important in computer science. And so abduction is a common and important kind of reasoning in computer science (Reiter, 1987). Abductive inference is tied to the known or presumed facts of a case, but can be altered should this set of given data be altered. It is for this reasoning that abductive reasoning has also been called "retroductive" (Woods, 1999, p. 118). It is a kind of reasoning that leads backwards from the given set of facts, to hypothesize a basis from which those facts could be inferred. From the positive and negative data above in the red marble case, a conclusion can be drawn by a process of negative reasoning sometimes called *argumentum ad ignorantiam*. Since there is no other plausible explanation of the red marble being on the floor that is suggested by the known facts, from closure of the boundaries of what is known in the case we can infer that the marble came from the bag of red marbles. If these boundaries are altered by new facts of the case, of course, that conclusion may have to be retracted. Negative reasoning from a knowledge base is called *argumentum ad ignorantiam* in logic. But in computer science, it is known as the lack-of-knowledge inference (Collins, Warnock, Aiello and Miller, 1975, p. 398). Abductive reasoning should be seen as not only a kind of knowledge-based reasoning, but also as tied to what is not known in a case.

Abduction is often associated with the kind of reasoning used in the construction of hypotheses in the discovery stage of scientific evidence. A nice idea of how abductive inference works in scientific reasoning can be gotten by examining Peirce's remarks on the subject. Peirce (1965, p. 375) described abduction as a process "where we find some very curious circumstance, which would be explained by the supposition that it was a case of a certain general rule, and there-

upon adopt that supposition." The description given by Peirce suggests that abduction is based on explanation of a given fact or finding, a "curious circumstance". The words 'supposition' and 'adopt' suggest the tentative nature of abduction. As noted above, you can accept an abductively derived conclusion as a provisional commitment even if it is subject to retraction in the future. The expression 'general rule' is significant. Abductive inferences are derived from the way things can normally be expected to go in a familiar kind of situation, or as a "general rule". A general rule may not hold in all cases of a certain kind. It is not based on a warrant of 'for all x', as deductive inferences so often are. It is not even based on a finding of most or countably many cases, as inductive inferences so often are. It holds only for normal or familiar cases, and may fail outside this range of "general rule" cases.

Two of the examples given by Peirce illustrate what he means by abductive inference. The first example quoted below came apparently from his own personal experience, and shows how common abductive inferences are in everyday thinking (1965, p. 375)

I once landed at a seaport in a Turkish province ; and, as I was walking up to the house which I was to visit, I met a man upon horseback, surrounded by four horsemen holding a canopy over his head. As the governor of the province was the only personage I could think of who would be so greatly honored, I inferred that this was he. This was an hypothesis.

The second example quoted below (p. 375) illustrates the use of abduction in science. In this case it is the science of paleontology.

Fossils are found; say, remains like those of fishes, but far in the interior of the country. To explain the phenomenon, we suppose the sea once washed over this land. This is another hypothesis.

The abductive inference in both these cases is easily seen to follow the pattern of inference to the best explanation. In the fossils case, Peirce actually used the word 'explain'. In the fossils case, we all know that fishes require water to survive. That could be described as a general rule - a normal or familiar way that fish operate. But it could be subject to exceptions. Some fish can survive on land for some time. But how could fish survive this far into the interior where there is now no water? The observed fact calls for an explanation. A best explanation could be that there was water there at one time. In the four horsemen case, the given facts are also "curious". Why would one man be surrounded by four other men holding a canopy over his head? To hazard a guess, the general rule might be something like the following: only a very important person (like the governor) would be likely to have a canopy supported by four horsemen. But the 'only' should not be taken to refer to the 'for all x' of deductive logic, or to warrant a deductively valid inference to the conclusion that this man must necessarily be the governor. It's just a guess, but an intelligent guess that offers a "best" explanation.

As well as being important in scientific and legal reasoning, abduction is highly abundant in everyday argumentation, and in everyday goal-directed reasoning of the kind that is currently the subject of so much interest in artificial intelligence. An

excellent and highly useful account of the form of abductive inference has been given in the influential work of Josephson and Josephson (1994). Their analysis is quite compatible with the account given by Peirce. They also describe abduction as equivalent to inference to the best explanation. Numerous examples of the use of abductive inference in everyday reasoning are cited by Josephson and Josephson, showing how common this form of inference is. The one quoted below (p. 6), in the form of a brief dialogue, is a good illustration.

Joe: Why are you pulling into this filling station?

Tidmarsh: Because the gas tank is nearly empty.

Joe: What makes you think so?

Tidmarsh: Because the gas gauge indicates nearly empty. Also, I have no reason to think that the gauge is broken, and it has been a long time since I filled the tank.

The reasoning used in this case follows Peirce's pattern of inference to the best explanation. Tidmarsh derives two alternative explanations for the given circumstances presented by the gas gauge. The obvious explanation is that the gas in the tank is nearly empty. But there is also a possible alternative explanation. The gas gauge could be broken. But Tidmarsh does remember that it has been a long time since he filled the tank. This additional evidence tends to make the hypothesis that the tank could be nearly empty more plausible. On balance, the best explanation of all the known facts is that the gas tank is nearly empty. This conclusion could be wrong, but it is plausible enough to warrant taking action. Tidmarsh should pull into the next gas station.

According to Josephson and Josephson (1994, p. 14), abductive inference has the following form, which clearly shows its structure as based on inference to the best explanation. *H* is a hypothesis.

D is a collection of data.

H explains *D*.

No other hypothesis can explain *D* as well as *H* does.

Therefore *H* is probably true.

It can easily be seen how the two examples from Josephson and Josephson above fit this form of reasoning. If you reconsider the two illustrations of abductive inference from Peirce, it is not hard to see how they too fit this model. But how, you might ask, could such a form of inference be evaluated in a given case? How should we evaluate the strength or weakness of an abductive argument in a given case?

The answer presented by Josephson and Josephson is that contextual factors of the given case, of various sorts, need to be taken into account. The multiplicity of these factors suggests that the evaluation of abductive inference is quite differ-

ent from that of deductive or inductive inference. According to Josephson and Josephson (p. 14, the judgment of likelihood associated with an abductive inference should be taken to depend on several factors.

1. how decisively *H* surpasses the alternatives
2. how good *H* is by itself, independently of considering the alternatives (we should be cautious about accepting a hypothesis, even if it is clearly the best one we have, if it is not sufficiently plausible in itself)
3. judgments of the reliability of the data
4. how much confidence there is that all plausible explanations have been considered (how thorough was the search for alternative explanations)

Beyond these four factors of "judgment of likelihood", Josephson and Josephson (p. 14) also list two additional considerations required for the evaluation of an abductive inference.

1. pragmatic considerations, including the costs of being wrong, and the benefits of being right
2. how strong the need is to come to a conclusion at all, especially considering the possibility of seeking further evidence before deciding.

The process for evaluating abductive inferences presented by Josephson and Josephson is different from the process of evaluating deductive or inductive inferences. In a given case, several explanations of the queried fact are possible. The conclusion to be inferred turns on which is the "best" explanation at some given point in an investigation or collection of data that may continue to move along. But the process of investigation may not be finished. Collection of more facts may suggest a new explanation that may even be better than the one now accepted. The conclusion is an intelligent guess, based on what is known at some given point in an investigation that may, or perhaps even should continue.

The account of abductive inference and inference to the best explanation presented above has emphasized the common elements found in the analyses given by Peirce, Harman and the Josephsons. It is necessary to add that this brief account may be misleading in some respects, and that a closer and more detailed explication of the finer points of the three analyses could reveal important underlying philosophical differences. Inferences to the best explanation, as expounded by Harman and the Josephsons, can involve deductive and inductive processes of a kind that would be apparently be excluded by Peirce's account of abduction. A main thesis for Harman, argued at length in his article, is the proposition, "all warranted inferences which may be described as instances of enumerative induction must also be described as instances of inference to the best explanation." (Harman, 1965, p. 88). For Peirce, on the other hand, it would seem

that deductive and inductive processes are distinct from the abductive proposal of a hypothesis to be tested. It could well be that, when analyzed in more depth, the notion of abduction presented by Peirce is different from the notion of inference to the best explanation presented by Harman and the Josephsons. However the examples presented above, along with the various definitions and characterizations given, suggest the hypothesis that abductive inference and inference to the best explanation can be taken to be equivalent notions. Peirce's frequent use of explanatory language in his account of abduction also suggests the closeness of the two notions in his view.

2. Plausible Inference

Plausibility, according to Rescher (1976, 28), evaluates propositions in relation to "the standing and solidity of their cognitive basis" by weighing available alternatives. Rescher (1976, p. 55) sees plausibility as closely related to presumption: "A positive presumption always favors the most plausible contentions among the available alternatives." A proposition stands as a plausible presumption until some alternative is shown to be more plausible. It is a controversial question whether plausibility is different from probability, and it is hard to entirely exclude the possibility that plausibility might turn out to be some special kind of probability. Rescher (1976, p. 30-31) puts the difference this way. Probability takes a set of exclusive and exhaustive alternative propositions and distributes a fixed amount (unity) across the set, based on the internal contents of each proposition. Plausibility does not assign weights on a basis of internal contents, but on a basis of the external support for each proposition being considered. The way plausibility is described in (Josephson and Josephson, (1994, p. 265-272) also makes it seem different from probability. As shown there, plausibility has often been measured by coarse-scale "confidence values" that seem to be good enough to decide actions, but are different from probability values. According to Josephson and Josephson (p. 266), confidence values are useful in expert medical diagnoses, but it is not helpful to treat them as though they were measures of probability (p. 270). I have presented a set of rules for evaluating plausible inferences (Walton, 1992). The rules are based on the distinction between linked and convergent arguments. How the rules work can be roughly explained as follows. In a linked argument, both (or all) premises are functionally related to support the conclusion. In a convergent argument, each premise is an independent line of evidence to support the conclusion. In a linked argument, Theophrastus' Rule applies. The plausibility value of the conclusion must be at least as great as that of the least plausible premise. In a convergent argument, the value of the conclusion must be at least as great as that of the most plausible premise.

The notion of plausible inference can best be explained by citing the standard example of it in the ancient world. Plato attributed this example to Corax and Tisias, two sophists who lived around the middle of the fifth century BC (Gagarin,

1994, p.50). Aristotle attributed the example to Corax (Aristotle 1937, 1402a17 - 1402a28). According to the example, there was a fight between two men, and one accused the other of starting the fight by assaulting him. The man who was alleged to have started the fight was quite a bit smaller and weaker than the other man. His argument to the jury ran as follows. Did it appear plausible that he, the smaller and weaker man, would assault the bigger and stronger man? This hypothesis did seem implausible to the jury. The example illustrates how plausible inference can have the effect of shifting a weight of evidence to one side or the other in a legal case. In such a case, because the event happened in the past and there were no witnesses, other than the two principals, a small weight of evidence could shift the balance of considerations to one side or the other. But how does plausible inference work as a kind of evidence in such a case. It is not empirical evidence describing what actually occurred. But it does have to do with appearances. It has to do with how the situation appeared to the jury, and how the participants would be likely to react in that kind of situation.

Plausibility does not have to do with the statistical likelihood of what happened in a given case. It has to do with the way things are normally expected to go in a type of situation that is familiar both to the participants and the onlookers, or judges of the situation. In the example, by an act of empathy, a juror could put himself into the situation just before the fight began. Then the juror can ask a hypothetical question. Would he, if he were the smaller man, assault the bigger man and start a fight with him? The answer is that there is a lot to be said against it. Why? Because such an attack would be imprudent. All else being equal, the chances of winning the fight would not be good. The expected outcome is that the smaller man would take a painful beating, and experience a humiliating defeat. The person on the jury therefore reaches the conclusion that the larger man's allegation that the smaller man started the fight is somewhat implausible. It might be true, but there is something to be said against it.

One of the most interesting thing about the example is that it is a typical sophistic argument that can be turned on its head. According to the example, as described by Aristotle (1402a11), the larger man used the following counter-argument. Since I am visibly so much larger and stronger than the smaller man, it was apparent to me that if I were to attack him, it would certainly look bad for me in court. Now, knowing this fact, is it plausible that I would attack the smaller man? The argument is similar to the previous one. The larger man alleges that he is aware of the likely consequences of his attacking a smaller man. It would be imprudent for him to do it. As long as any person on the jury is aware that the larger man would be aware of these consequences, he too can appreciate why the larger man would be reluctant to assault the smaller man. So by a kind of act of empathy, and an awareness of facts that would be familiar to both the jurors and the participants in the example, each member of the jury can draw a plausible inference. This inference gives a reason why it is implausible that the larger man

would attack the smaller man. It can be seen that there are plausible arguments on both sides.

The plausible inference in the example only carries some weight, all other factors in the case being equal. If the smaller man was known to be an experienced pugilist, whereas the larger man was not, the evidence in the case would be changed. This fact could explain why the smaller man had reason to think that he could win the exchange, or at least put up a good fight. This new fact would tend to alter the evidence in the case, and detract from the plausibility of his earlier argument. So a plausible inference can be defeated by new facts that enter a case. But plausible inference is different from probable inference, as shown by Rescher's account (1976, pp. 31-32) of the functional differences between the two types of reasoning. For example, in the probability calculus, the probability of a statement not- A is calculated as $1 - \text{pr}(A)$. In the ancient example of plausible inference, this equation will not work. It is plausible, other things being equal, that the smaller man did not start the fight, for the reason given. But it is also plausible, other things being equal, that the larger man did not start the fight. But it is an assumption of the case that either one or the other (exclusively) started the fight. In other words, if one started the fight, the other didn't. From a point of view of probable inference then, if it is highly probable that one started the fight, it can't be highly probable that the other did. But from a point of view of plausible inference, even though it is plausible, other things being equal, that one started the fight, it can also be plausible, other things being equal, that the other started the fight. The reason, as indicated above by Rescher's account of plausible reasoning, is that plausibility is localized to the body of evidence on the one side of the controversy. As is typical of many legal cases, there are two competing "stories", or accounts of what supposedly happened (Pennington and Hastie, 1991). Each one can be fairly plausible internally, and in relation to the body of evidence that exists. That body of evidence can be incomplete, so it may not rule out plausible accounts on both sides. It is for this basic reason, as Rescher has so rightly emphasized, that plausible inference is inherently different from probable inference.

The above account of plausible inference is clear enough perhaps. But it is very hard to get modern readers to come to accept plausible inference as having any hold on rational assent at all. We are so accustomed to the basing of our notion of rationality on knowledge and belief, we tend to automatically dismiss plausibility as "subjective", and therefore of no worth as evidence of the kind required to rationally support a conclusion. The modern conventional wisdom is used to thinking of rationality as change of belief or knowledge guided by deductive reasoning and inductive probability. This modern way of thinking finds the notion of plausibility alien or even unintelligible, as an aspect of rational thinking. As an antidote to the pervasive influence of this modern way of thinking about rationality, it may be useful to delve deeper into the history of plausibility as a philosophical notion.

3. History of Plausibility as a Basis for Rational Acceptance

It may come as surprise therefore to find out that the notion of plausible reasoning as a model of rational thinking actually has a long and continuous history. It did not die out with the sophists, or with Plato and Aristotle. The very best definition of plausibility was given by Carneades, a not very well known Greek philosopher who lived well after the time of Plato and Aristotle. Carneades (c. 213 - 128 B. C.), born in Cyrene, Cyrenaica (now in Libya) was the head of the third Platonic Academy that flourished in the second century B.C. His most important legacy to philosophy was his famous theory of plausibility. According to Carneades' theory, something is plausible if it appears to be true, or (is even more plausible) if it appears to be true and is consistent with other things that appear to be true. Or thirdly, it is even more plausible if it is stable (consistent with other things that appear to be true), and is tested. According to the epistemological theory of Carneades, everything we accept, or should accept, as reasonably based on evidence, is subject to doubt and is plausible only, as opposed to being known (beyond all reasonable doubt) to be true.

Carneades wrote nothing himself, but his lectures were written out by one of his students. Unfortunately, none of these survived either. But we do have some accounts of Carneades' theory of plausibility in the writings of Sextus Empiricus. In *Against The Logicians* (AL), Sextus tells us about the theory of plausibility Carneades proposed as a solution to problems he found in earlier skeptical and Stoic views. According to this theory, there are three criteria for plausible acceptance. The first one has to do with experiencing a presentation or appearance in a convincing way. When a subject experiences a "presentation" (something that appears to him), one kind of presentation is "apparently true" or seems convincingly to be true (AL, 168-170). Such a presentation, according to Carneades' theory, represents a proposition that should be accepted as tentatively true. Of course, as a skeptic would point out, one could be mistaken. But the theory rules that if a proposition is based on a presentation that is apparently true, then that proposition should, for practical purposes, be accepted as true, even though it is not known for sure to be true, and might later be shown to be false or dubious. As Sextus puts it, sometimes we accept a presentation that appears true, but is really false, so "we are compelled at times to make use of the presentation which is at once both true and false." (AL 175). The second criterion is a presentation that is both plausible in the first sense, and is also "irreversible", meaning that it fits in with other presentations that also appear true (AL 176). Sextus offers a medical illustration in which a physician initially concludes that a patient has fever from his high temperature but then supports this inference by other findings like soreness of touch or thirst (AL 179-180). The third criterion involves the "tested" presentation (AL 182-183). Sextus cites the classic Carneadean illustration of the rope (AL 188). A man sees a coil of rope in a dimly lit room. It looks like a snake, and he infers the conclusion that it is a snake. Acting on this assumption, he jumps over it. But when he turns back, he sees it did not move. Then he readjusts his inference,

inferring the new conclusion that it is not a snake, but a rope. But then again, he reasons, snakes are sometime motionless. Thus he carries out a test. He prods the object with a stick. If it still fails to move, that finding would indicate that the object is indeed a rope.

Carneades' theory provides the best definition of the basic notion of plausibility. Something is plausible if it seems, or appears to be true, or if it fits in with other things we accept as true, or if it tested, and passes the test. According to this approach, if something is plausible to someone, it does not follow that this person knows it to be true, or even necessarily that she believes it to be true. Plausibility is not a theory of knowledge or belief. It is a guide to rational acceptance or commitment, a guide to action. Bett (1990, p. 4), using evidence from Cicero, argued that Carneades distinguished between two kinds of assent. There is a strong kind of assent, based on knowledge or belief. But the alternative to this strong kind of assent is not indifference or skepticism. There is also a kind of attitude that could be called commitment or approval, that enables the skeptic to go ahead with the ordinary tasks of life. Carneades was reacting against Stoic and other ancient views that claimed rational thinking was based on knowledge and belief. Carneades argued that plausibility offers an alternative to these views that is compatible with skepticism. You might think, however, that the notion of plausibility was only a kind of answer to Greek skepticism, and that it was an obscure ancient notion that did not carry at all over into later philosophy. That hypothesis is not entirely true, however. It can be argued that some modern philosophers have also adopted and advocated the notion of plausibility as important in rational thinking.

A notion of plausibility was used to support a theory of degrees of assent by Locke in chapter 15 of his *Essay Concerning Human Understanding*. Locke defined "probability", or what should properly be called plausibility, by contrasting it with demonstration. Demonstration yields certainty. As an example of a demonstration, Locke cited a proof in Euclidean geometry (1726, p. 274). Arguments based on plausibility occur in cases where something "appears, for the most part to be so." (1726, p. 273), but where there is lack of knowledge and, hence, no basis in certainty on which we can say the proposition is true. Locke presented an interesting example to illustrate plausibility (1726, pp. 275-276). Locke (1726, p. 276) tells about a Dutch ambassador who was entertaining the king of Siam. The ambassador told the king that the water in the Netherlands would sometimes, in cold weather, be so hard that men could walk on it. He said that this water would even be so firm that an elephant could walk on the surface. The king of Siam found this story so strange that he concluded that the ambassador had to be lying. The story makes the point that plausibility refers to an inference drawn on the basis of normal, commonplace expectations based on conditions that a person is familiar with. In the tropics, people were not familiar with freezing conditions, and hence the story of the freezing canal did not fit in with the normal expectations they were used to in their environment. They just found the whole story implausible and unconvincing.

The core of Bentham's so-called natural theory of evidence was his theory of probability, or probative force. It strongly appears that Bentham used these terms to refer to the same notion of plausibility described by Locke. In Bentham's natural system, there are two parts to plausibility. One is the establishing of the plausibility of a proposition, and the other is the testing of that plausibility by subsequent process of examining it. Bentham discussed the question whether plausibility can be measured by some number or ratio of numbers in the way that we are familiar with in handling statistical data. On the one hand, he wrote (1962, v. 7, p. 64) that, on an individual occasion, the degree of strength at which a persuasion stands "would be capable of being expressed by numbers, in the same way as degrees of probability are expressed by mathematicians, viz by the ratio of one number to another." But he seems to disagree that these numbers could be assigned in a way that would be consistent with the mathematical theory of probability. Thus Bentham's approach to plausibility would appear to be quite consistent with that advocated by Josephson and Josephson, above.

The second part of Bentham's method of evaluating probability is his so-called system of securities for testing the trustworthiness of a proposition put forward as plausible, for example, by a witness. The degree of plausibility of a proposition can be calculated, according to Bentham, by a formula. The outcome is a function of the initial probative force of the evidence supporting it minus the probative force of any of the contrary indicators which may have been introduced by the testing of the probability of the proposition in the subsequent analysis of it (Twining 1985, p. 55). Another part of the system involves a sequence of inferences called by Bentham (1962, v. 7, p. 2) a "chain of facts". Bentham describes such a chain of facts (1962, v. 7, p. 2) as originating in a so-called "principle fact", which leads, by a series of links, to succeeding evidentiary facts drawn by inference from the principle fact and from the previous conclusions drawn in the sequence of inferences. Bentham then goes on to discuss (1962, v. 7, p. 65) cases where there is an evidentiary chain composed of a number of links. Evaluating the plausible reasoning in such a chain is based on the principle that "the greater the number of such intermediate links, the less is the probative force of the evidentiary fact proved, with relation to the principle fact." (1962, v. 7, p. 65) As the chain grows longer, the inference gives less plausibility for accepting the ultimate conclusion in the chain because the chain is weakened. As an example Bentham cited the following case (1962, v. 7, p. 65): "The more rounds a narrative has passed through, the less trustworthy it is universally understood to be." This notion of the chain of reasoning is familiar in modern argumentation theory as the serial form of argumentation.

Through Locke and Bentham the notion of plausibility survived as the basis of a kind of reasoning that could support rational acceptance of an inference leading to a conclusion, based on something other than deductive reasoning or inductive probability. But did the notion of plausibility, of the kind captured in Carneades' theory, survive even longer? Doty (1986) argued that the Carneadean notion of

plausibility is manifested in the tests of truth and rational inference advocated by modern pragmatists like William James. Whether Doty's hypothesis is supportable is controversial, and proving or disputing it requires a close reading of what the modern pragmatists wrote about rational acceptance. But Doty has, at any rate, made an interesting case that the Carneadean notion of plausibility has not altogether died out or remained obscure, and that traces of it can even be found in the writings of the modern pragmatists. But there is another way in which the Carneadean notion of plausibility has survived in an important way into modern ways of thinking about rational assent and evidence. It is made quite clear in the historical development of ideas outlined so very well in Twining (1985) that the Lockean and Benthamite notion of plausible reasoning formed the very basis of the influential theory of legal evidence developed by John H. Wigmore. One only has to look at modern rules of evidence in the Anglo-American system of law to see how the foundational notion of probative weight evolved into law through Locke, Bentham and Wigmore.

4. Presumptive Inference

Another kind of reasoning that is very important in legal argumentation is presumptive inference. In law, a person may be presumed to be dead, for purposes of settling his estate after a prescribed period, even though it is not known for sure that he is dead. As long as there has been no evidence that he is still alive, after a prescribed number of years, the conclusion may be drawn that he is (for legal purposes) dead. Of course, this conclusion may later be retracted if the person turns up alive. It is merely a presumption, as opposed to a proved fact. A presumption then is something you move ahead with, for practical purposes, even though it is not known to be true at the present time. It is a kind of useful assumption that can be justified on practical grounds, in order to take action, for example, even though the evidence to support it may be insufficient or inconclusive. Presumption and plausibility are both concerned with the practical need to take action, or to provisionally accept a hypothesis, even though the evidence is, at present, not sufficient to prove the hypothesis beyond doubt, or show it is known to be true.

Abduction also relates to hypotheses that are accepted provisionally, often for practical reasons, or to guide an investigation further along. Thus the practical motivation of using abductive inference is comparable to those of presumptive inference and plausible inference. Presumptive inference is easily confused with abductive inference, and the two often tend to be seen as either the same thing, or very closely related. The notion of presumptive inference tends to be more prominent in writings on legal argumentation, while the term 'abductive inference' is much more commonly used in describing scientific argumentation and in computer science. Both types of inference are provisional in nature. Both types of inference are also hypothetical in nature, and have to do with reasoning that moves forward in the absence of complete evidence. Judging from the account of

abductive inference above, it seems like it can be described as presumptive in nature. But what does that mean? To explore the question, it is useful to begin with some account of what presumptive inference is supposed to be.

A dialectical analysis of presumptive inference has been put forward in Walton 1996, and the main points of the analysis have been nicely summarized in Blair, 1999, p. 56. The analysis presumes a structure of dialogue in which, in the simplest case, there are two participants. They are called the proponent and the respondent, and they take turns asking questions, putting forward arguments, and making other moves. In such a dialogue, when the proponent puts forward an assertion, there is a burden of proof attached to that move. If the respondent asks for justification of the assertion, the proponent is then obliged, at the next move, to either give an argument to justify the assertion, or to retract it. This requirement is a rule that applies to the making of assertions in certain types of dialogue. With respect to this rule, assumption may be contrasted with assertion. In a dialogue, a proponent can ask the respondent to accept an assumption at any point, and there is no burden of proof attached. Assumptions are free, so to speak. An assumption is just a hypothesis. It may be proved or disproved when later evidence comes into a dialogue. But you don't have to prove it right away. Presumption can be described as a move in dialogue that is mid-way between assertion and assumption. According to the dialectical analysis in Walton 1996, when the proponent puts forward a presumption, she does not have to back it up with proof, but she does have to give it up if the respondent can disprove it. As Blair (1999, p. 56) puts it, "A presumption so conceived has practical value by way of advancing the argumentation, and, in accepting something as a presumption, the interlocutor assumes the burden of rebutting it." As Reiter (1980) and Blair (1999, p. 56) indicate, presumptive inference, comes into play in cases where there is an absence of firm evidence or knowledge. The practical justification of presumptive reasoning, despite its uncertain and inconclusive nature, is that it moves a dialogue forward part way to drawing a final conclusion, even in the absence of evidence for proof at a given point. Because of its dependence on use in a context of dialogue, it is different in nature from either deductive or inductive inference.

A legal example cited above can be used to illustrate how presumption has an inherently practical justification in moving a dialogue forward. As mentioned, the presumption that a person is dead is often invoked in legal reasoning in cases where the person has disappeared for along time, and there is no evidence that the person is still alive. In order to deal with practical problems posed by estates, courts can rule that a person is presumed to be dead as long there has been no evidence for a fixed period that she is still alive. For practical purposes, say to execute a will, the conclusion is drawn by presumptive inference that for legal purposes the person will be declared dead. This legal notion of presumptive inference fits the dialectical analysis. There may be insufficient positive evidence to prove that the person is dead. But for legal purposes, a court can conclude by presumptive inference that she is dead. The justification is the lack of positive

evidence that she is alive. Presumption, according to the dialectical analysis, is comparable to assertion as a move in dialogue except that the burden of proof is reversed. Normally in a dialogue in which the goal is to resolve a conflict of opinions by rational argumentation, when you make an assertion, you are obliged to prove it or give it up (van Eemeren and Grootendorst, 1992). But when you put forward a presumption to be accepted, at least provisionally, by all parties to the dialogue, you are only obliged to give it up if the other party can disprove it. It is this dialectical reversal that characterizes presumptive inference. This type of legal case also illustrates quite well the connection between presumption and the argument from ignorance (*argumentum ad ignorantiam*), a type of argument often taken to be fallacious in logic. Such arguments from lack of evidence (often called *ex silentio* argument in history) are, however, not always fallacious (Walton, 1996). Under the right conditions, they can be quite reasonable presumptive arguments. These kinds of arguments are very common in legal reasoning. The most obvious cases are those associated with the so-called presumption of innocence in criminal law.

5. Argumentation Schemes

There are many different kinds of arguments that are best evaluated in a vast preponderance of cases by standards that are neither deductive nor inductive. These types of argumentation are often equated with traditional informal fallacies. However, in many cases of their use, they are not fallacious. In such cases, if seen as presumptive arguments, they do have some weight as rational arguments that could be used to support a claim. Many of them were identified in (Perelman and Olbrechts-Tyteca, 1969). Some of the best known examples are argument from analogy, *ad hominem* argument, argument from ignorance, argument from sign, argument from consequences, appeal to popular opinion, appeal to pity, and appeal to expert opinion. Each of these types of argument does appear to have a recognizable form. But that form is not, at least in the vast range of cases, either a deductively valid form of argument or an inductively strong form of argument. In fact, they all seem to fall into the third category of arguments having some presumptive (or perhaps abductive) weight of plausibility. Now there is a literature studying these forms of argument. They are usually called argumentation schemes in this literature. Many different argumentation schemes have been analyzed in (Hastings, 1963), (Kienpointner, 1992) and (Walton, 1996). To show the beginning reader, an analysis one of these argumentation schemes is presented below, with an account of how particular cases are evaluated using the scheme.

Argument from expert opinion is often also called the appeal to expert opinion in logic textbooks. According to the analysis given in (Walton, 1997, p. 210), argument from expert opinion has the following argumentation scheme, where *E* is an expert source and *A* is a statement.

Argument from Expert Opinion

Major Premise: Source *E* is an expert in subject domain *S* containing proposition *A*.

Minor Premise: *E* asserts that proposition *A* (in domain *S*) is true (false).

Conclusion: *A* may plausibly be taken to be true (false).

Argument from expert opinion shifts a weight of presumption in a dialogue favoring the acceptance of the statement put forward as true by the expert. If the premises are acceptable to the respondent, then the respondent should also, at least tentatively, accept the conclusion. But this acceptance (or commitment) is subject to retraction depending on the asking of appropriate critical questions by the respondent in the dialogue. Six appropriate critical questions for the appeal to expert opinion are cited in (Walton, 1997, p. 223).

1. *Expertise Question:* How credible is *E* as an expert source?
2. *Field Question:* Is *E* an expert in the field that *A* is in?
3. *Opinion Question:* What did *E* assert that implies *A*?
4. *Trustworthiness Question:* Is *E* personally reliable as a source?
5. *Consistency Question:* Is *A* consistent with what other experts assert?
6. *Backup Evidence Question:* Is *A*'s assertion based on evidence?

Some discussion is needed to indicate how question 1 is different from question 4. Question 4, the trustworthiness question, queries the honesty or veracity of the source. This question is about the ethical character of a source. Question 1, the expertise question, queries the competence of the expert. An expert has credibility not only because of her knowledge in the field in question, but also because she has the judgment skills to use that knowledge as applied to a particular problem. When depending on expert opinion, you can go wrong if the expert is lying, or if the expert is incompetent. The relevance of the other critical questions is more obvious, but the analysis of these critical questions in (Walton, 1997, chapter seven) gives full details. It is significant to note, however, that each of the six basic critical questions above can admit of critical subquestions, used to continue a dialogue in more detail.

The defeasibility of appeal to expert opinion as a type of argument is brought out by the dialectical evaluation of it, explained above. Argument from expert opinion has only a weight of presumption favoring one side in a dialogue. When subjected to critical questioning by the other side, the argument defaults, temporarily, until such time as the critical question has been answered satisfactorily. A question about how argumentation schemes should be used to evaluate arguments used in particular cases can now be posed. When has a dialogue reached the stage

where all the appropriate critical questions to a proponent's argument have been satisfactorily answered so that the respondent must now accept the argument without going on and on asking more critical questions?

In the case of a deductively valid argument, if the respondent accepts the premises as true, then he must necessarily accept the conclusion. In the case of an inductively strong argument, if the respondent accepts the premises as true, then he must accept the conclusion as probably true. And the degree of probability can be calculated, in many cases, in relation to the degree of the inductive strength of the argument. The addition of new premises can make an inductively strong argument into an inductively weak argument. But an inductively strong argument cannot be made inductively weak simply by asking a relevant question, like whether the sample is large enough to warrant the generalization. To make the argument less strong, evidence must be given by the respondent to show that the sample was too small. In the case of an argumentation scheme, the respondent is bound to tentatively accept the conclusion, given that he accepts the premises of such an argument, even if the argument is neither deductively valid nor inductively strong. But the acceptance is only tentative depending on further progress of the dialogue. If the respondent just asks the right question, the acceptance of the worth of the argument to determine commitment is suspended. So when is an argument having the form of one of the argumentation schemes binding on the respondent? Even if all the critical questions have been answered satisfactorily by the proponent, can the respondent still go on asking critical subquestions? When is the argument finally binding on the respondent? This difficult question probes into the status of argumentation schemes as being based on a standard of argument evaluation that is different from the kinds of standards properly used to evaluate arguments that are supposed to be deductive and inductive.

The answer to this difficult question is that argumentation schemes represent a different standard of rationality from that represented by deductive and inductive argument forms. This third class of presumptive (or abductive) arguments result only in plausibility, meaning that if the premises seem to be true, then it is justified to infer that the conclusion also seems to be true. But seeming to be true can be misleading. You can go wrong with these kinds of arguments. For example, if an expert says that a particular statement is true, but you have direct empirical evidence that it is false, you had better suspend judgment. Or, if you have to act on a presumption one way or the other, go with the empirical evidence. But a presumptive argument based on an argumentation scheme should always be evaluated in a context of the dialogue of which it is a part. When the dialogue has reached the closing stage, and the argumentation in it is complete, only then can an evaluator reach a firm determination on what plausibility the argument has. And this evaluation of the argument must always and only be seen as relative to the dialogue as a whole. Typically, one individual argument has only a small weight of plausibility in itself. The significance of the argument is only that it can be combined with a whole lot of other relevant plausibilistic arguments used in the case. The important

factor is the combined mass of evidence in the case. There will be two sides to the case, and there will be a mass of evidence on both sides. The final outcome of the case should be determined by how the mass of evidence on both sides tilts the burden of proof set at the initial stages of the dialogue.

The answer to the completeness question sketched out above is brief. It raises a whole host of other related questions. But one central question stands out. Are these kinds of argument modeled by argumentation schemes abductive in nature? It is easily seen that they are presumptive in nature, and that the notion of presumption helps to understand how they should properly be evaluated. But how does abduction come into it? And what is the difference between presumption and abduction? That was a central question that motivated this investigation. What can be said in answer to it? The first observation to make is that some of the argumentation schemes are very readily cast as modeling abductive arguments. For example, argument from sign is clearly abductive. An example of argument from sign is the following inference: here are some bear tracks in the snow, therefore a bear recently passed this way (Walton, 1996, p. 47). This argument can be seen as an inference to the best explanation, as follows. The bear tracks in the snow are the observed facts or given data. What could explain them? A plausible, but not the only possible explanation is that a bear recently passed that way, producing the tracks. If the area is one where bears might be expected to pass, and there is no indication that someone has cleverly faked these imprints, it is reasonable to infer that a bear passed that way. Inference to the best explanation works fine here, but what about with other argumentation schemes, like appeal to expert opinion for example? If a physician tells me I have measles, using argument from expert opinion, it is a plausible hypothesis that I have measles. But is the argument abductive? Is my having measles the best explanation of what the expert said. Well maybe, but fitting the argument into this format does not seem to throw much light on its structure. The fit seems awkward, at best.

A better way to proceed is to begin with the insight of Blair (1999, p. 57) that some argumentation schemes seem to be more general, or more abstract than others. In other words, there may be hierarchies of argumentation schemes. Could it be that some groups of argumentation schemes fall under other argumentation schemes? Following this line of reasoning, it seems possible that some argumentation schemes fit under abduction while others do not⁵. What this hypothesis suggests, in turn, is that abduction could be viewed as a distinctive form of argument in its own right. If this is so, there should be an argumentation scheme for abductive argument. Taking this line of reasoning to its logical conclusion, a new argumentation scheme for abductive argument is proposed below.

6. A New Argumentation Scheme for Abduction

What is suggested by the accounts of abductive inference presented above is that this form of inference should be evaluated in a context of use in an investigation of the facts that is dynamic. The data base is not fixed. New facts are coming into the circumstances of the case. This dynamic aspect suggests that abductive inference could be best evaluated in an evolving dialogue between two parties.⁶ In other words, abductive inference could be seen as fitting into the standard scheme for evaluation of argumentation characteristic of the new dialectic (Walton, 1998). Several other aspects of the account of abductive inference given above also suggest the contextual variability of this kind of reasoning. One is that abductive inference is typically triggered by the asking of a question. How did something happen, or why did it happen? Another aspect is that abduction is based on the notion of explanation. And it can be argued that explanation is itself a dialectical notion that can only be analyzed by seeing it in a context of dialogue between two parties. Another aspect is the Tidmarsh example presented by the Josephsons. It is in the form of a dialogue. And in fact, presenting the abductive inference in this form best shows the process of reasoning that is characteristic of abduction, and how it works. All these aspects combined suggest that abductive inference could very nicely be modeled as a presumptive form of reasoning, fitting the many other argumentation schemes (forms of inference) for presumptive reasoning presented in (Walton, 1996). Following up this dialectical approach, below is presented a new analysis of the form of abductive inference as a kind of argumentation scheme.

The argumentation scheme for abductive argument is based on two variables. The variable F stands for a set of what are called the given set of facts in a case. A given set of facts can be viewed as a set of statements that describe the so-called "facts", or what are presumed to be the facts in a given case. They are called "facts" because they are presumed to be true statements, or at least their truth is not in question for the present purposes. The variable E stands for an explanation. But what is an explanation? According to the account on which the argumentation scheme below is based, the concept of explanation is dialectical, in the following sense. A set of statements E is judged to be a satisfactory explanation of a set of facts F if and only if E is a set of statements put forward by an explainer in a dialogue that gives the explainee in the dialogue a better understanding of F . An explanation, so defined, is a response offered to a particular type of question in a dialogue. The satisfactoriness of an explanation, so considered, depends on the type of dialogue the two parties are engaged in, on how far the dialogue has progressed, on what has been said in the dialogue before the explanation was attempted, and on the collective goal the dialogue is supposed to fulfill. So conceived, abduction is a form of argument that has the same kind of structure of an inference to the best explanation as postulated by the accounts of Peirce and the Josephsons. But instead, in the argumentation scheme presented below, the structure of the abductive form of argument is more explicitly dialectical.

Abductive Argumentation Scheme

F is a finding or given set of facts.

E is a satisfactory explanation of *F*.

No alternative explanation *E'* given so far is as satisfactory as *E*.

Therefore, *E* is plausible, as a hypothesis.

The term 'hypothesis' in the conclusion suggests that the abductive argument is a form of presumptive argumentation in a dialogue. The conclusion is only a tentative assumption, relative to the progress of the dialogue to a given point. It is not proved beyond doubt by the premises, but only sets in place an assumption that both parties to the dialogue should accept for the time being, so that the dialogue can progress further. As the dialogue proceeds, the abductive conclusion may stay in place, or further evidence may dislodge it. Things could go either way. The abductive conclusion can be seen as having a certain "weight" behind it. But that weight can be lightened, or even removed through the asking of appropriate critical questions by the other party in the dialogue. What are these critical questions? The evaluation factors of Josephson and Josephson, cited above, offer good guidance. The following critical questions provide a basis for evaluation that center on many of these same factors, or comparable ones.

- CQ1 : How satisfactory is *E* itself as an explanation of *F*, apart from the alternative explanations available so far in the dialogue?
- CQ2: How much better an explanation is *E* than the alternative explanations available so far in the dialogue?
- CQ3: How far has the dialogue progressed? If the dialogue is an inquiry, how thorough has the search been in the investigation of the case?
- CQ4: Would it be better to continue the dialogue further, instead of drawing a conclusion at this point?

The evaluation procedure outlined above explicitly analyzes abductive arguments as dialectical. Each abductive argument put forward in a given case has some weight in a dialogue, making its conclusion an assumption that should be reasonably accepted for the present. But each single abductive argument needs to be evaluated in a dialogue containing other abductive arguments as well. Some abductive arguments can conflict with others, because none of them, by itself, tends to be conclusive, or have very much weight. The small weight of plausibility of each argument needs to be evaluated, and then possibly re-evaluated, within the larger body of evidence compiled as the dialogue proceeds. Only once the dialogue is completed will the mass of evidence on both sides be weighed up and compared. The prior distribution of the burden of proof, presumably set at the beginning of the dialogue, will determine the final conclusion to be drawn. Typically however, single abductive arguments, as used in a given case, need to be evaluated

provisionally at a mid-point of the dialogue. Hence such argument are typically defeasible in nature. Even so they can be useful as rational arguments because they can play a small, but potentially important part, in the final outcome.

7. Tentative Conclusions

So what should be said in answer to the question about which is the third type of argument, as contrasted to deductive and inductive arguments? Is this third type of argument best described as abductive, presumptive or plausible? The best answer, although it will be unsatisfying to many who want a simple answer, is that this type of reasoning is both presumptive and plausibilistic, and it is very often abductive as well. It is perhaps even fair to say that it is typically abductive in nature. Plausible reasoning is like that. What characterizes it as a type of reasoning is that it selects from a set of alternatives, as Rescher's description of it (above) showed, and is relativized to a given body of evidence. These two characteristics are also properties of abductive reasoning. But abductive reasoning has the additional characteristic that it is always based on an explanation, or set of explanations, of the given body of evidence, or set of facts in a case. So abductive reasoning seems to be a special kind of plausible reasoning. But abductive reasoning seems to be inherently presumptive in nature. As Peirce's account makes clear, abduction is a kind of supposition-based reasoning that proceeds by the construction of a hypothesis. A hypothesis is a provisional guess that may have to be given up later, when more experimental evidence comes in. So abductive reasoning is presumptive in nature. The burden of proof is not there. A guess is allowed, even if there is very little or no firm evidence to support it yet. But the hypothesis has to be given up, if later contra-evidence falsifies it.

When the deductive and inductive categories are contrasted with some third category, what is the basis of the distinction? Is it the strength of the link between the premises and the conclusion? It is this aspect that often seems to be stressed as important. As Blair (1999a, p. 4) pointed out, philosophers interested in the norms that govern argument have focussed on the illiative (logical) core, rather than on the social practice in which the argument is embedded. But perhaps that way of classifying arguments looks to the wrong place. What should be looked at is how the argument is useful to contribute to goals of social practices, and how the goals can be interfered with by fallacious arguments. Presumption, abduction and plausibility have a logical core, as types of reasoning. But it is not possible to grasp the important differences between (among) them, unless they are viewed dialectically as types of argument. Presumption is best understood dialectically, as indicated above, by seeing how it operates in a dialogue by reversing the obligation to prove. Abduction, as indicated by the analysis above, is also best understood as a dialectical sequence with several distinctive steps. The first step is the existence of a given set of facts (or presumed facts) in a given case. A why-question or a how-question is then asked about this fact. In other words, an explanation for this

fact is requested by one participant in the dialogue. Then the other participant answers the question by offering an explanation. Through a series of questions and answers, several alternative explanations are elicited. Then there is an evaluation of these explanations and the "best" one is selected out. This best explanation is then detached by the first participant as the conclusion of the abductive argument. The dialectical nature of plausible argument has also been brought out by the analysis above, showing how plausible reasoning should be evaluated in a given case.

What should really be emphasized is that plausible reasoning is only based on appearances, on impressions of a case that could turn out to be misleading once the case has been studied in more depth. This aspect of it was brought out most clearly by the account of plausibility given by Carneades, with its three criteria for judging what is plausible. Plausible reasoning applies to cases where there is some evidence, but where there is doubt whether this evidence is veridical or conclusive. Something could appear to be true now, but when tested later, it may turn out to actually have been false. Or, at any rate, it may now appear to be false, on the balance of the evidence. Plausible reasoning is especially useful in cases where there is some unsettled issue or controversy, so that opinions on both sides of the issue are feasible. Plausible reasoning is best judged as relative to the given evidence in the case and even, or especially when that evidence is yet incomplete. Thus typically, in a kind of case in which plausible reasoning is most useful, there are two opposed theses, both are alternatives with some weight of evidence behind them, and the total evidential situation is incomplete. As Blair (1999a, p. 6) puts it, "in the kind of reasoning characteristic of argumentation schemes, there are both reasons to support a conclusion, and reasons to support the contradictory of the conclusion." The choice between alternatives is made on a balance of considerations. Neither alternative can be proved, but neither can be disproved. It is a decision between carrying the search for more evidence forward, or because of costs and practical exigencies, making a guess now. Plausible reasoning steers an evidence-gathering but open-minded dialogue ahead through a mass of uncertainties in a fluid situation by making the presumptive inferences that point the best path ahead. Thus the context of dialogue is essential to the evaluation.

If this approach is on the right track, then maybe it is better to resist the triadic terminology of deductive, inductive, abductive (despite the attraction that the words have, since they go so nicely together). Instead, we should have dual classification. On the one side are deductive and inductive arguments. On the other side is plausible argument. Plausible argument is a kind of guessing that is especially susceptible to wrong impressions and fallacies. It is not very exact, and it is variable and presumptive in nature. It is vitally important for the user of plausible argument to be open-minded, steering a mid-path between respecting the facts of a case and asking critical questions. The two main faults are the extremes of being dogmatic and leaping too quickly or too firmly to a questionable conclusion. Being dogmatic is a failure to be open to further dialogue. Leaping too quickly or too

firmly may be a failure to seek more evidence, or even a closure to new evidence. Thus plausible reasoning requires different skills from deductive and inductive reasoning. It is less a matter of exact calculation than a matter of steering a dialogue ahead by balancing and weighing up many complex arguments on both sides. Abduction is best defined as a special kind of plausibilistic argumentation that has a distinctive argumentation scheme. Many, but not all plausible arguments are abductive in nature. Abductive arguments, and plausible arguments generally, tend to be presumptive, resulting in conclusions that are hypotheses or partially supported guesses.

Josephson and Josephson (1994) have argued for a new taxonomy of basic inference types, as opposed to Peirce's tripartite taxonomy of deduction, induction and abduction. They classify inductive generalization as a subspecies of abduction (p. 28). They argue (pp.19-22) that it is possible to treat every good (that is, reasonable or valid) inductive generalization as a species of abduction. They see abduction not as contrasted with deduction or induction, but with prediction. Their arguments for this new taxonomy are impressive, and raise many interesting fundamental questions, but in view of the controversial nature of the subject, it is hard to see them as resolving the issue. Perhaps the most significant lesson that can be drawn from their work on abduction, for our purposes here, is their insistence on the importance of plausible reasoning as a fundamental category. What should also be noted is the impressive body of evidence they have presented showing how abduction (and prediction as well) are best treated as species of plausible reasoning.

This paper will not offer any final word on this controversial issue. As abductive and defeasible reasoning is more and more an important topic in artificial intelligence and legal reasoning (Prakken, 1996; Verheij, 1996), the issue will become more and more hotly debated. Instead of trying to offer the final word, this paper will conclude by offering tentative definitions of the key concepts featured in the argumentation in the paper. These proposed definitions have partly a historical and conventional basis, as outlined above. But they also have a stipulative or persuasive aspect, in that they are based on the philosophical reasons given above that indicate how these terms ought properly to be defined in light of recent work in argumentation theory and informal logic.

Tentative Definitions of the Different Kinds of Inference

Abductive. From *ab* and *duco*, leading back. An abductive inference goes backwards from a given conclusion to search for the premises that conclusion was based on. Abductive reasoning is familiar in knowledge-based systems in computer science. For example, in an expert system, a user may want to ask what premises were used by the expert system, in the chain of reasoning the expert

advice-giver used to arrive at a conclusion. Abductive inference is widely taken to be the same as inference to the best explanation.

Presumptive. The prefix *pre* indicates that a presumption is a kind of speech act assuming that something is taken as acceptable in relation to something else later in the line of argumentation. A presumption is something that can be accepted by agreement temporarily as things go forward unless at some future point in the exchange it is shown to be unacceptable. A presumption is a proposition put forward by one party for acceptance by both parties to a discussion, subject to possible retraction of acceptance by the other party at some future point. A presumptive inference enables a conclusion to be drawn provisionally from premises, in the absence of refutation from either party to a discussion, and subject to future refutation by either party.

Plausible. To say something is plausible means that it seems to be true. A more specific definition was proposed by Carneades of Cyrene. According to this definition, a proposition is plausible if it seems to be true, and (even more plausible) if it is consistent with other propositions that seem to be true, and (even more plausible) if it is tested, and passes the test. A plausible inference is one that can be drawn from the given apparent facts in a case suggesting a particular conclusion that seems to be true. Both a proposition and its negation can be plausible, as the ancient legal case of the stronger and the weaker man showed.

Deductive. The notion of deductive inference is the one of this family of terms about which there is the least disagreement. Deductive inference is characterized by the notion of deductive validity, the success criterion to which a deductive inference is aimed. A deductively valid inference is one in which it is (logically) impossible for the premises to be true and the conclusion false. Logic textbooks and scholarly writings in logic widely agree on this way of defining deductive validity.

Inductive. This kind of inference is often defined using the term 'probability'. But there are deep differences of opinion what this term should be taken to mean (Skyrms, 1966). There is an older meaning of the term 'inductive' coming from Aristotle and Greek philosophy, where it means something like generalizing from a set of particular cases. In modern terminology however, inductive inference seems to be equated with probability of the kind characteristic of statistical reasoning.

Probable. Probable inference can be taken to mean many things, but perhaps the clearest definition of it comes from the axioms for the probability calculus. For example, the probability value of not-*A* (the negation of *A*) is defined as the probability value of unity minus the probability value of *A*. There is also an older mean-

ing of 'probable', most evident in writings on casuistry, which goes back to Greek philosophy. The term used in Greek philosophy for what is, or should nowadays be translated as 'plausible' (*pithanon*), was traditionally translated as 'probable'. This translation is very confusing since the advent of the probability calculus, because modern readers assume that what is meant is the modern use of the term 'probability', referring to statistical inferences of the kind we are so familiar with in statistical polling and collection of data.

In examining the definitions above, a common element of 'presumptive' and 'plausible' is apparent. Both are based on the idea of a process of collecting evidence that is moving forward. It could be a process of discussion of an issue or a process of collecting data, or both. The process is not conclusive, in the sense that the conclusion arrived at will be known to be true (or false) beyond doubt. But the process may entail that commitment to a proposition that seems to be true at a given point may be retracted or altered at some future point. For example, at a future point the proposition may seem to be false. Or sufficient doubts may arise so that it no longer seems to be true. The common process is one of dynamic collection and use of evidence in which things may go one way or another. Acceptance of a proposition can be contra-indicated, leading to its "defeat". Or the new evidence may yield additional reasons for its acceptance.

Notes

¹ Peirce in 'Pragmatism and Pragmaticism' (1965, p. 99) wrote: "Reasoning is of three types, Deduction, Induction, and Abduction".

² It will be shown below that Greek philosophers were very familiar with forms of inference closely related to abductive inference, and that there is a long, but not well known history linking these ancient notions to modern notions of plausible inference. Much historical work on the development of informal logic remains to be done, and much is simply not yet known.

³ Wellman's category of conductive argument showed the importance of a third category in ethical argumentation. It is beyond the scope of this paper, however, to go into the question of whether conductive and abductive arguments are the same or different. The author is currently working on studying this question as a research project on the subject of ethical justification. The research is to be published in a book, *Ethical Argumentation*, Lexington Books, 2002.

⁴ Skyrms (1966, p. 4) put forward the view that 'deductive' and 'inductive' are not the names of kinds of arguments, but should be seen as success criteria for arguments.

⁵ A controversial case in point is whether argument from sign is abductive. Many instances of argument from sign are clearly abductive, and viewing them as abductive inferences seems revealing and useful. But some arguments from sign are not abductive. For example, we take the presence of certain kinds of dark clouds as a sign that it will rain. Yet as the Josephsons (1994, p. 24) have convincingly argued, predictions are not abductions.

⁶ Cawsey (1992) has argued very convincingly, using many examples, that the concept of explanation can best be analyzed as an interactive notion of goal-directed dialogue. If abduction is to be defined as inference to the best explanation, it would follow that abduction is inherently dialectic-

cal in nature. This hypothesis is, of course, opposed to the traditional positivistic conception of explanation as being based on deductive and inductive inferences from laws (where laws are taken to be universally quantified statements or inductive regularities).

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