Abstract
This paper aims to show, first, that Peirce's theory of the origin of abduction in Aristotle's *Prior Analytics* II.25 is mistaken, for Peirce forced the dialectical syllogisms of that passage to resemble his conception of abduction as a syllogism of the second figure that attempts to infer a minor premise. Second, it aims to show that there are abductive syllogisms in other passages of Aristotle's work that Peirce neglected. In those passages, Aristotle distinguished between the syllogism that infers the fact and the one that infers the reason. The latter is a syllogism in the second figure that explains the cause of a phenomenon, and it has been qualified by ancient and modern comentators as the syllogism of discovery. Moreover, Aristotle related that kind of syllogism with the mental capacity of discovering the cause, namely, *anchinoia*, translated as the skill of conjecture or sagacity.

Keywords: Charles Peirce, Aristotle, abduction, logic, anchinoia (skill of conjecture).

Peirce's Theory of the Origin of Abduction in Aristotle

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Peirce's theory of the origin of abduction in Aristotle's *Prior Analytics* II.25 is based on his account of abduction as a second-figure syllogism. Peirce read the difficult and (what he thought to be) corrupted passage of *Prior Analytics* II.25 and tried to amend its errors and explain its difficulties in order to argue that Aristotle was trying to present a syllogism in the second figure that infers a case, which is Peirce's definition of abduction. "[H]e would not be Aristotle, to have overlooked [the] question" whether such an inference sometimes occurs, said Peirce in his 1901 paper "The Logic of Drawing History from Ancient Documents" (CP 7.249).

Several years after suggesting that Aristotle had described abduction in that passage, Peirce claimed that it was doubtful whether Aristotle had done so. Nevertheless, the fact that Peirce continued mentioning it indicates that he did not regard it as completely wrong. He simply regarded it as a hypothesis that would require further testing.

In this article I argue that Peirce's hypothesis of the origin of abduction in *Prior Analytics* II.25 is not only doubtful but wrong. Aristotle did not want to postulate a syllogism that proves the minor premise, and Peirce forced that passage to fit with his own account of abduction as second-figure syllogism. As a result, it is highly improbable that *Prior Analytics* II.25 can be a first account of abduction. Nevertheless, this does not mean that Aristotle did not think of abduction. There are other passages in his logical works, passages neglected by Peirce, where it is possible to find an account of abduction as reasoning that explains a cause.

This paper is divided into two sections. The first is devoted to arguing against Peirce's hypothesis of the origin of abduction in *Prior Analytics* II.25 and explaining the difficulties with Peirce's hypothesis. In the second section, I present my own hypothesis of the origin of abduction in Aristotle. I will point out other passages, in *Posterior Analytics*, where Aristotle dealt with the syllogism that infers the cause (διότι) and the noetic capacity for discovering the cause (ἀγχίνοια). It is surprising that Peirce neglected those passages for, from my point of view, they fit perfectly into his theory of abduction as an inference in the second-figure that infers a case and discovers a cause.

1. Peirce's Hypothesis of the Origin of Abduction in Aristotle

Although Peirce had contemplated his hypothesis of the Aristotelian origin of abduction in some earlier writings,[1] he presented it in detail for the first time in 1901's "On the Logic of Drawing History from Ancient Documents."[2] Later he qualified it as "doubtful" (CP 8.209, 1905, a letter to Signor Calderoni), yet without saying why it was so. The hypothesis is certainly complex and implies more than what is expressed in those extant passages by Aristotle. However, it is important to take into account that Peirce did not claim that Aristotle had a clear and distinct concept of abduction. Rather, he claimed that Aristotle was "groping" (CP 5.144, 1903) for the kind of inference that infers a hypothesis. I agree that Aristotle did try to find an explicative syllogism, but I think that Peirce is wrong in pointing to *Prior Analytics* II.25 as the text in which Aristotle did so.

Peirce's hypothesis is that *Prior Analytics* II.25 was originally devoted to explaining abduction as an inference of the case (the minor premise in a deductive syllogism) from the rule and the result (the major premise and the conclusion of a deductive syllogism) as data. This passage needs some correction before it can be read as containing a predecessor

of abduction, but those corrections are justifiable, said Peirce, by the fact that most of Aristotle's writings are full of misreadings and blunders and by the fact that the "stupid[ity]" (CP 5.144, 1903) of Apellicon in correcting the manuscripts might be responsible for some incongruences. As a result, Peirce suggested, it is possible to amend those blunders with the simple addition and change of some words. Peirce stated his theory as follows:

> Now, Aristotle is throughout the Prior Analytics, especially, so unfailingly thorough in examining every case which is formally analogous to other cases treated by him, that we cannot doubt for an instant that, having remarked that induction, Ἐπαγωγή· [Epagögé], is the inference of the major premiss of a syllogism in Barbara or Celarent from its other two propositions as data, [he] would have asked himself whether the minor premiss of such a syllogism is not sometimes inferred from its other two propositions as data. Certainly, he would not be Aristotle, to have overlooked that question; and it would no sooner be asked than he would perceive that such inferences are very common. Accordingly, when he opens the next chapter with the word Ἀπαγωγή· [Apagögé] a word evidently chosen to form a pendant to Ἐπαγωγή· [Epagögé] we feel sure that this is what he is coming to (CP 7.249, 1901).

Peirce was right that those last chapters of *Prior Analytics* are devoted to the study of non-demonstrative reasoning. Peirce's theory consists in claiming that since Aristotle already stated that ἐπαγωγή (*epagōgē*) is the inference of a major premise, ἀπαγωγή (*apagōgē*) should therefore be the inference of a minor one. "[H]e would not be Aristotle, to have overlooked that question."

Aristotle began *Prior Analytics* II.25 by saying that *apagōgē* leads us closer to knowledge (*epistēmē*). To say that *apagōgē* takes us closer to knowledge is the same as to say that it is not a demonstrative or apodictic inference as is deduction. The latter takes us to knowledge directly, whereas *apagōgē* is not as perfect and therefore merely takes us closer to it. It is to say that its conclusion is only probable or plausible, not necessary or certain. According to Anderson, this element of Aristotle's *apagōgē* is clearly present in Peirce's concept of abduction.[3]

The passage continues with the claim that there are two kinds of *apagōgē*. First, there is *apagōgē* when the major premise is well-known but the minor premise is unknown, although as or more credible (πιστόν) than the conclusion. Peirce claimed that Aristotle should have added "which conclusion we find to be a fact" (CP 7.249). Second, there is *apagōgē* when there are few middle terms between the last and the middle.

Next, Aristotle presented an example of each kind of *apagōgē*. The first example presented is that in which, from a well-known major

premise and from a minor premise that is unknown (although as credible as the conclusion or more), we can infer dialectically, not apodictically, the conclusion.

Epistēmē (B) is teachable (A).	(major premise—evident proposition)
Justice (C) is *epistēmē* (B).	(minor premise—as or more credible than the conclusion)
∴ Justice (C) is teachable (A).	(conclusion)[4]

This is a first-figure syllogism, i.e., a perfect and valid form of inference. It is not, however, a sound and apodictic inference, for its minor premise is not a necessary and true proposition. Nevertheless, it is a valid form of inference. Peirce complained about this reading, which renders this syllogism as a deductive one in the first figure. He rejected such a reading as a *petitio principii*, for, he said, it is impossible to prove that justice is *epistēmē*, except by its being teachable (CP 7.251); that is, it is impossible to prove the minor premise except by way of the conclusion. Moreover, added Peirce, "few in Aristotle's time had used this absurd argument; it had scarcely been seriously doubted, what all experience shows, that virtue can be taught" (ibid.). Thus, the argument, thought Peirce, is constructed in order to prove that 'justice is *epistēmē*' (minor premise) rather than to prove something that no one had doubted, namely, that 'justice is teachable.' In other words, if 'justice is teachable' is a fact, then it can be used as a premise to infer the more problematic proposition 'justice is *epistēmē*.'

As a result, Peirce claimed that what Aristotle intended was to prove the minor premise through the major premise and the conclusion, and therefore some changes are necessary in the extant passage in order to sustain Peirce's reading. It has to become a second-figure syllogism, and it has to add that "the conclusion is a fact." Consequently, Peirce's reading of this example was as follows: from the well-known and evident major premise that '*epistēmē* is teachable' and from the fact that 'justice is teachable,' it is possible to infer the less-evident minor premise that 'justice is *epistēmē*.' The abductive argument in the second figure that Peirce drew is as follows:

Epistēmē (B) is teachable (A).	(major premise—evident proposition)
Justice (C) is teachable (A).	(conclusion—fact)
∴ Justice (C) is *epistēmē* (B).	(minor premise—a better explanation of the teachability of justice)

However, there are some problems with Peirce's reading that render his hypothesis doubtful, as he himself conceded later. First, Peirce not only added some words, but he also had to modify the extant ones insofar as he reversed the order of the propositions in a way that Aristotle did not indicate. Clearly, he forced the passage to resemble his own theory of abduction in a second-figure syllogism.

Second, Aristotle wrote that there is *apagōgē* when the first premise is evident and the second premise is not evident although as or more credible than the conclusion. If we accept the emendation that Peirce proposed, namely, that "we find the conclusion to be a fact," then we should accept it as fact even though Aristotle held that it was less or as credible as the minor premise. Thus, from Peirce's reading the argument is stated as follows: if it is evident that "*epistēmē* is teachable," and it is an undeniable fact that "justice is teachable," then the best explanation is that "justice is episteme." However, that "justice is teachable" is not a fact but one of the most controversial statements of Greek philosophy. Peirce wrongly claimed that "it had scarcely been seriously doubted, what all experience shows, that virtue can be taught" (CP 7.251). Such a proposition is so controversial that Plato constantly reacted against the sophists who intended to teach virtue. Moreover, Plato mentioned several cases of virtuous men, such as Themistocles, Aresteides, Pericles and Thucydides,[5] who educated their sons in many things and tried to educate them in virtue but were unsuccessful. For that reason, Socrates concluded that "virtue cannot be taught."[6]

It is interesting that Aristotle is using the same argument that Plato used in *Meno*. The aim of that dialogue is to discuss whether virtue is teachable. Plato claimed only that virtue would be teachable **if** virtue is knowledge (*epistēmē*). His argument is not conclusive or apodictic. It is only a hypothetical argument (*ex hypotheseos*).[7] The minor premise 'virtue is *epistēmē*' is only a hypothesis for Plato; if that condition is true, then it follows that 'virtue is teachable.' It is very evident that Aristotle bore in mind this passage from Plato and that his apagogical argument assumes neither that the premise 'virtue is knowledge' is apodictically asserted nor that the conclusion 'virtue is teachable' is a fact.

Peirce seems to have misread this example, forcing it to fit with his own conception of abduction as a second-figure syllogism. He also seems to have forgotten that Aristotle distinguished between demonstrative syllogisms and dialectical syllogisms, both of which are valid deductive syllogisms that differ only in the nature of their premises, which are either necessary or contingent, respectively. In this first example from *Prior Analytics* II.25, Aristotle wanted only to show that if we are certain of the major premise and we have a credible minor premise (contingent or dialectical), then the conclusion is at least as credible as the minor premise. Likewise, Aristotle actually thought of this argument as being in the first figure with a problematic or hypothetical

minor premise. In short, *apagōgē*, for Aristotle, was simply a kind of first-figure dialectical argument in which there is an apodictic major premise and a credible or dialectical minor premise.

The second example that Aristotle presented in *Prior Analytics* II.25 refers to the kind of *apagōgē* in which there are few middle terms between the major and the middle term, that is, when the minor premise is problematic but can be asserted with the addition of only a few other middle terms. This example is more complex, and Peirce thought that there was a corruption in the text that could be corrected with the change of a single word in order to fit his formal account of abduction. Aristotle's argument can be formalized as follows:

Any rectilinear figure (E) is capable of being squared (D).	(major premise)
The circle (Z) is a rectilinear figure (E).	(minor premise—there is only one middle term between these terms, namely, 'lunes')

∴ The circle (Z) is capable of being squared (D). (conclusion)

This argument, like the former example, is a valid first-figure syllogism. Similarly, the minor premise is the problematic one, for it asserts paradoxically that 'the circle is a rectilinear figure,' which, according to Aristotle, can be proved by means of one middle term, the 'lunes' (*mēniskoi*). This is a clear reference to Hippocrates' geometrical experiment of squaring the circle according to which the sum of lunes can be equal to a rectilinear figure and also equal to a circle.[8] Since the syllogism makes clear reference to the problem of squaring the circle, it is evident that it intends to prove that "the circle is capable of being squared." In order to prove it, Aristotle stated as major premise the evident and necessary proposition "a rectilinear figure is capable of being squared," and he also stated as a minor premise a problematic proposition that would be accepted only if Hippocrates' geometrical experiments were accepted. Therefore, this second kind of *apagōgē* is similar to the first example in that both have a problematic or contingent minor premise, namely, that 'justice is *epistēmē*' and that 'the circle is a rectilinear figure.' In the former, it is a credible dialectical proposition; in the latter, it is a proposition that needs more than one middle term to be accepted.

Peirce, on the other hand, believed that the major term (D) 'capable of being squared' (*tetralōnizesthai*) was corrupted and that it makes more sense if it is read 'equal to a sum of lunes' (*ison méniskos*). Moreover, Peirce also complained about the traditional reading of this argument as a deduction in the first figure, in spite of the fact that that is the

way in which Aristotle himself presented it. As a result, Peirce proposed to reverse the order of the propositions and have a second-figure abductive syllogism as follows:

Any rectilinear figure (E) is equal to a sum of lunes (D).

The circle (Z) is equal to a sum of lunes (D).

∴ The circle (Z) is a rectilinear figure (E).

As in the former example, Peirce's reading presents many problems. First of all, it is difficult to see the difference in Peirce's correction, for the only thing it does is to avoid the additional middle term. Yet, if there is not an additional middle term, then it does not correspond to Aristotle's definition and becomes nothing but another example of the previous argument about 'justice.' Just as in the first example, Peirce attempted to show that the major premise or rule is evident, that the minor premise or result is a fact, and that the conclusion therefore follows abductively from them. However, such a reading suffers from the same problem as the former one, for it is far from obvious that the minor premise is a fact. The proposition "the circle is equal to a sum of lunes" does not express a fact but is instead a debatable proposition derived from some geometrical experiments that not everyone accepted. Indeed, Peirce acknowledged that Aristotle was not a good mathematician and that he did not understand Hippocrates' experiment: "Mathematics was not Aristotle's strong point, and possibly he did not clearly understand that it was only two or three special lunes that Hippocrates had squared" (CP 7.251). Moreover, in his book *Mathematics in Aristotle* Heath recognizes that the Stagirite did not understand Hippocrates' geometrical experiment: "We are driven to the conclusion that Aristotle was not well informed as to what Hippocrates had actually done."[9] In addition, Anderson notes that Peirce's requirement of abduction that it have a minor premise as a fact is definitely not correct with regard to the second example.[10] As result, if the minor premise is not a fact, we are left with the fact that it is only a problematic or contingent premise.

In conclusion, Peirce's hypothesis of the presence of abduction in Aristotle's *Prior Analytics* II.25 is indefensible. Both examples in that passage are first-figure syllogisms with a dialectic or contingent minor premise. Aristotle did not give any indication of reversing propositions in order to create a second figure. Furthermore, both examples have a dialectic minor premise, in contrast to Peirce's suggestion that such a minor premise is a fact. Moreover, Peirce's theory of the presence of abduction in Aristotle's *Prior Analytics* II.25 is based on his account of abduction from the point of view of a categorical syllogism in the second figure,[11] which he later recognized to be mistaken because it confuses

abduction with qualitative induction.[12] And most importantly, he himself recognized that such a hypothesis of the origin of abduction in Aristotle is questionable, describing as "doubtful" his theory "that the meaning of the XXVth chapter of the second book of the Prior Analytics has been completely diverted from Aristotle's meaning by a single wrong word having been inserted by Apellicon where the original word was illegible" (CP 8.209, c.1905, letter to Signor Calderoni). I conclude that Peirce was wrong to claim that Aristotle had provided an account of abduction in *Prior Analytics* II.25.

Many reasons can be postulated to explain Peirce's mistake. For instance, he may have been misled by the similarities between *apagōgē* and abduction, such as the non-deductive character of Aristotle's examples and of his claim that *apagōgē* gets us closer to knowledge. Perhaps Peirce was also misled by the medieval translation of '*apagōgē*' as 'abduction' by Giulio Pacio.[13] Or perhaps he was misled by the similarity of the terms ἀπαγωγή and ἐπαγωγή; again, he wrote that the former was "evidently chosen to form a pendant to" the latter (CP 7.249). In any case, it seems to me very clear that *apagōgē* does not correspond with Peirce's abduction, for all the changes that Peirce proposed to make that passage fit with his conception of abduction are very extreme and improbable.

As a result, we are left with two options: either deny completely that Aristotle had an account of abduction or look elsewhere in his works for an account of abductive inference. I will take the latter option. As we will see, there are passages in *Posterior Analytics* in which what Aristotle said closely resembles Peirce's notion of abduction.

2. A Theory of Abduction in Aristotle, Beyond Peirce's Hypothesis

The passages in *Posterior Analytics* that resemble Peirce's theory of abduction are those that deal with the syllogism that explains a cause and with the cognitive capacity to grasp a cause. Aristotle stated a distinction between a fact (ὅτι) and a reason or cause (διότι), that is, between the occurrence of an event and the explanation of its causes. For instance, it is one thing to state that a lunar eclipse is taking place, which is a fact (ὅτι), and a different thing to state that the reason for the eclipse is the interference of the earth between the sun and the moon, which is a cause (διότι).[14] Nonetheless, what is most important to our discussion here is the fact that Aristotle stated that there is a difference between the syllogism of the fact and the syllogism of the cause, and that there is a cognitive capacity to grasp the cause of an event, ἀγχίνοια (*anchinoia*), which has been translated as 'quick wit' or 'sagacity.' This seems to me very similar to Peirce's conception of abduction, for Aristotle proposed a syllogistic form for the inference of the cause and a capacity for grasping it. For Peirce, knowing the cause of something is the objective of abduction. Aristotle faced this same problem, and his solution, although rudimentary and incipient, greatly resembles that of Peirce.

It is surprising that Peirce seems to have neglected these passages since they fit perfectly with his account of abduction. In this section I will present Aristotle's account of a syllogism that explains the cause as well as his concept of ἀγχίνοια.

The syllogistic description of the form in which a cause is inferred can be found at *Posterior Analytics* I.13 78a22–78b11. Aristotle was trying to show that some syllogisms do not prove a fact and a reason at the same time; thus he proposed the following example:

Whatever does not twinkle (B) is near (A).	(major premise)
Planets (C) do not twinkle (B).	(minor premise)
Therefore, planets (C) are near (A).	(conclusion)

This syllogism proves that the planets are near by means of a fact (ὅτι), namely, that they do not twinkle. For, he said, "it is not because the planets do not twinkle that they are near, but because they are near that they do not twinkle."[15] On the contrary, if it aims to prove that "planets do not twinkle" it will have to do so through its cause (διότι). The interesting thing is that to formulate this causal syllogism Aristotle followed a procedure that greatly resembles that of Peirce, namely, the inversion of the propositions. The Greek philosopher stated: "It is possible, however, to prove the middle premise through the major, and this will be the demonstration [*apodeixis*] of the cause"[16]. This is an inversion of the propositions of the syllogism, for in a deductive inference the proof is made though the middle term, but if the proof of the cause is going to be made through the major term, then the order of the propositions has to be inverted. Likewise, with regard to another example Aristotle also argued for the necessity of reversing the propositions: "when the middle term is reversed [ἀνάπαλιν δὲ τεθένος τοῦ μέσου] it generates a causal syllogism [διότι]."[17] Hence, the inversion of that syllogism transforms it into a second-figure syllogism:

Whatever does not twinkle (A) is near (B).	(major premise)
Planets (C) are near (B).	(conclusion)
Therefore, planets (C) do not twinkle (A).	(minor premise)

Aristotle offered a second example that Ross judged to be a "scientific explanation."[18] The syllogism in the first figure that uses a fact (ὅτι) in order to conclude something else is as follows:

That which waxes in this way (A) is spherical (B).

The moon (C) waxes in this way (A).

Therefore, it is evident that the moon (C) is spherical (B).[19]

But if the middle term is interchanged we have a syllogism that explains the fact through the reasoned cause (διότι) and it becomes a second-figure syllogism:

That which waxes (A) is spherical (B).

The moon (C) is spherical (B).

Therefore, the moon (C) waxes (A).

This is the very same procedure that Peirce proposed, for the syllogism that explains the cause is in the second figure. Likewise, the inversion of propositions corresponds to Peirce's proposed changes, namely:

Deduction	**Abduction**
Rule—Major Premise	Rule—Major Premise
Case—Minor Premise	Result—Minor Premise
Result—Conclusion	Case—Conclusion

Table 1. Comparison of Deduction and Abduction

The similarity between Aristotle's and Peirce's accounts with regard to the symmetry of the two kinds of reasoning is increased when it is noted that Aristotle also included induction, as Peirce did. Aristotle said with regard to the first example that the major premise "Whatever is near does not twinkle" is a proposition that should be assumed by means of induction or sense-perception.[20] The conclusion or result is inferred deductively through a first-figure syllogism, the major premise or rule is inferred inductively through a third-figure syllogism, and the minor premise or case is inferred abductively through a second-figure syllogism. For if this major premise proceeds from induction, the deductive syllogism can be inverted in order to explain induction (like the example of induction in *Prior Analytics* II.23):

Planets do not twinkle.	(case—minor premise)
Planets are near.	(result—conclusion)
Therefore, whatever does not twinkle is near.	(rule—major premise)

DEDUCTION	**ABDUCTION**	**INDUCTION**
First Figure	*Second Figure*	*Third Figure*
Rule	Rule	Case
Case	Result	Result
Result	Case	Rule

Table 2. Comparison of the Three Kinds of Reasoning

Another aspect of Peirce's concept of abduction is that the inference that adopts an explicative hypothesis is the less-controlled inference; therefore, for the most part it involves guesses or flashes of insight, although it does not lose its inferential character. In *Posterior Analytics* I.34, Aristotle proposed a cognitive capacity that grasps the cause. The importance and brevity of this passage warrant its complete transcription:

> Quick wit [ἀγχίνοια] is a sort of hitting [εὐστοχία] upon the middle term in an imperceptible time [ἀσκέπτῳ χρόνῳ]. For example, if someone sees that the moon always has its bright side toward the sun, he immediately realizes [ἐνενοήσεν] the reason [διὰ τί τοῦτον], that is, because the moon gets its light from the sun. Or if he sees someone talking with a rich person, he realizes [ἔγνω] the reason [διότι], namely, because he is trying to borrow money. Or he understands that some people are friends, because they have the same enemy. In all these cases, seeing the extreme terms enables him to know the cause [αἴτια] or middle term. A stands for 'bright side facing the sun,' B for 'receiving brightness from the sun,' and C for 'moon.' Then B, 'receiving brightness from the sun' can be applied to C 'moon'; and A can be applied to B, this is, 'what receives its brightness from the sun is facing it.' As a result, A applies to C through B.[21]

Ἀγχίνοια ('*anchinoia*') has been translated as 'quickness of wit'[22] and 'quick wit.'[23] It is also defined as "ready wit, sagacity, shrewdness."[24] Aristotle mentioned it in *Nichomachean Ethics* 1142b5–6 as well, and although it can also have a sense related to ethical virtues, the sense with which I am concerned is that of the capacity of grasping a cause. From an etymological point of view, ἀγχίνοια is closely related to '*nous*.' The word is a compound of the noun *nous*. Moreover, Aristotle noted that the action of realizing the cause is a noetic act (ἐνενοήσεν). The word is also a compound of the adverb ἄγχι, which means "near" in the spatial and temporal sense and "like" in the sense of resemblance.[25] Therefore, etymologically ἀγχίνοια means "what is near or like *nous*."

In his definition of ἀγχίνοια, Aristotle stated that it is a kind of εὐστοχία, which, besides meaning "hitting upon," has been translated as "skill of conjecture,"[26] and "skill in shooting at a mark," "good aim," or metaphorically, "sagacity," "shrewdness."[27] ἀνχίνοια hits upon the middle term or cause in an "imperceptible time" (ἀσκέπτῳ χρόνῳ). This last expression has been translated as "imperceptible time" by Ross,[28] which I prefer over Tredenerick's translation, "without a moment of hesitation"[29], or Mure's translation, "instantaneously."[30] Ross's translation is more accurate because it retains, I think, what Aristotle meant, namely, that there is an inferential process that has duration and can be expressed in syllogistic form, even though it cannot be perceived at that time.

Next, Aristotle offered three examples of ἀγχίνοια, among which the first is most useful because it provides the key for formalization. First he said: "if someone sees that the moon always has its bright side toward the sun, he immediately realizes [ἐνενοήσεν] the reason, that is, because the moon gets its light from the sun."[31] Second, a few lines later he provides the elements to formalize this argument, which indicates that it is not just an intuitive grasping or even immediate but an inference "imperceptible" through a middle term. The elements are: "A" stands for "bright side facing the sun," "B" for "receiving brightness from the sun," and "C" for "the moon." Based on his other indications, the argument stands as follows:

Everything that derives its light from the sun (A) has its bright side facing it (B).

The moon (C) always has its bright side facing the sun (B).

Therefore, the moon (C) derives its light from the sun (A).

This is a syllogism in the second figure. It has the very same form Aristotle used in the other causal syllogisms (διότι). The other two examples are not formalized. Aristotle only mentioned them briefly as follows: "if he sees someone talking with a rich person, he realizes [ἔγνω] the reason [διότι], namely, because he is trying to borrow money. Or he understands that some people are friends, because they have the same enemy." If we follow the same process Aristotle gave in order to formalize the first example, these two last examples stand as follows:

Everyone who tries to borrow money talks to a rich person.

Someone is talking to a rich person.

Therefore, that person is trying to borrow money.

All who have a common enemy are friends.

Two people are friends.

Therefore, these two people have the same enemy.

There is an interesting commentary by Alexander of Aphrodisias on this passage in *Posterior Analytics* I.34.[32] In general, Alexander cited the same examples as Aristotle, but the interesting thing is that he related *anchinoia* with discovery (*euresis*) of causes. This is a clear reference to the retroductive character of abduction as the inference of discovery. *Anchinoia*, he said, is not an apodictic demonstration; hence it is not a valid and sound deduction. However, it is the best way to grasp the cause of an event. That is why it is translated also as 'sagacity' or 'discernment.'

In conclusion, if Peirce's interest was to find the predecessor of his own idea of abduction in Aristotle, he should have looked at *anchinoia* rather than *apagōgē*. Peirce wrongly took the passage in *Prior Analytics* II.25 as containing an abductive inference. That passage contained only a dialectical syllogism. Instead, Peirce should have looked to those other passages in *Posterior Analytics* where Aristotle discussed the syllogism of the cause (*dioti*) and the cognitive faculty of realizing the cause, *anchinoia*.

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NOTES

1. RLT 140–141, R 440:33, 1898 ("Detached Ideas"); R 441:29, 1898 ("Types of Reasoning"). (References to "R" are to Peirce's unpublished manuscripts according to the catalog numbers assigned in Robin 1967, by manuscript and page number.) These are the earliest papers in which I have been able to track Peirce's theory of Aristotle's origination of abduction. In his Harvard Lectures of 1865, Peirce dealt at length with the symetrical figures of the three kinds of inferences, but he did not consider whether inference concluding in a hypothesis had an origin in Aristotle's logic. He did mention Aristotle's account of deduction, which is obvious, and of induction. See, for instance, W 1:177, 179, 262–264; and R 741:11ff., which according to the *Writings* dates from spring 1865. The idea that induction is an idea found in Aristotle is repeated by Peirce in other, later writings. See RLT 139, 1898; R 440:31, 1898 ("Detached Ideas"); CP 7.249, 1901 ("On the Logic of Drawing History from Ancient Documents"); R 764:13, n.d. However, Peirce's theory of Aristotle's origination of abduction is an idea that I have found only in his writings from between 1898 and 1905.

2. He also mentioned it in the following passages: "At any rate, even if my conjecture is wrong, and the text must stand as it is, still Aristotle, in that chapter on Abduction, was even in that case evidently **groping** for that mode of inference which I call by the otherwise quite useless name of Abduction,—a word which is only employed in logic to translate the [ἀπαγωγή {*apagōgē*}] of that chapter" (CP 5.144, EP 2:205, 1903, bold emphasis added). "*Presumption,* or, more precisely, *abduction* (which the present writer believes to have been what Aristotle's twenty-fifth chapter of the second *Prior Analytics* **imperfectly described** under the name of ἀπαγωγή {*apagōgē* }, until Apellicon substituted a single wrong word and thus disturbed the sense of the whole), furnishes the reasoner with the problematic theory which induction verifies" (CP 2.776, 1902, bold emphasis added). "The second figure of probable reasoning is in my opinion what Aristotle meant by apagoge, which is always translated abduction. For the true theory of induction, which he gave, would inevitably bring him to this. It is true that in ordinary Greek ἀπαγώγη generally means abduction; but it sometimes means Reduction, or carrying back. I shall call this figure retroduction" (R 440:32a, 1898). See also R 764:71, n.d.; R 475:12–16, 1903.

3. See Anderson 1986, 145–146.

4. Formalized argument from *Prior Analytics* 69a 24–29.

5. See Plato, *Meno* 92e–94c; see also *Protagoras* 319e3.

6. Plato, *Meno* 94e2; *Protagoras* 320b4–5.

7. Plato, *Meno* 87b2–87c6.

8. See Ross 1949, 491, and Heath 1949, 33–36.

9. Heath 1949, 35.

10. Anderson 1986, 146.

11. Ibid., 148.

12. In a draft of a letter to Paul Carus, Peirce said that "what I there [in "A Theory of Probable Inference," 1883] call hypothesis is so far from being that, that it is rather Quantitative than Qualitative Induction" (CP 8.234, c.1910). What he meant was that the syllogism in the second figure uses the predicate or quality in both premises as a middle term in order to join the two extremes in the conclusion and for that reason should be understood as qualitative induction rather than hypothesis.

13. See Peirce's definition of "abduction" in the *Century Dictionary*.

14. Peirce read Aristotle's *Posterior Analytics* from early in his career, and it is obvious that he knew Aristotle's distinction between ὅτι and διότι, for he mentioned it in his Lowell Lectures of 1866 (W 1:502).

15. *Posterior Analytics* 78a38–39.

16. Ibid., 78a39–79a1.

17. Ibid., 78b8.

18. Ross 1949, 554.

19. *Posterior Analytics* 78b4–8.

20. Ibid., 78a35–36.

21. 89b10–20. The translation is mine.

22. *Posterior Analytica,* Loeb Classical Library, no. 391, translated by Hugh Tredennick, 171.

23. *The Basic Works of Aristotle*, edited by McKeon, translated by Mure, 158; and Ross 1949, 609.

24. See Liddell and Scott, *A Greek-English Lexicon*.

25. Ibid.

26. See the translation of *Nichomachean Ethics* 1142a33–b6 by Ross in *The Basic Works of Aristotle*, edited by McKeon, 1030.

27. See Liddell and Scott, *A Greek-English Lexicon*. Peirce mentioned *eustoxia* and the passage from *Posterior Analytics* II.34 in the context of deduction (see R 764:32, n.d.).

28. Ross 1949, 609.

29. *Posterior Analytica,* Loeb Classical Library, no. 391, translated by Hugh Tredennick, 171.

30. *The Basic Works of Aristotle*, edited by McKeon, 158.

31. Posterior Analytics 89b11–14.

32. Alexander of Aphrodisias 1883, xxii. The passage says:

> *Anchinoia* was defined as hitting upon (or sagacity) through the expression "one who sees the middle term through the cause." For he who discovers the cause of something seen to be such and such has discovered the middle term.
>
> Among the examples, the first is through a necessary middle term, while the others are common opinions accepted by many. In all cases the extremes and the conclusion are seen, but the middle term is realized [*noēsis*], which he explained with the first example, saying that "the bright side is facing the sun" is A; "the shining comes from the sun" B; "moon" C [quotation of 89b17–18].
>
> The moon derives its brightness and receives its light from the sun, which he realized [*enoēsen*], and what is receiving its light from the sun is its

shining part. It happens that 'the shining side of the moon is facing the sun' is inferred [*sunagomenon*] through the middle term–being illuminated by the sun, whose discovery [*euresis*] is *anchinoia* in an unobserved time [*askeptō xronō*]. By this, not deductively, although syllogistically, is that the discovery of the cause from those premises comes via *anchinoia*. Here the middle is inferred from the conclusion, while with deduction it goes the other way around (i.e. that the conclusion is inferred from the premises). For, the activity of *anchinoia* seems more like analysis than a syllogism: it differs from analysis in that it takes place in an unobserved time.

The same reason and the same analysis hold in the other examples. For, "talking with the rich man" is A; B is to realize [*noēthen*] that one wants to borrow money, and C is some individual. For he wants to talk to the rich man for the sake of a loan. Similarly again in the other examples: let "these men stand here" be C, "they are friends" be B, and the thing which is discovered and realized [*noēthen*] is A, namely, that they are friends with one another because they have the same enemy.