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"A familiar logical triplet": on Peirce's grammar of representation and its relation to scientific inquiry

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Abstract

This essay focuses on Charles S. Peirce's grammar of representation and its relevance for a logical conception of scientific inquiry. Closely relying on Peirce's writings, one of his important trichotomies of signs will be discussed in particular: that distinguishing between substitutive signs, or "semes", informational signs, or "phemes", and persuasive signs, or "delomes". According to Peirce, these three categories of signs result from an extension of the traditional division between "terms", "propositions", and "arguments" to *all* signs (not just symbols), understood as the foundational elements with and on which the scientific mind operates. It is shown that such an extended view of logic, conceived as a "semiotic", or general doctrine of signs, is consistent with Peirce's metaphysical views on truth and reality. Logic-as-semiotic, and its three corresponding branches of stecheotic, critic, and methodeutic, is thus conceived as a requisite normative trivium for the practice of scientific inquiry, whose purpose is to represent reality truthfully. In the end, we aim to remind that Peirce's semiotic epistemology must necessarily be contextualized within the frame of his comprehensive philosophy of the scientific "settlement of opinion".

Keywords Charles S. Peirce · Signs · Semiotic · Scientific inquiry · Reality · Representation

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1 Introduction

In a well-known but unidentified fragment, Charles Peirce suggested that "logic, in its general sense, is […] only another name for*semiotic* (σημειωτική), the quasi-necessary, or formal, doctrine of signs" (CP 2.227 [ca. 1897]).[1] This conception implies "that we observe the characters of such signs as we know, and from such an observation, by a process which I will not object to naming Abstraction, we are led to statements […] as to what must be the characters of all signs used by a 'scientific' intelligence, that is to say, by an intelligence capable of learning by experience". Within this limited scope, a sign thus becomes anything "which serves to convey knowledge of some other thing, which it is said to *stand for* or *represent*" (EP2: 13 [1895]), and because *true knowledge* is precisely that to which scientific inquiry, relying upon experience and reasoning, is destined to lead, such manufacture of truth may be reframed in semiotic terms: signs, indeed, in the final analysis, are the fundamental ingredients with and on which the scientific mind operates. Furthermore, because experience and reasoning are ultimately grounded in actual facts (and not just general thought), a logic of scientific inquiry shall embrace any kind of signs, of whichever mode of being they may be.

With such premisses in mind, and well aware of the fact that Peirce's thought greatly evolved over time, I will nevertheless attempt to present a "synchronic" account of his grammar of representation and examine its relevance for a semiotic understanding of the scientific settlement of opinion, which he continually strived to theorize throughout his career as a scientist, logician (i.e. semiotician) and philosopher of science. In proposing such an attempted overview, I will try in particular to reassemble various "diachronic" elements which, although they are scattered on the timeline and belong to different and sometimes conflicting conceptual stages in Peirce's thought, would not necessarily contradict one another when brought into relation within a more unified framework.

2 Really being versus being represented

In a passage skipped from the last of his 1903 Harvard lectures devoted to pragmatism, Peirce came to suggest that "a man cannot consistently engage […] in any discussion unless he admits that there is a distinction between truth and falsity", and that admitting this opposition would necessarily lead him to recognize that there are things "whose characters are what they are independently of what he may think that they are" (EP2: 532*n12* [1903]). In that perspective, then, truth would consist in the correspondence of a representation with its object, understood as being that which

[1] References to Peirce (1931–1935) are given by CP, in decimal notation, followed by volume and paragraph number; references to Peirce (1982–2009) are given by W, followed by volume and page number; references to Peirce (1998) are given by EP2, followed by page number; references to Peirce's unpublished Mss. (Houghton Library, Harvard University) are given by R, followed by Ms. number as established by Robin (1967) and page number as penned by Peirce.

is such as it is, independently of its being represented so[2]—a position which led him to conclude accordingly that "whatever is true represents a real" (EP2: 340 [1905]).

In his important review of Alexander Fraser's *Works of George Berkeley*, published in 1871, Peirce had already claimed that such objects of thought could be "divided into figments, dreams, etc., on the one hand, and realities on the other" (W2: 467 [1871]). In the very same text, he made it clear that "the former are those which exist only inasmuch as you or I or some man imagines them" while "the latter are those which have an existence independent of your mind or mine or that of any number of persons". Consistent with the later claim stated above, the real was to be defined as "that which is not whatever we happen to think it, but is unaffected by what we may think of it". A few years later, in the well-known *How to Make Our Ideas Clear*, published in 1878, Peirce had argued in the same vein that an abstract definition of the real "may perhaps be reached by considering the points of difference between reality and its opposite, fiction" (W3: 271 [1878]). Once again, a figment was defined as "a product of somebody's imagination; it has such characters as his thought impresses upon it", while "that whose characters are independent of how you or I think is an external reality".

More specifically, Peirce's writings contain scattered examples of such distinction. For instance, in a partial draft of his 1900 review of Karl Pearson's *Grammar of Science*, ultimately published in the *Popular Science Monthly*, Peirce contended that the "question of whether Hamlet was insane is the question whether Shakespeare conceived him to be insane. Consequently, Hamlet is a figment and not a reality" (CP 8.153, 1900). Likewise, in the third *Harvard* lecture of 1903, Peirce acknowledged that "when the Arabian romancer tells us that there was a lady named Scheherazade, he does not mean to be understood as speaking of the world of outward realities, and there is a great deal of fiction in what he is talking about. For the *fictive* is that whose characters depend upon what characters somebody attributes to it; and the story is, of course, the mere creation of the poet's thought" (EP2: 209 [1903]). Of course, Peirce insisted that once an author "has imagined Scheherazade and made her young, beautiful, and endowed with a gift of spinning stories, it becomes *a real fact that so he has imagined her*, which fact he cannot destroy by pretending or thinking that he imagined her to be otherwise" (EP2: 209 [1903], our emphasis).

That peculiar characterization persisted until his later years,[3] when he still reminded that *real* "is a word invented in the thirteenth century to signify having Properties, i.e. characters sufficing to identify their subject, and possessing these whether they be anywise attributed to it by any single man or group of men, or not" (EP: 434 [1908]). Likewise, in a 1909 letter to William James, Peirce maintained that "an object does not need to be Real in order to have predicates, since to be Real means to have predicates independently of what you or I or any individual mind or

[2] In the actual reading of the lecture, Peirce declared that "every man is fully satisfied that there is such a thing as truth, or he would not ask any question. *That* truth consists in a conformity to something *independent of his thinking it to be so*, or of any man's opinion on that subject" (EP2: 240 [1903]).

[3] See Hookway (1985), Fisch (1986), and Lane (2018) for a more systematic account of Peirce's views on reality.

collections of minds may opine, imagine, or otherwise represent", and made it clear that "predicates so independent are a particular class of predicates, and a Figment is an Object that does not possess these, but *does* possess such Predicates as it was fabricated to have" (EP2: 497 [1909]).

It follows from this line of thought that an object of representation, or that which is precisely represented as having determinate characters, may either be *real* or *fictitious*. In the first case, it is understood as being such as it is, independently of its being represented so, while in the second case, it is understood as being such as it is or was fabricated to be. Consequently, anything real may either be *truly* or *falsely* represented: in both cases, the representation attributes a given character to the object represented, but in the second case, the character does not *really* belong to it. Moreover, it would not make much sense to claim that something fictitious may either be truly or falsely represented. If Sherlock Holmes, as an object of representation, may be described as Dr. Watson's roommate, professing that "Sherlock Holmes is Watson's roommate" is either true or false would not be very pertinent, for such representation could not conform to that which it precisely *fabricates*. In the third *Harvard* lecture, already cited, Peirce thus insisted that "the [real] object represented is supposed not to be affected by the representation. That is essential to the idea of representation"[4] (EP2: 171 [1903]). In other words, reality shall then be construed as determining, or constraining, its own representation, whereas fiction shall be construed as being determined, or constrained, by it. *Really being* and *being represented* are two different things indeed (R 7: 3 [ca. 1903?]).

3 The semiotic structure of representation

Now, any representation of something real may be conceived as an interpretable *sign* attributing some character to that object. More precisely, a representation must thus involve two simpler signs, or parts, the first being understood as signifying a possible character (for nothing may be represented as possessing some character if that possible character is not explicitly signified), the second being understood as denoting the object to which the possible character is applied (for nothing may be represented as possessing some character if nothing supposedly possessing it is indicated[5]). Therefore, every complete representation, in so far as it brings these two simpler parts into relation, expresses a *fact* and, as such, conveys some *information* about its object. It is on that logical ground that a representation may either be

[4] In a 1909 unpublished manuscript, Peirce assured in the same vein that "no thinking *about it* will at all modify the Real object, since this is precisely what is meant by calling it Real. It is sometimes an object shaped by thinking,—of which the very last sentence affords an example; but so far as it is Real, it is not modified by thinking *about it*" (R 634: 9 [1909]). In the specific case of fiction, however, the object happens to be "modified" by the representation. For instance, Conan Doyle could have imputed blindness to Holmes, therefore affecting "him" as an object of thought.

[5] This amounts to saying that a character may be "prescinded" from an object while an object may not be "prescinded" from a character.

true or false, while each of its parts, considered incomplete by themselves, may be neither.

3.1 Propositions and their parts

From a logical point of view, any given*proposition* thus constitutes a complete representation, for a proposition is indeed a double sign involving two simpler signs, traditionally called *subject* and *predicate*: "every proposition has two parts, that part which conveys the idea, the predicate, and that part which indicates what it is to which this idea is said to be applicable, the subject" (R 791: 2 [s. d.]). Furthermore, and accordingly, any complete proposition may either be true or false. For instance, it may either be true or false that "Napoleon was a French general", for this proposition expresses that something explicitly denoted by its subject (i.e. Napoleon) possesses the possible character explicitly signified by its predicate (i.e. some "generalness"): a professed conformity to some reality may thus be assessed.[6] However, any subject or predicate may neither be true nor false in themselves. For instance, it would not make any sense to say that "Napoleon" or "was a general" (or simply "general" for that matter) could either be true or false, for those simple, or incomplete, signs cannot express any fact (and convey some information) by themselves.[7]

3.2 Acts of assertion

Now, as it has been mentioned above, the possibility that a proposition, or representation, be true (or false) of its object implies that what it strives to represent be real, that is, be such as it is regardless of its being represented so by any single man or group of men. Accordingly, it must necessarily be shown that the real is precisely that which is spoken of, for otherwise one could not distinguish between propositions *related to the real* and propositions *related to the fictitious*. A specific *act of assertion* is thus required.

In the first place, when a proposition is *asserted*, an enunciator makes himself or herself responsible for its truth—something that is not required of fiction, in which case the assertion is merely *feigned*. However, in normal cases, and relying on the *context* in which it occurs, "an act of assertion supposes that, a proposition being formulated, a person performs an act which renders him liable to the penalties of the social law (or, at any rate, those of the moral law) in case it should not be true, unless he has a definite and sufficient excuse" (EP2: 278 [1903]). In the second place, when a given proposition *is* genuinely asserted, bringing its illocutionary strength to be rightly recognized, its enunciator is therefore understood to

[6] Hence, "to say that every proposition is either true or false is to say that whatever the predicate, *X*, of a proposition may be, its subject *S* is either *X* or not *X*" (EP2: 168 [1903]), and "it is propositions alone that are either true or false" (EP2: 224 [1903]). Likewise, "any proposition you please, *once you have determined its identity*, is either true or false" (EP2: 351 [1905]).

[7] A fact may thus be construed as an abstract state of things, itself a constituent element of reality, that "can be wholly represented in a simple proposition" (EP2: 378 [1906]).

refer to some individual and real object which it professes to represent truly. In the same 1909 letter to William James cited above, Peirce thus argued that "a sentence about something, though it be utterly false, is nevertheless determined by the [real] subject-thing which it misrepresents. If it weren't, it would not even *mis*-represent it: It wouldn't have anything to do with it" (EP2: 497 [1909]).

More precisely, this act of reference may only be accomplished by means of an *existential* identification, or indication, with the real object concerned. This is something that was not possible with Kant's famous *Ding an sich*, for instance. According to Peirce indeed, that which this expression denotes "can neither be indicated nor found. Consequently, no proposition can refer to it, and nothing true or false can be predicated of it" (CP 5.525 [ca. 1905]). Such existential connection with something real is precisely that which is required of an asserted proposition's subject-sign.

3.3 The semiotic function of subject-signs

As it was reminded above, what were traditionally called "subjects" are simple signs interpretable as merely denoting the object which their proposition professes to represent. When a proposition is asserted, however, they must act as genuine*indices*, or signs that are interpretable as being existentially connected with their object.[8] Said Peirce in his unpublished *Logical Tracts*: when words "are used to construct an assertion, this assertion relates to something real. It must not only *profess* to do so, but must really *do* so; otherwise, it could not be true; and still less, false. Let a witness take oath, with every legal formality, that John Doe has committed murder, and still he has made no assertion unless the name John Doe denotes some existing person. But in order that the name should do this, something more than an association of ideas is requisite. For the person is not a conception but an existent thing. The name, or rather, *occurrences* of the name, must be existentially connected with the existent person" (CP 4.500 [ca. 1903]). Likewise, "if somebody rushes into the room and says, 'There is a great fire!' we know he is talking about the neighbourhood and not about the world of the *Arabian Nights' Entertainments*. It is the circumstances under which the proposition is uttered or written which indicate that environment as that which is referred to"[9] (CP 2.357 [1902]).

More specifically, in asserted propositions, any*designation*, like a proper name or demonstrative pronoun, shall thus act as an index interpretable as denoting an individual and real object.[10] The same holds good for any complex precept "not only

[8] In an 1895 unpublished essay, Peirce thus maintained that "the real world cannot be distinguished from a fictitious world by any description. Now reality is altogether dynamic, not qualitative. It consists in forcefulness. Nothing but a dynamic sign [i.e. an index] can distinguish it from fiction" (CP 2.337 [ca. 1895]). Ten years later, in his 1906 *Monist* paper, *Prolegomena to an Apology for Pragmaticism*, he reminded in the same vein that indices "furnish positive assurance of the reality and the nearness of their Objects" (CP 4.531 [1906]).

[9] This quotation, among others, establishes Peirce as an early precursor of *linguistic* pragmatism. See, for instance, Réthoré (1993), Bergman (2009a, b), and Bellucci (2018) on that matter.

[10] Peirce thus argued that "the expressed subject of an ordinary proposition approaches most nearly to the nature of an index when it is a proper name which, although its connection with its object is purely

describing to the Interpreter what is to be done, by him or others or both, in order to obtain an Index of an individual (whether a unit or a single set of units) of which the proposition is [interpreted] as meant to be true, but also assigning a designation to that individual"[11] (EP2: 286 [1903]). These words, in so far as they are existentially connected with their objects or may *ultimately* be in any way connected with them in such manner, may function as indices bringing their interpreters to attend to those realities.

3.4 The semiotic function of predicate-signs

Once an object is identified, there remains to express its attributed character. As it was reminded above, a mere subject-sign cannot be true nor false in itself: to express any fact, it must be brought into connection with a predicate-sign.[12] Now, what is traditionally called a "predicate" is a simple sign interpretable as merely signifying a possible character which its proposition professes to attribute to the object. Accordingly, when a subject is destined to be connected with an *object*, a predicate is destined to be connected with a *subject*, in such wise that their being brought into relation makes up a proposition expressing a determinate fact. It follows that predicates, as ordinary terms, are "assertory" by nature, provided there be a subject to indicate that upon which their signification shall bear: they "assert as soon as they are in any way attached to any object. If you write GLASS upon a case, you will be understood to mean that the case contains glass"[13] (CP 4.56 [1893]).

Footnote 10 (continued)
intentional, yet has no reason (or, at least, none is thought of in using it) except the mere desirability of giving the familiar object a designation" (CP 2.357 [1902]).

[11] In other words, "when the subject is not a proper name, or other designation of an individual within the experience (proximate or remote) of both speaker and auditor, the place of such designation is taken by a virtual precept stating how the hearer is to proceed in order to find an object to which the proposition is intended to refer" (CP 2.357 [1902]). Peirce gave the following example of such a "precept by following which a singular could be found" (EP2: 168 [1903]): "*Some woman is adored by every Catholic*. This means that a well-disposed person with sufficient means could find an index whose object should be a woman such that allowing an ill-disposed person to select an index whose object should be a Catholic, that Catholic would adore that woman. Thus the subject of a proposition if not an index is a precept prescribing the conditions under which an index is to be had". Peirce made it also clear that a proposition could "describe, or otherwise indicate, the kind of collateral observation by which [its] Object is to be found. Thus, a proposition whose subject is distributively universal […], such as 'Any man will die,' allows the interpreter, after collateral observation has disclosed what single universe is meant, to take any individual of that universe as the Object of the proposition, giving, in the above example, the equivalent 'If you take any individual you please of the universe of existent things, and if that individual is a man, it will die" (EP2: 408 [1907]). Thus, it may be "necessary to give a general direction as to the manner in which an object intended may be found. Especially it is necessary to be able to say that any object whatever will answer the purpose, in which case the subject is said to be *universal*, and to be able to say that a suitable object occurs, in which case the subject is said to be *particular*" (CP 4.59 [1893]).

[12] In his unpublished *New Elements*, probably written in early 1904, Peirce thus remarked that "in addition […] to denoting objects, every sign sufficiently complete signifies characters" (EP2: 304 [1904]). Such a "complete" sign is a proposition.

[13] In that particular example, the predicate *itself* acts as an index existentially connected with the said case.

More specifically, such predicate-signs are*symbols*: they signify the characters that they do by virtue of *their being interpreted as signifying* them. In other words, the signification of a symbol ultimately requires a *habit of interpretation*, when the signification of an index ultimately required an *experiential* reaction.[14] In the draft chapter of his contemplated *Grand Logic*, from which the "glass" example above was taken, Peirce thus argued that "it seems certainly the truest statement for most languages to say that a *symbol* is a conventional sign which being attached to an object signifies that that object has certain characters. But a symbol, in itself, is a mere dream; it does not show what it is talking about. It needs to be connected with its object. For that purpose, an *index* is indispensable. No other kind of sign will answer the purpose. That a word cannot in strictness of speech be an index is evident from this, that a word is general—it occurs often, and every time it occurs, it is the same word, and if it has any meaning *as a word*, it has the same meaning every time it occurs; while an index is essentially an affair of here and now, its office being to bring the thought to a particular experience, or series of experiences connected by dynamical relations. […] It is the connection of an indicative word to a symbolic word which makes an assertion"[15] (CP 4.56 [1893]).

More particularly, the very object which a general predicate may be asserted of may be construed as an *instance* of the character, or concept, which it is generally purposed to signify in each particular case when it is used: a symbolic predicate is thus a sign "connected with its Object by an association of general ideas in such a way that its Replica calls up an image in the mind which image, owing to certain habits or dispositions of that mind, tends to produce a general concept, and the Replica [i.e. the predicate as an actual word or compound of words] is interpreted as a sign of an Object that is an instance of that concept" (EP2: 295 [1903]). Put differently, "the active law [of thought] that it is may require its interpretation to involve the calling up of an image, or a composite photograph of many images of past experiences, as ordinary common nouns and verbs do" (CP 4.447 [ca. 1903]). For instance, "gave" in "Anthony gave a ring to Cleopatra" is a predicate which

[14] In his 1885 paper *On the Algebra of Logic*, published in the *American Journal of Mathematics*, Peirce thus contended that "the index asserts nothing; it only says 'There!' It takes hold of our eyes, as it were, and forcibly directs them to a particular object, and there it stops" (W5: 163 [1885]). Its purpose is to bring its interpreter to have a collateral experience with its object, or to give determinate instructions to live one.

[15] Note in passing that a symbolic predicate is a so-called *legisign*, or general sign: a legisign "is not a single object, but a general type which, it has been agreed, shall be significant. Every legisign signifies through an instance of its application, which may be termed a *Replica* of it" (EP2: 291 [1903]). Accordingly, I agree with Short (2007, p. 210) that "the essential feature of legisigns and their replicas […] is that the purpose they have to signify constitutes their significance". We shall then complete what has been said above: proper names and designations are legisigns as well, albeit *indexical* instead of *symbolic*. As a matter of fact, Peirce often used the definite designation "the" as an example of a prototypical legisign: "there is but *one* word in the English language which is used as a definite article, and this word is no more printed that it is pronounced. In a literal sense, it *cannot* be printed or pronounced; it can only govern and determine what is printed or pronounced. Its being consists in its so governing existents, while it does not itself exist. I term such a sign a *Type*" (R 295: 24–26 [ca. 1906]). In other words, indexical legisigns are "types" as well, but types whose actual instances are meant to be construed as referring to something individual and real which they are existentially connected with.

"conveys its meaning because the interpreter has had many experiences in which gifts were made; and a sort of composite photograph of them appears in his imagination" (CP 5.542 [c. 1902]). This led Peirce to conclude that asserting a proposition "amounts to saying that an image is similar to something to which actual experience forces the attention" (EP2: 96 [1901]), or that "every proposition is a compound of two signs, of which one functions significantly, the other denotatively. The former is intended to create something like a picture in the mind of the interpreter, the latter to point to what he is to think of that picture as being a picture of"[16] (R 284: 43 [1905]).

3.5 Quasi-propositions

Now, if a "broad definition of a proposition be accepted, a proposition need not be a symbol" (CP 2.357 [1902]). In other words, a proposition may not necessarily be *general* while involving the same logical structure as ordinary propositions do. Such signs are called "quasi-propositions" (EP2: 275 [1903]). Bringing their "subject" and "predicate" parts into relation, they may also be construed as expressing facts and equally be either true or false. In that case, the equivalent of the subject, or "quasi-subject" (EP2: 282 [1903]), is a singular and existent thing existentially connected with the object, and assuming the function that had pertained to designations, proper names, or other precepts. For instance, "any mere landmark by which a particular thing may be recognized because it is as a matter of fact associated with that thing" (EP2: 163 [1903]) may function *as if it were* a proper name: such ungeneral index also "forces attention to the object with which it reacts and puts the interpreter into mediate reaction with that object"[17] (EP2: 306 [1904]). Like their

[16] Peirce also noted that depending on the kind of concept symbolically signified, an object may actually be conceived as a *set of partial objects*. Some propositions may thus involve polyadic predicates destined to be saturated by multiple *subjects* that could each function indexically. For instance, "John" and "Peter" in "John kills Peter", and "John", "the book", and "Peter" in "John gives the book to Peter" are such "partial objects" (EP2: 492 [1909]). Said Peirce in his 1907 rejected letter to the editors of the *Nation* and the *Atlantic Monthly*: "The object of a sign, though singular, may nevertheless be multiple, and may even be infinitely so. […] What, for example, is the object of 'runs'? Answer: it is something, a runner. What is the object of 'kills'? Answer: it is a pair of indesignate individuals, the one a killer, the other killed by him. So 'gives' has for its object a triplet of related indesignate singulars, a giver, a gift, a recipient of that gift from that giver" (EP2: 408 [1907]). Incidentally, Peirce showed also that a predicate in a position of subject really remains a predicate: "the sentence 'every man loves a woman' is equivalent to 'whatever is a man loves something that is a woman'" (EP2: 17 [1895]). Several passages testify to that doctrine. For instance, in the same draft chapter of his unfinished *Grand Logic* cited above, Peirce observed that "we find in grammatical forms of syntax, a part of the sentence particularly appropriate to the index, another particularly appropriate to the symbol. The former is the *grammatical subject*, the latter the *grammatical predicate*. In the logical analysis of the sentence [however], we disregard the forms and consider the sense. Isolating the indices as well as we can, of which there will generally be a number, we term them *the logical subjects*, though more or less of the symbolic element will adhere to them unless we make our analysis more recondite than it is commonly worth while to do; while the purely symbolic parts, or the parts whose indicative character needs no particular notice, will be called the *logical predicate*" (CP 4.58 [1893]).

[17] Anything existentially connected with something else necessarily *reacts* with that second thing: "nothing can be contiguous but acts of reaction. For to be contiguous means to be near in space at one time; and nothing can crowd a place for itself but an act of reaction" (CP 4.157 [ca. 1897]). Likewise,

general counterparts, signs that may be interpretable as quasi-subjects do not convey any information about the existent object that they indicate and, accordingly, may neither be true nor false in themselves.

However, they may still be connected with "quasi-predicates" (EP2: 282 [1903]), or any quality, orcomplexus of qualities, inhering in the quasi-subject *itself* or in some other existent thing connected with it, and which happens to *resemble* that of the object denoted. More precisely, quasi-predicates are nothing but *icons*: unlike their symbolic counterparts, they signify the very character they do by virtue of *their exhibiting it*. From there, iconic predicates merely "serve to represent objects in so far as they resemble them in themselves"[18] (EP2: 460 [1909]). The quasi-subject may acquire such resembling character by virtue of an *actual reaction* with its object, or it may simply be connected with some other thing possessing that very quality. In any case, a quasi-proposition is interpreted as professing that the character which its quasi-predicate immediately signifies resembles the very (qualitative) character belonging to the object indexically denoted by its quasi-subject.[19] Once again, like their general counterparts, signs that may be interpretable as iconic predicates do not convey any information about anything by themselves, and, accordingly, may neither be true nor false in themselves as well.

Two well-known examples are found in Peirce's writings: those of the photograph and the weathercock. In the first place, a photograph "may be gazed out as a mere appearance, and so considered, is a mere icon. But if we scrutinize a photograph in order to obtain information, we rely on the fact that a physical force makes it accurately represent the object, and it becomes an informant index"[20] (R 491: 5

Footnote 17 (continued)

"any real connection whatsoever between individual things involves a reaction between them" (EP2: 153 [1903]).

[18] It follows that iconic predicates cannot generally signify any kind of characters, or concepts, like symbolic predicates can. An icon merely signifies a quality, or complexus of qualities, as it immediately is and this, even if no mind ever interpreted it as a sign: "an icon is significant with absolute directness of a character which it embodies" (EP2: 320 [1904]). Symbolic predicates, on their side, may generally signify the character or concept they do (by virtue of a habit of interpretation), even though their proper interpretation may ultimately result in pure icons (i.e. composite mental photographs of images of all the past experiences which actual instantiations of this or that concept have implied). More essentially, contrary to mere icons, they are susceptible of signifying any possible consequences which the possession of the character signified *would* imply for its object, provided conditional events are actually fulfilled. For instance, stamping a stone as "hard" implies that it *would* resist an attempt to leave a mark, *if* scratched (e.g. EP2: 254 [1903], EP2: 401 [1907]). Something's reality is not indeed reducible to its mere *existence*, i.e. its capacity to actually react with (and affect) me and the other things in its universe: it also comprises all the predictable possible and conditional facts that its very existence does not necessarily actualize *hic et nunc* but which *would* occur if conditions were fulfilled, and provided that object really is governed by the *law* which its related predicate is purported to signify.

[19] In both cases, subject and predicate must actually be "physically collocated" (Stjernfelt 2015): a proposition or quasi-proposition forces us to regard its (quasi-)predicate as a sign of the same object to which its collocated (quasi-)subject is itself connected, therefore conveying some information about that object. Said Peirce in his unpublished *Basis of Pragmaticism* essay: "a proposition has a subject (or set of subjects) and a predicate. The subject is a sign; the predicate is a sign; and the proposition is a sign that the predicate is a sign of that of which the subject is a sign. If it be so, it is true" (EP2: 379 [1906]).

[20] Put differently, "the fact that the [photograph] is known to be the effect of the radiations from the object renders it an Index and highly informative" (EP2: 297 [1903]). Peirce thus argued that "we have

[ca. 1903]). Likewise, the telescopic image of a double star "is not an icon simply, because an icon […] represents its object solely by virtue of its similarity to it [and] the mere appearance of the telescopic image of a double star does not proclaim itself to be similar to the star itself. It is because we have set the circles of the equatorial so that the field must by physical compulsion contain the image of that star that it represents that star, and by that means we know that the image must be an icon of the star, and information is conveyed" (EP2: 171 [1903]). In the second place, in so far as it is "not only connected with the wind but points in the same direction" (R 462:86–88 [1903]), a weathercock also conveys information and "this it does because in facing the very quarter from which the wind blows, it resembles the wind in this respect, and thus has an icon connected with it" (EP2: 306 [1904]).

Note in passing that symbolic propositions may comprise quasi-subjects as well. For instance, a pointing arm may function as a designation without strictly being a general word (e.g. *that*, *this*, etc.): "when a baby points at a flower and says, 'Pretty,' that is a symbolic proposition; for the word 'pretty' being used, it represents its object only by virtue of a relation to it which it could not have if it were not intended and understood as a sign. The pointing arm, however, which is the subject of this proposition, usually indicates its object only by virtue of a relation to this object, which would still exist, though it were not intended or understood as a sign. But when it enters into the proposition as its subject, it indicates its object in another way. For it cannot be the subject of that symbolic proposition unless it is intended and understood to be so. Its merely being an index of the flower is not enough. It only becomes the subject of the proposition, because its being an index of the flower is evidence that it was *intended* to be" (CP 2.357 [1902]). Conversely, Peirce also recognized that quasi-predicates could be connected to (replicas of) general words assuming a subjectival function: for instance, "a portrait with the proper name of the original written below it is a proposition asserting that so that original looked" (CP 2.357 [1902]).[21]

4 The semiotic structure of argumentation

Now, when a mere proposition, bringing its subject and predicate into relation, constitutes a *complete* sign, an argument, bringing its premisses (or copulate premiss) and conclusion into relation, constitutes a *perfect* sign: it affords indeed a justification for the *truth* of its conclusion. This led Peirce to recognize that propositions merely "declare facts" when arguments "profess to enlighten us as to the rational

Footnote 20 (continued)
an important division of indices into those which give information and those which merely serve to identify individuals" (R 491: 4 [ca. 1903]).

[21] Other passages in Peirce's writings attest to that understanding, although he used "proposition" in its broader sense: "a man's portrait with a man's name written under it is strictly a proposition, although its syntax is not that of speech" (EP2: 282 [1903]), or "a portrait with the name of the original below it is a proposition. It asserts that if anybody looks at it, he can form a reasonably correct idea of how the original looked" (CP: 5.569 [1906]), etc.

connection of facts or possible facts" (R 142: 6 [ca. 1899–1900]). In other words, an argument professes that something *unknown* may be derived from something *known* about an object—and gives a reason for that inference.

4.1 Premisses and conclusion

More specifically, when the subject of an asserted proposition is understood to refer to something otherwise known (i.e. the real object professed to be represented), its predicate conveys something new (i.e. the real character professed to be applied). In that case, the connection between antecedent and consequent is brought about by *compulsive experience*, having compelled the determination of the given predicate, without reason. Likewise, when the two premisses (or copulate premiss) of an asserted argument are understood to refer to something otherwise known (i.e. the real facts in which its premisses are true), its conclusion conveys something new (i.e. the real fact in which its conclusion is true).[22] However, in that second case, the connection between the premisses and the conclusion is brought about by *self-controlled reasoning*, having justified us "in some kind of belief in the truth of a proposition that in the absence of the reasoning we should not have been so much justified in believing"[23] (CP 7.102 [ca. 1910]). Accordingly, "it is not 'I think' that always virtually accompanies an argument, but it is 'Don't you think so?'" (R 636: 30 [1909]). In that same unpublished manuscript, he thus concluded that "something more is needed to constitute an Argument. It is an appeal to its interpreter's own reason to assent to its soundness when once he has asserted to the truth of its copulate premiss" (R 636: 31 [1909]).

So, when a mere isolated proposition may either be *true* or *false*, an argument, on its side, may either be *sound* or *unsound*. An argument is sound if the general principle which it is understood to pursue leads to the truth: "the very essence of an argument,—that which distinguishes it from all other kinds of signs,—is that it professes to be the representative of a general method of procedure tending toward the truth. […] Now if that profession is true, and the conclusions of that method really will be true, to the extent and in the manner in which the argument pretends that they will, the argument is sound; if not, it is a false pretension and is unsound" (EP2: 534*n6* [1903]).

[22] In the 1907 rejected letter to the editors of the *Nation* and the *Atlantic Monthly*, already cited, Peirce appealed to the semiotic distinction raised by John of Salisbury "between that which a term *nominat*,—its logical breadth,—and that which it *significat*,—its logical depth. In the case of a proposition, it is the distinction between that which its subject denotes and that which its predicate asserts. In the case of an argument, it is the distinction between the state of things in which its premisses are true and the state of things which is defined by the truth of its conclusion" (CP 5.471 [1907]).

[23] In his unpublished *Sketch of Logical Critics*, Peirce defined "reasoning" in the following terms: "By '*Reasoning*' shall here be meant any change in thought that results in an appeal for some measure and kind of assent to the truth of a proposition called the '*Conclusion*' of the reasoning, as being rendered '*Reasonable*' by an already existing cognition (usually complex) whose propositional formulation shall be termed the '*Copulate Premiss*' of the reasoning" (EP2: 454 [1911]).

4.2 Abduction, deduction, induction

Now, Peirce identified three irreducible kinds of inference, each relying on a specific leading principle: they are *abduction*, *deduction*, and *induction*. An *abduction* is the inference of a possible case from a rule and result: "If those beans are white and all the beans from this bag are white, then those beans *may possibly* be from this bag". A *deduction* is the inference of a result from a case and rule: "If all the beans from this bag are white and those beans are from this bag, then those beans *must necessarily* be white". An *induction* is the inference of a probable rule from a case and result: "If those beans are from this bag and those beans are white, then the beans from this bag *are probably* white". In short, abduction "merely suggests that something *may be*", deduction "proves that something *must* be", and induction "shows that something *actually is* operative" (EP2: 216 [1903]).[24]

Each kind of reasoning thus affords a different *kind and degree of assurance* regarding the truth of its conclusion, which assurance may range from the mere hypothetically possible to the deductively necessary. In the first case, abduction relies on an assurance of *instinct*: "the very undertaking to find out a truth one does not directly perceive assumes that things conform in a measure to what our reason thinks they should" (EP2: 502 [1909]). In other words, abduction "tries what *il lume naturale*, which lit the footsteps of Galileo, can do. It is really an appeal to instinct" (EP2: 32 [1898]): it is grounded in the belief that our "Reason is akin to the Reason that governs the Universe" (EP2: 502 [1909]). In the second case, deduction relies on an assurance of *logical form*: "the warrant is that the facts presented in the premisses could not under any imaginable circumstances be true without involving the truth of the conclusion, which is therefore accepted with necessary modality" (CP 2.778 [1902]). And in the third case, induction relies on an assurance of *experience*: "the justification of its conclusion is that that conclusion is reached by a method which, steadily persisted in, must lead to true knowledge in the long run of cases of its application" (EP2: 97 [1901]), therefore correcting errors.

4.3 The real and its inquiry

Compulsive experience and self-controlled reasoning, therefore, are the two ways by means of which knowledge about the real may be produced, the essential difference being "that in learning by reasoning, each new accretion to our belief is *justified* to our eyes, *by what was in our minds just before*, while what we are taught by experience is not *justified* at all: on the contrary, the less it is like previous knowledge, the more valuable an information it is, other things being equal. We are compelled

[24] Of course, "the first step of inference usually consists in bringing together certain propositions which we believe to be true, but which, supposing the inference to be a new one, we have hitherto not considered together, or not as united in the same way. This step is called *colligation*" (EP2: 22 [1895]). A mere proposition cannot, by itself, signify any one of the possible consequent propositions which it might imply: its *meaning* is undetermined. But such determination of an intended conclusion is precisely that which two premisses are purposed to do.

to admit it" (EP2: 454 [1911]). In other words, when the course of experience may *unjustifiably* compel us to admit beliefs about facts directly observed, habits of reasoning may *justifiably* urge us to infer beliefs about facts not directly observed (yet). These elements accord with Peirce's definition of a sound reasoning cited above, i.e. a conscious and self-controlled intellectual process justifying us "in some kind of belief in the truth of a proposition that in the absence of the reasoning we should not have been so much justified in believing" (CP 7.102 [ca. 1910]).

Now, reality had already been defined in the well-known 1868 *Consequences of Four Incapacities* essay as "that which, sooner or later, information and reasoning would finally result in, and which is therefore independent of the vagaries of me and you" (W2: 239 [1868])—a definition echoing the ones given above. Accordingly, from a methodological point of view, next to being that which is such as it is independently of its being represented so (by any single man or group of men), the real becomes that to which sufficiently carried inquiries shall *ultimately* lead. This is precisely where Peirce's grammar of representation rejoins with his conception of the scientific "settlement of opinion" (e.g. W3: 248 [1877]): each irreducible kind of reasoning happens to be coextensive with each one of the three fundamental stages of scientific inquiry, which unfold in the following characteristic manner.

In the first place, a scientist may be surprised that a given fact contradicts an established prediction or breaks some habits of expectation. In that case, the researcher is compelled to suggest a plausible explanation which, "if it had been known to be true before the phenomenon presented itself, would have rendered that phenomenon predictable, if not with certainty, at least as something very likely to occur" (EP2: 89 [1901]). That explanatory *hypothesis* shall be suggested by the very facts themselves and selected with three considerations in mind: it must be capable of being experimentally tested, it must have the power to explain the very surprising fact scrutinized, and it must satisfy some economic criteria (e.g. cost, value, and heuristic effect upon other inquiries) (EP2: 107 [1901]). In the second place, the scientist explicates the consequences virtually implied by that hypothetical explanation *were it be operative*, and which could be tested experimentally: "the entire meaning of a hypothesis lies in its conditional experiential predictions" in such wise that "if all its predictions are true, the hypothesis is wholly true" (EP2: 96 [1901]). In the third place, lastly, the scientist sets himself to test whether future facts of perception, as predicted from the conjecture, effectively come into being, before evaluating how far the deduced consequences have accorded with such experience. That last stage thus "consists in actually going to work and making the experiments, thence going on to settle a general conclusion as to how far the hypothesis holds good" (EP2: 288 [1903]), that is, how truthful that representation may actually be. In the end, our scientist, accounting for all the evidence at hand, will either *accept*, *modify*, or *reject* the hypothesis at stake, which is the "Sentential part" of the inquiry[25] (EP2: 442 [1908]). As it is here implied, each three fundamental stages of scientific inquiry are

[25] See Wiggins (2004) and Rodrigues (2011) for a comprehensive approach of Peirce's logic of scientific inquiry.

nothing but an exercise in argumentation, the rational production and interpretation of *signs*.

5 "A familiar logical triplet"

I began this essay by reminding that Peirce's conception of scientific inquiry relied on an extended doctrine of logic understood as a semiotic. The three stages of an inquiry just mentioned above constitute a clear testament to this doctrine: scientific inquiry, in so far as it is destined to yield*true* representations of the real, relying on experience and reasoning, necessarily deals with the production and interpretation of signs. As the fundamental ingredients with and on which the scientific mind operates, they may be construed as anything serving to "convey knowledge" of some "other thing", their object, which they are said to "stand for or represent". Remind accordingly that for Peirce a general semiotic shall imply the determination of "what must be the characters of all signs used by a 'scientific' intelligence, that is to say, by an intelligence capable of learning by experience".[26] It may now become clearer why Peirce conceived his logic-as-semiotic to embrace "all signs", of whatever mode of being they may be: in so far as experience and reasoning are ultimately based on actual facts, a logic of scientific inquiry shall embrace *all kinds* of signs, not just symbols, in its quest for truth. Indeed, we saw that two other kinds of signs could also be taken into account: those whose semiotic function is to denote and identify an actual object (i.e. indexical signs), and those whose semiotic function is to signify and suggest a possible quality (i.e. iconic signs).

Such recognition required an extension of the logical categories of "terms" (either subjects or predicates), "propositions" and "arguments" to all kinds of signs, be they symbols, indices, or icons—a generalization which Peirce effectuated in the 1903*Syllabus of Certain Topics of Logic* in which the *rheme-dicisign-argument* trichotomy was introduced.[27] A few years later, in a draft to the 1906 *Monist* paper, already cited, he defended his earlier move in the following terms: "I must draw your attention to a trichotomy of all signs. This time, there is nothing that can generously be stigmatized as novel about the division. It is only the terminology, and the extension of the division to *all* signs (with the consequent necessary modifications) that is not to be found in every treatise on Logic" (R 295: 26 [ca. 1906]). In the final published paper, Peirce thus recognized the central importance of the "familiar

[26] It shall here be mentioned that Peirce invariably pointed out the irrelevance of psychology for the business of logic, the reason being that the latter is precisely concerned with *signs* and not with "judgments as they are in the mind" (R 637: 30 [1909]). More precisely, in his unpublished *Basis of Pragmaticism* essay, Peirce had argued that "Logic includes a study of reasoning […] and reasoning may be regarded […] as a psychical process. If we are to admit that, however, we must say that logic is not an all round study of reasoning, but only of the conditions of reasoning being bad or good, and if good to what degree, and in what application. […] The psychological process of reasoning is wholly aside from the purpose of logic" (EP2: 386 [1906]). As a result, Peirce had reminded a few years earlier that "the logicality of a given argument […] does not depend on how we *think* that argument, but upon what the truth is" (EP2: 257 [1903], our emphasis).

[27] See Bellucci (2004; 2018) for a historical account of this extension of the scope of logic.

logical triplet" of symbols—terms, propositions, and arguments—but argued that "in order to make this a division of all signs, the first two members [had] to be much widened" (CP 4.538 [1906]). This resulted in the 1903 trichotomy, renamed as *seme-pheme-delome* in 1906, and which can be characterized as follows.

In the first place, aseme (from ancient Greek σῆμα, sêma, or "sign") is a mere "substitutive sign" (EP2: 275 [1903]), an incomplete representation, which may either be *rhematic* (signifying a character) or *onomatic*[28] (denoting an object), and which may neither be true nor false in itself. It "embraces the logical Term, the Subject or Object of a sentence, everything of any kind be it a man or a scribed character, such as h or Pb, which will serve or is supposed to serve, for some purpose, as a substitute for its Object"[29] (R 295: 28 [ca. 1906]). In the second place, a pheme (from ancient Greek φήμη, phêmê, or "utterance") is an "informational sign" (EP2: 275 [1903]), or complete representation, which may either be true or false.[30] It "embraces all Propositions; but not only Propositions, but also all Interrogations and Commands,[31] whether they be uttered in words or signalled by flags, or trumpetted, or whether they be facts of nature like an earthquake (saying 'Get out of here!') or the black vomit in yellow fever (with other symptoms of disease, which virtually declare, or are supposed to declare, some state of health to exist)" (R 295: 29 [ca. 1906]). Finally, in the third place, an argument, or delome (from ancient Greek δήλωμα, delôma, or "a means of making known"), is a "rationally persuasive sign" (EP2: 275 [1903]), or perfect representation, which may either be sound or unsound. It "embraces all arguments, syllogisms, and inferences, sound or not" and "professes or has the air of professing, to convey the very creative law or reason which determines facts to be as they are" (R 295: 29 [ca. 1906]).

[28] I believe it unfortunate that Peirce had used "rheme" (from ancient Greek ῥῆμα, rhêma, or "verb") to refer to pure indices. Defined as that which remains when a proposition is severed from its subject (e.g. EP2: 221 [1903], EP2: 308 [1904]), a rheme shall thus only be conceived as a predicate (or its equivalent). To our knowledge, there is only one instance in Peirce's writings acknowledging the "onomatic" nature of subjects (from ancient Greek ὄνομᾰ, ónoma, or "name"): in the 1903 *Syllabus*, it is stated indeed that "any term fit to be the subject of a proposition may be termed an *Onome*" (EP2: 286 [1903]). On this ground, following Bricteux (2014, p. 28), I think that Peirce should have maybe called his "indexical rheme" an "indexical onome" instead, and could have simply distinguished between *rhematic* and *onomatic* semes, which is the direction taken here.

[29] Summing it up, an iconic seme is anything that is fit to serve as a substitute for anything that it is like (EP2: 273 [1903]), an indexical seme is anything that is fit to serve as a substitute of anything that it is existentially connected with (EP2: 163 [1903]), and a symbolic seme is anything that is fit to serve as a substitute of anything that supposedly constitutes an instance of the very character, or concept, that the symbol is purposed to signify.

[30] An alternative term for *pheme* was the well-known "dicisign", or "dicent sign" (e.g. EP2: 275 [1903], EP2: 292 [1903], and EP2: 478 [1906]): a sign "that says" something.

[31] The *fact* that an interrogation or command expresses remains the same, whether it be interrogated or commanded: "an assertion has its *modality*, or measure of assurance, and a question generally involves as part of it an assertion of emphatically low modality" (CP 4.57 [1893]).

6 Conclusion

In the 1903 *Syllabus*, when presenting his own general classification of the sciences, Peirce defined logic as "the theory of self-controlled, or deliberate, thought", and "all thought being performed by means of signs, logic may be regarded as the science of the general laws of signs" (EP2: 260 [1903]). In this broader sense, logic shall thus embrace "all the necessary principles of semeiotic, and I recognize a logic of icons, and a logic of indices, as well as a logic of symbols" (CP 4.9 [1906]).

More specifically, such logic-as-semiotic shall be divided into three branches, each one depending on the other preceding it. This trivium of sciences would constitute the necessary normative basis of scientific inquiry, whose purpose is to represent reality truthfully. The first branch is *speculative grammar*, or *stecheotic*, which shall study "the nature and meanings of signs, whether they be icons, indices, or symbols" (EP2: 260 [1903]). The second is *speculative critic*, or *logic* in its narrow sense, which shall study the nature of "arguments and determines the validity and degree of force of each kind", which analysis "cannot be undertaken until the whole structure of signs, especially of general signs, has been thoroughly investigated" (EP2: 245 [1903]). And the third branch is *speculative rhetoric*, or *methodeutic*, which shall study "the methods that ought to be pursued in the investigation, in the exposition, and in the application of truth", which theory "is not possible until the logician has first examined all the different elementary modes of getting at truth and especially all the different classes of arguments" (EP2: 256 [1903]). As a matter of fact, Peirce did not elaborate much on that latter branch but, among all things, viewed Francis Bacon's *Novum Organum* as a work of methodeutic, though a "total failure, eloquently pointing out some obvious sources of error, and to some minds stimulating, but affording no real help to an earnest inquirer" (CP 2.109 [1902]). This led him to remark that "THE book on this subject remains to be written; and what I am chiefly concerned to do is to make the writing of it more possible". More particularly, the study of "the exposition of truth" shall actually coincide with a rhetoric (understood in its narrow sense) of scientific communication, as it is envisaged, among other few places, in his *Ideas, Stray or Stolen, about Scientific Writing* essay (EP2: 325 [1904]).

Commenting on semiotic, Peirce came to the conclusion that "the proper sphere of any science in a given stage of development of science is the study of such questions as one social group of men can properly devote their lives to answering; and it seems to me that in the present state of our knowledge of signs, the whole doctrine of the classification of signs and of what is essential to a given kind of sign, must be studied by one group of investigators" (CP 4.9 [1906]): that of logicians-as-semioticians. More than one hundred years later, "the work of clearing and opening up what I call semiotic" (CP 5.488 [ca.1906]) seems to remain a fascinating but vertiginous task which, as a "pioneer, or rather a backwoodsman", Peirce had only begun to foresee.

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References

Bellucci, F. (2014). 'Logic, considered as Semeiotic': on Peirce's philosophy of logic. *Transactions of the Charles S. Peirce Society, 50*(4), 523–547.

Bellucci, F. (2018). *Peirce's speculative grammar: Logic as semiotics*. New York: Routledge.

Bergman, M. (2009a). Experience, purpose, and the value of vagueness: On C. S. Peirce's contribution to the philosophy of communication. *Communication Theory, 19*(3), 248–277.

Bergman, M. (2009b). *Peirce's philosophy of communication. The rhetorical underpinnings of the theory of signs*. London: Continuum International Publishing Group.

Bricteux, G. (2014). *Philosophie de la notation logique : une approche sémiotique*. Thèse présentée comme exigence partielle du doctorat en philosophie. Montréal : Université du Québec à Montréal. https://archipel.uqam.ca/7061.

Fisch, M. H. (1986). Peirce, semeiotic, and pragmatism. In K. L. Ketner & C. Kloesel (Eds.), *Essays by Max H. Fisch*. Bloomington: Indiana University Press.

Hookway, C. (1985). *Peirce*. London: Routledge & Kegan Paul.

Lane, R. (2018). *Peirce on realism and idealism*. Cambridge: Cambridge University Press.

Peirce, C. S. (1931–1958). *Collected Papers of Charles Sanders Peirce*. 8 vols. In P. W. Hartshorne, & A. Burks. Cambridge, MA: Harvard University Press.

Peirce, C. S. (1998). *The essential Peirce: selected philosophical writings*. *Volume 2 (1893–1913)*. Edited by the Peirce Edition Project. Bloomington and Indianapolis: Indiana University Press.

Peirce, C. S. (1982–2009). *Writings of Charles Sanders Peirce: a chronological edition*. 8 vols. Edited by the Peirce Edition Project. Bloomington and Indianapolis: Indiana University Press.

Réthoré, J. (1993). A few linguistic concepts revisited in the light of Peirce's semiotics. *Semiotica, 97*(3/4), 387–400.

Robin, R. S. (1967). *Annotated catalogue of the papers of Charles S. Peirce*. Amherst: University of Massachusetts Press.

Rodrigues, C. T. (2011). The method of scientific discovery in peirce's philosophy: deduction, induction, and abduction. *Logica Universalis, 5*(1), 127–164.

Short, T. L. (2007). *Peirce's theory of signs*. Cambridge: Cambridge University Press.

Stjernfelt, F. (2015). Dicisigns: Peirce's semiotic doctrine of propositions. *Synthese, 192*(4), 1019–1054.

Wiggins, D. (2004). Reflections on inquiry and truth arising from Peirce's method for the fixation of belief. In C. Misak (Ed.), *The Cambridge Companion to Peirce* (pp. 87–126). Cambridge: Cambridge University Press.