The Philosophical Context of Peirce's Existential Graphs

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Charles S. Peirce's ambition was to ground and expand logic on a fundamentally new basis–a general theory of representation that he called "semeotic"–which could account for the continuous nature of thought and communication operating mediationally in human experience to generate knowledge. He was convinced, through his professional work as a scientist, that absolute accuracy is unattainable, and his pragmatism regards truth as a *limit* successively approached by increasingly refined investigations, which depend on communication among collaborating investigators. Peirce's theory has been recognized as a new philosophical perspective responding to (and reconciling the effects of) Cartesian dualism, materialism, and reductionism–the demand for an absolute foundation for knowledge that prevents us from explaining how communication is possible at all. The Existential Graphs are the key instrument in fulfilling his ambition.

Placing the Existential Graphs within Peirce's philosophical context requires perseverance. Although 10,000 pages of his scientific work were published during his lifetime (1839-1914), most of his philosophical writings (100,000 manuscript pages archived in the Houghton Library at Harvard) remain unpublished, except in 30-year-old microfilm. The misleadingly named *Collected Papers of Charles Sanders Peirce* (eight volumes published 50-60 years ago) contains about 150 selections from his unpublished manuscripts, and only one-fifth of them are complete: parts of some manuscripts appear in up to three volumes and at least one series of papers has been scattered throughout seven. A more recent attempt to publish this material, *Writings of Charles S. Peirce: A Chronological Edition* (projected in 30 volumes) has only succeeded in issuing sux volumes in twenty-five years of work and, even if the edition is completed, this would represent less than one-third of the entire Houghton collection.   Most significantly, the print format cannot easily present his progressively more graphical and colorful work: manuscripts filled with symbols and complicated graphics and crucially meaningful color, in both words and diagrams. He produced his most intensive theoretical work, which includes the Existential Graphs, during the last 10 years of his life (40,000 pages, or nearly half of the whole collection).

Because of the complexity of its conceptual nature (and the difficulties of access to its holograph expressions), Peirce's philosophy has been interpreted piecemeal by most scholars. Christopher Hookway, who has worked with Peirce's manuscripts extensively, comments on the limited progress of Peircean scholarship as it appeared (in 1985) when he set himself the task of writing the book that he looked for when he began to study Peirce's philosophy.

Many people share the opinion that Charles S. Peirce is a philosophical giant, perhaps the most important philosopher to have emerged in the United States. Most philosophers think of him as the founder of 'pragmatism' and are aware of

doctrines—about truth and meaning, for example—which they describe as 'Peircean'. But, curiously, few have read more than two or three of his best-known papers, and these somewhat unrepresentative ones. On reading further, one finds a rich and impressive corpus of writings, containing imaginative and original discussions of a wide range of issues in most areas of philosophy: he appears to have anticipated many important philosophical discoveries of the last eighty years. However, the interest of Peirce's work does not consist simply in these detailed examinations of philosophical problems, for he was, above all, a systematic philosopher. Inspired by Kant, he devoted his life to providing foundations for knowledge and, in the course of doing so, he brought together a number of different philosophical doctrines: the new logic of relations and quantifiers invented independently by Frege in Germany and Peirce in the United States; sophisticated insights into the structure of science and the logic of probability; a systematic theory of meaning and interpretation; a developed philosophy of mathematics; a general theory of value; and a metaphysics incorporating an ambitious evolutionary cosmology. It is not wholly surprising that he is not read more widely. . . . He never produced a unified coherent presentation of the system. We have to work from a mass of papers, sets of lectures notes, reviews, and manuscripts, and on that basis—helped by his many programmatic statements—reconstruct the structure and development of his system. [Hookway: ix]

Joseph Esposito, who has also worked extensively with Peirce's manuscripts, has explicated his work as a comprehensive *metaphysics* (which Peirce called "the science of unclear thinking") that responds to the limitations of modern philosophy.

An early exponent of Peirce's work, Ernest Nagel explains that Peirce's ambition was "to construct a system of philosophy so comprehensive that for a long time to come achievements in all departments of research, in mathematics, in the natural sciences, in history, in sociology, would appear simply as details filling out its outline" [in Buchler: xiii]. Nagel finds a unique pair of fundamental insights in Peirce's thought—"the recognition of the role played by symbols or language in human behavior and knowledge; and the recognition that human knowledge is an achievement of biological organisms functioning in social contexts." He concludes that Peirce conceived his semeotic as a theory that would assimilate the findings of both the formal (logical) and the empirical (biologico-social) approaches of inquiry: "He was the first, or among the first, to work out an empiricism which could combine recognition of the indispensable function in inquiry of strict logic and other regulative principles, with a recognition of the equally indispensable role of sensory observation" [ibid.: xvi].

What Nagel calls "an empiricism," Peirce called "pragmatism" (and often "pragmaticism"), a mode of conducting inquiry that avoids the puzzles of traditional philosophy and logical theory, which (as Nagel recognized) "derive almost entirely from isolating knowledge from the procedures leading up to it, so that it becomes logically impossible to attain" (ibid.). Hookway explains that Peirce does not remove philosophical problems (expressed in such terms as mind vs body, rationalism vs empiricism, and idealism vs materialism) by exposing their errors, but his pragmatism "makes them tractable" [2]. Peirce explains his pragmatism's purpose:

What is it expected to accomplish? It is expected to bring to an end those prolonged disputes of philosophers which no observations of facts could settle, and yet in which each side claims to prove that the other side is wrong. Pragmatism maintains that in those cases the disputants must be at cross-purposes. They either attach different meanings to words, or else one side or the other (or both) uses a word without any definite meaning. What is wanted, therefore, is a method of ascertaining the real meaning of any concept, doctrine, proposition, word, or other sign. The object of a sign is one thing; its meaning is another. Its object is the thing or occasion, however indefinite, to which it is to be applied. Its meaning is the idea which it attaches to that object, whether by way of mere supposition, or as a command, or as an assertion. [*CP* 5.5]

Pragmatism, for Peirce, was the conduct of inquiry implied by his semeotic as a theory of experience, which he conceived as essentially mediated by our ability to create and rely on representations. Pragmatism tells us how the conditions of experience, semeotically defined, *effect* learning. Semeotic explains the need for pragmatism (a procedure for learning) and offers a conceptual framework with which to identify and examine what are the necessary conditions for meaning to occur in experience. Pragmatism describes the practice or procedure for creating those conditions: "Nobody will expect of a theory that it should furnish skill or render practice needless" [*CP* 2.201].

Peirce's Philosophical Perspective

In a discussion about whether it would be possible to build a machine capable of logical inference, Peirce describes a mechanical syllogism solver invented by Marquand, but concluding that no logical machines yet constructed are able to perform mathematical deductions. And that, he contends, is only one test of a theory of reasoning, and speculates: "There is, however, a modern Exact Logic [the logic of relations] which, although yet in its infancy, is already far enough advanced to render it a mere question of expense to construct a machine that would grind out all the known theorems of arithmetic and advance that science still more rapidly than it is now progressing" [CSP-MS 831; 1900]. [1] But, he asks, would this be a reasoning machine?

What, then, is the use of designating some formulations of opinion as rational, while others (perhaps leading to the same results) are stigmatized as blind followings of the rule of thumb or of authority, or as mere guesses? When we reason we set out from an assumed representation of the state of things. This we call our *premise*; and working upon this, we produce another representation which professes to refer to the same state of things; and this we call our *conclusion.* . . . The irrationality here consists in our following a fixed method [an algorithm], of the correctness of which the method itself affords no assurance; so that if it does not happen to be right in its application to the case in hand, we go hopelessly astray. In genuine reasoning, we are not wedded to our method. We deliberately approve it, but we stand ever ready and disposed to reexamine it and so improve upon it, and to criticise our criticism of it, without cessation. Thus the utility of the word "reasoning" lies in its helping us to

discriminate between self-critical and uncritical formations of representations. If a machine works according to a fixed principle involved in the plan of it, it may be a useful aid in reasoning; but unless it is so contrived that, were there any defect in it, it would improve itself in that respect, then, although it could correctly work out every possible conclusion from premises, the machine itself would afford no assurance that its conclusions would be correct. Such assurance could only come from our critical examination of it. Consequently, it would not be, strictly speaking, a reasoning-machine.

Self-criticism can never be perfectly thorough for the last act of criticism is always itself open to criticism. But as long as we remain disposed to self-criticism and to further inquiry, we have in this disposition an assurance that if the truth of any question can ever be got at, we shall eventually get at it. [CSP-MS 831; 1900]

>>>>>>>Peirce developed his theory of experience to explain how self-critical conduct (learning by experience) is possible, as a context for generalizing logic: "Logic, in its general sense, is, as I believe I have shown, only another name for *semiotic*" [MS 798; *CP* 2.227—1896; however, he preferred the spelling "semeotic," see *CP* 8.377]. He formulated his pragmatism as the procedure for achieving this conduct, and he created his Existential Graphs as a communication instrument for insuring the validity of this procedure. Generally, his life's work can be seen as a struggle to build the philosophical perspective needed to examine how intellectual growth occurs. Knowledge, to be both vital and viable, must evolve from the progressive resolution of the diversity of our individual experiences of the world in the continuity of collective inquiry, by means of communication. His semeotic examines the esthetic, ethical, and logical basis of the self-critical control necessary for collective experience to progress effectively.

He considered traditional logic to be inadequate for examining the nature of inquiry (learning) as the process by which we can examine beliefs, interpretations, and assumptions in the course of our experience, because it provides no comprehensive account of language and meaning—of communication. Hookway explains: "An argument familiar among empiricists runs thus: we can show that we understand an expression by providing a synonym or by giving a verbal definition of it, and we can use synonyms and definitions to teach the meanings of expressions. However, these represent indirect ways of explaining the meaning of an expression; they simply point out that it is the same as the meaning of some other expression. In order to break out of the web of words, we must have a way of explaining or showing what the expression applies to" [259]. Peirce regarded science as the most effective means of conducting inquiry, and his pragmatism attempts to capture its essential methodological nature in philosophically useful terms.

The semeotic perspective views the primary challenge of any science as the mediating effort to resolve the many different observations (as views or experiences of some phenomenon) that are possible, by continuing to formulate and test hypotheses (which are representations of these views), with some hope that the many views can be brought together to form a coherent, valid, and reliable interpretation from which investigation can proceed. Effective inquiry proceeds only through cooperation of individuals working to represent their experience (express their views), thereby creating a viable community that can give each member a broader perspective (collective

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experience) but which can only remain vital through continued individual contributions. Trying to overcome the solipsism or individualism (nominalism) that characterizes both rationalism and empiricism, Peirce (based on his own experience as a working scientist) developed his semeotic and pragmaticism to account philosophically for *a community of inquirers* as what makes knowing possible.

> The real is that which, sooner or later, information and reasoning would finally result in, and which is therefore independent of the vagaries of me and you. Thus, the very origin of the conception of reality shows that this conception essentially involves the notion of a COMMUNITY, without definite limits, and capable of an indefinite increase of knowledge. [*W2:*239)]

As a practising scientist (30 years as geodesist, mathematician, and computer for the Coast and Geodetic Survey) and an extraordinarily proficient philosopher (broadly and deeply versed in ancient, medieval, and modern traditions), Peirce concluded that while successful investigation of any sort involves sophisticated instruments and techniques, successful inquiry (the growth of knowledge) relies on effective communicational conditions, operations, and awareness: careful observation and ingenious conceptualization generate knowledge only insofar as we collaboratively validate and continue to test our interpretations of what might be true.

One difficulty for those who study Peirce's semeotic (he did not use the form we commonly see: "semiotics") has been the need, first of all, to appreciate that it is one thing to see mathematics, chemistry, or any other subject from a semeotic perspective, and quite another to construct or to examine the construction of that perspective itself. Esposito explains that his study of signs and development of a theory "grew out of his use of sign concepts to solve *specific* philosophic questions," for many years prior to his realization of the need to develop that theory [1979: 19]. And Leroy Searle warns: "Perhaps the greatest difficulty, aside from the probability that [most of us] are born and bred nominalists, is that most will bring to Peirce's writing assumptions about 'logic,' 'metaphysics,' and 'semiotics' or about the idea of the 'sign' that may be fundamentally incompatible with the position Peirce elaborates" [559]. Support for nominalism lies in traditional logic, which (as mentioned above) conveniently ignores the problem of establishing objective reference for abstract concepts and general terms. Nagel and Newman (in their account of Gödel's proof) explain that "[f]or almost two thousand years Aristotle's codification of valid forms of deduction was widely regarded as complete and as incapable of essential improvement. As late as 1787, the German philosopher Immanuel Kant was able to say that since Aristotle formal logic 'had not been able to advance a single step, and is to all appearances a closed and completed body of doctrine.' The fact is that the traditional logic is seriously incomplete, and even fails to give an account of many principles of inference employed in quite elementary mathematical reasoning" [27].

Peirce's semeotic perspective grew from his profound study of traditional logic and its medieval and ancient origins in the theory of "semiosis," an originally Greek conception of how our ability to represent the objects of experience makes it possible for us to generalize (symbolize, categorize, measure): to establish relations that make possible the continuous growth or spreading of ideas. From this comprehensive view of

the mediating experience, *Ontology* can be viewed as examining one dimension of semeotic; its field of investigation is the structure of the world (elements and relations of existence). *Epistemology* examines a second dimension of semeotic; its field of investigation is the meaning of the world (our relations to the world through representations of its existential relations). *Semeotic* examines the third dimension, incorporating the first two dimensions in a field of investigation into the *occurrence* of meaning in the world (our experiential reliance on representations of the relations in the world, by which we continue to gain knowledge of it). We know what exists to the extent that we are capable of representing our observations effectively (that is, usefully, as a basis for further observation)—and can continue to develop this capability. According to Esposito, Peirce's aim was "to discover a unified theory of logic, psychology, and metaphysics, and to present it in some sort of logical form" [1980: 147].

He proposed that logic finally be developed as a genuine science of reasoning, in terms of semeotic, with three branches: abduction, induction, and deduction. Abduction refers to the creative effort to formulate hypotheses (guesses) that represent how conditions in the world must be in terms of facts (relations among objects) to render any body of data conceptually explicable. Anderson explicates the "pragmatic disposition," by which according to Peirce we can clarify our opinions to make them more effectively testable and comparable with the opinions of others. "A hypothesis must explain the phenomena in question. An analysis of its logical purport, of its would-bes, allows an inquirer to determine this. Deduction then develops the implications of the would-bes, and induction tests for the reality of the generality that is the hypothesis or, more accurately, the object of the hypothesis, and thus 'gives us the only approach to certainty concerning the real that we can have'" [56; *CP* 8.209].
These three branches of logic, then, can be used to investigate the conduct of creating, testing, and validating representations. Peirce claims that all three meet a defensible standard of logical correctness (abduction and induction can be considered inferences from samples to the character of the population from which they were drawn; see Hookway: 31) and, together, they account for the effective formation of concepts as explained by his semeotic and described by his pragmatism.

Existential Graphs is a formal system of deductive logic intended to provide a means of observing and carefully building the rational component of concept generation to match what sophisticated instruments and techniques have provided empirical investigation. He insisted that deductive logic is not the rigid rule-driven (algorithmic) procedure that traditional logic conveniently assumes it to be (since Kant put "the lock on the door of philosophy" [Hookway: 18; see *CP* 5.348], and that only with a logical instrument such as his Graphs can the conduct of demonstrative reasoning be "observed" [see *CP* 4.8] [3] well enough to provide proof of his pragmatism as an account of the conduct of inquiry, in which meaning tends to become more and more reliable.

If there were aspects of meaning which were not revealed through the application of the pragmatist maxim, then they would be reflected in the use of hypotheses in deliberation—for they certainly do not emerge in ordinary inductive testing. Hence, if the existential graphs could be completed, we could use them to find out whether such non-pragmatic intellectual meaning was to be found. [S]hould the theory of Pragmatism be erroneous, the student would only have to compare concept after

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concept, each one, first in the light of the Existential Graphs, and then as Pragmaticism would interpret it, and it could not be that before long he would come upon a concept whose analyses from these two widely separated points of view unmistakably conflicted. [*CP* 4.534n —from a projected later paper for the *Monist* series of 1905-6]

Observing the Mediation Relations of Experience

Searle explains why Peirce's philosophy fundamentally challenges the prevailing attitude and condition of modern philosophy—and its effect on science.

While Philosophical commentators may wish to "ignore the metaphysical side of Peirce's thought" (*Nauta* 121), but it was crucial for Peirce, whose persistent complaint about metaphysics since René Descartes was that it was unclear, self-contradictory, or confused—not that one could get rid of it or otherwise deconstruct it. His turn to Duns Scotus, the subtlest medieval defender of realism, combined with his study of Kant, led to a version of critical realism in which he rejects the nominalism he finds in virtually all modern philosophers since Descartes (*CP* 1.18-19).
In general, Peirce took the view that "nominalism" involves a metaphysical reduction of modes of reality to the existence of individual entities (*CP* 1.21), thereby hopelessly obscuring the dependence of thought and inquiry on diverse forms of representation and so ensuring in all intellectual pursuits, but especially in experimental science, a chronic state of crisis or confusion over the status of truth claims, as well as the proliferation of destructive and not merely critical forms of skepticism. [559]

Nearly a century ago, Peirce developed his semeotic to explain problems that have since been recognized in modern physics. Einstein's relativity theories, for example, do not account for communication between observers; time is conceived as reversible, giving observers no basis for comparing time intervals. A theory of experience must explain the nature of contextual conditions in which communication is possible.
We establish experience of the past (in memories and records of all kinds)—even our awareness of the present (to the extent that we turn our attention to it) becomes consciousness of the immediate past—but we cannot have such experience of the future. Peirce's philosophical *observation* of this "asymmetry of experience," based on the irreversibility of time, indicated to him a fundamental "directionality in experience": we are bound in our conscious experience to "go from the past toward the future" [CSP-MS 304; 1903]. This metaphysical observation was the foundation for his semeotic as a theory of the *continuity* of experience (the *growth* of meaning, rather than its haphazard expansion). Uncertainty about the future tends to draw us out of the certainty of the past. Notions of probability and chance (or *tendencies*) have no meaning (that is, are of no use to us) without our awareness of time, which gives us the basis for comparing our experiences through thought and communication (and the urge to do so).

Medieval scholars, in their development of the Greek theory of *semiosis*, conceived thought *as* communication [all thought is dialogic in form; see CSP-MSS 634 and 637; 1909] and investigated the necessary conditions for any form of such *mediation* to occur. A medium of expression does not simply "convey meaning." It becomes part of what its message expresses, and is thereby capable of affecting the experience of those using it in some way that cannot be completely predicted. In our modern technological conception of communication, we routinely consider the process as no more than the transmission of information, taking no comprehensive account of mediation—the conditions that must be part of the occurrence of meaning in anyone's experience. According to Peirce, *ideas* cannot be fully accounted for simply in terms of information-transfer used in modern communication theory.

> We are accustomed to speak of ideas as reproduced, as passed from mind to mind, as similar or dissimilar to one another, and, in short, as if they were substantial things . . . . But taking the word "idea" in the sense of an event in an individual consciousness, it is clear that an idea once past is gone forever, and any supposed recurrence of it is another idea. These two ideas are not present in the same state of consciousness, and therefore cannot possibly be compared. [*EP* 313]

Western philosophy, in its symbolic logic tradition and preoccupation with linguistic *structure*, has not fully appreciated what *functional* conditions the Greeks had tried to explain and understand. "A sign is a thing which causes us to think of something beyond the impression the thing itself makes upon the senses" [St. Augustine; in Robertson: 2.1.1, 34]. We might say, in modern terms, that when we effectively use a medium of communication, it becomes "transparent" for us, to the extent that it focuses our thoughts on the thing to which it refers. (See Keeler.) How can we examine the conditions necessary for such transparency to occur?

A chemist by training, Peirce employed the concept of sign to examine conditions that we cannot observe by empirical methods (as we can the structure of a medium and the behavior of participants) the way a chemist employs the concept of molecule as the basis for explaining molecular activity underlying the observable behavior of materials in reaction. Mediation is not merely reaction; we cannot discover "the rules" of sign-mediated behavior simply by external observation and statistical summary.

> I hold a different theory; namely that in the first place every composition of concepts is built up by the application of relatives, . . . and in the second place that this composition takes place, as in chemistry, by units of valency, so that each correlate of a relative term is a single individual, and for example the relation of being a loving servant is not correctly a mere compound of the relations of loving and of serving. [CSP-MS 300; 1908]

Signs, as semeotically defined, give us the conceptual means to analyze the conditions of mediating experience (whether we label it "thought" or "communication" for the purposes of empirical investigation). Signs, as mediation (*in experience)*, cannot be examined simply as objects (*of experience),* by means of the empirical approach, but must also be conceived in terms of semiosis—as continuous phenomena. We must speak

of "signs" as though they were entities, because language, our conventional medium of inquiry, is designed to treat *objects* of inquiry. (Consequently, says Bertrand Russell, we know much more about physics than about anything else.) Because of this limitation of language, when we use the word "sign" as a theoretical concept in semeotic, we must remain concurrently aware that we have abstracted the ongoing occurrence of semiosis ("hypostatic abstraction"). Symbolic expressions (as empirical phenomena: marks on paper, for example) are the periodic products of semeosis, but their empirically identifiable features (structures) alone do not determine what meaning will be made of them as signs (in semiosis): "In the first place, a sign is not a real thing. It is of such a nature to exist in replicas. Look down a printed page, and every *the* you see is the same word, every *e* the same letter. A real thing does not so exist in replica (and metaphysics must account for such existence). The being of a sign is merely *being represented*" [CSP-MS 517; 1904].

An expression has *virtual*, not factual, meaning—meaning that thought and communication continually generate. What makes an expression more than its objective properties is the not-strictly-causal (only vaguely determinable) relation to what *someone's* thought *might* take it to mean—in a particular space-time context, for some purpose. From any (necessarily limited) human point of view, the meaning of any expression cannot be simply a matter of *probability* (established conventional response) or *actuality* (conditionally stimulated response) but must include *possibility* (an individual's unique experience in which the interpretation of meaning occurs) that cannot help but generate new meaning—growing experience. The *essential continuity* of experience, in which meaning is always a possibility in the future, is theoretically fundamental to Peirce's pragmatism (pragmaticism)—a point ignored by his contemporary, as well as by the modern, "pragmatists."

> I do not think that the import of any word (except perhaps a pronoun) is limited to what is in the utterer's mind <u>actualiter</u>, so that when I mention the Greek language my meaning should be limited to such Greek words as I happen to be thinking of at the moment. It is, on the contrary, according to me, what is in the mind, perhaps not even <u>habitualiter</u>, but only <u>virtualiter</u> which constitutes the import.*

> *This was said in 1868, before declaring for pragmaticism, thus: "No present actual thought (which is mere feeling) has any meaning, any intellectual value; for this lies, not in what is actually thought, but in <u>what</u> this thought may be connected with in representation by subsequent thoughts; so that the meaning of a thought is altogether something virtual." [CSP-MS 291; 1905, with footnote taped to manuscript page]

Peirce's semeotic conceives experience as mediation, in the fundamentally *tri-relative* conceptual structure (object-sign-subjective idea) needed to capture its generative or continuously growing nature, which dualistic conceptions (such as mind/body, sense/reference, signifier/signified) do not. Although experience cannot be conceived in less than the two terms of subject and object, more than these two concepts are needed because the theory must account for the *relationship* between the two separate terms when we speak of a subject *experiencing* an object. The necessary third term

(focusing attention on the *relation* of experience between subject and object as a phenomenal element in its own right—to define, analyze, and explain) makes the minimum adequate conceptual structure a tri-relative one. The third, relational, term can be used to account for the space-time (context) as a basis (or point-of-view) for comparing other possible views, in which new relations constitute growing experience.

This "logic of relations" [4] prescribes an essential ordering (context dimension) of conceptual terms, a construct that makes it possible for Peirce to account for the generative or creative aspect of experience in terms of tri-relative sign-activity. Of course, this theoretic construct must be pragmatically tested for its usefulness in explaining particular mediational circumstances, as must any theoretical conception. When put to such a test, traditional dichotomous theories (such as Saussure's of signifier/signified and those of the logical positivists), without the relation of generation, cannot explain the productivity of thought and communication in creating new signs. Because the conditions conceptualized in these theories are timeless (language coded to thought as accomplished fact), they cannot explain the uniqueness of someone's meaning in a particular time and place or how it can come to be understood by others. Without the tri-relation that constitutes experience theoretically accounted for, communication (meaningfully relating ideas) must be considered irrelevant and even impossible.

On this point, Searle remarks: "While Peirce's "semiotics" may appear intriguingly similar to Saussure's proposed discipline of "semiology", it should not be overlooked that the first of many fundamental differences is that Peirce's [semeotic] is not based on the *word . . .* but on the proposition as that which unifies consciousness and creates intelligibility or comprehension. In this sense, Peirce's [semeotic] is not a theory of language but a theory of the production of meaning" [560]. Linguistic structure, in terms of words in sequence, does not immediately capture (efficiently express) the leading nature of propositions, which make intricate connections. In fact, in terms of mediational efficiency, the linguistic mode of expression puts a cognitive burden on us to track the progress of related ideas, constantly trying to follow the rules of its structure and conventions of its use—as a symbol system.

Beyond accounting for thought and communication as time-based and productively evolving, Peirce's comprehensive theory exposes difficulties that result from basing logic (any explanation of reasoning) on language alone. In the first place, he said,

> Logic, for me, is the study of the essential conditions to which signs must conform in order to function as such. How the constitution of the human mind may compel men to think is not the question; and the appeal to language appears to me no better than an unsatisfactory ascertaining of psychological facts that are of no relevancy to logic. But if such appeal is to be made, (and logicians generally do make it; in particular their doctrine of the copula appears to rest solely upon this,) it would seem that they ought to survey human languages generally and not confine themselves to the small and extremely peculiar group of Aryan speech. [CSP-MS 291; 1905]

Traditional logic's focus on the purely symbolic character of language fundamentally prevents us from making use of it as an observational science, particularly in examining the essential continuity of experience. Graphical notation, such as the

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Existential Graphs, is a more effective instrument for investigating the formal relations of linguistic symbols diagrammatically, "since no reasoning that amounts to much can be conducted without *icons* and *indices"* [*SS* 118] [5], argues Peirce, to make their logical (relational) character *observable.*

> [T]he intricate forms of inference of relative logic call for such studied scrutiny of the representations of the facts, which representations are of an *iconic* kind, in that they represent relations in the fact by analogous relations in the representation, that we cannot fail to remark that it is by *observation* of diagrams that the reasoning proceeds in such cases. We successively simplify them and are always able to remark that such observation is required. [*CP* 3.641]

Even so, he cautioned against the notion that any mode of reference performs complete representation.

> The system of Existential Graphs may be characterized with great truth as presenting before our eyes a moving picture of thought. Provided this characterization be taken not as a flatly literal statement, but as a simile, it will, I venture to predict, surprise you to find what a strain of detailed comparison it will bear without snapping. A picture is visual representation of the relations between the parts of its object; a vivid and highly informative representation, rewarding somewhat close examination. Yet from the nature of things it must fall short of perfection, just as a representation of any kind must. It cannot directly exhibit all the dimensions of its object, be this physical or psychic. It shows this object only under a certain light, and from a single point of view. [CSP-MS 291; 1905]

> But there is one assurance that the Icon does afford in the highest degree, namely, that which is displayed before the mind's gaze—the Form of the Icon, which is also its object—must be *logically possible.* [*CP* 4.533]

The semeotic qualities of diagrams allow us to keep track of logical relations (and their evolution) more efficiently than does linguistic structure, which even obscures relations in its symbolic transparency.

Individual points-of-view (whether of someone comparing experiences moment-to-moment or of a group in communication) are accounted for in terms of Peirce's tri-relation, which can be used to examine what constitutes the *potential* advantage of a conventional medium of communication, such as language: "It appears to me that the essential function of a sign is to render inefficient relations efficient,—not to set them into action, but to establish a habit or general rule whereby they will act on occasion. . . . [A] sign is something by knowing which we know something more" [*SS* 31-32].

The last part of that quotation is crucial to understanding what Peirce means by "efficient relations." Just as mediation in a language (when conventionally used by all participants) allows us to treat the medium transparently in order to express ideas, this very transparency can prevent us from examining the generalizing character of that medium's established structure and habituated function. Taking the sign (mediating relation between subject and object) as an analytical focus, we can imagine that a

response to the sign may be perfectly automatic but, if the sign's relation to its object is not well-established (based on the sign-user's experience of that object), then the tri-relation as a whole will not be efficient (efficiency entails effectiveness) in its role of referring to *something* for someone. As the units of language (words, sentences, paragraphs, documents, etc.) grow, their combinatorial power increases, while their referential power decreases (symbols can take on a life of their own). We are easily misled by symbolic power, as any rhetorician knows. Our ability to create and use symbolic expression, the boon of human intellect, is often our bane—when we take for granted their logical validity and referential reliability: do not continue to test and develop them based on further experience.

Pragmatic procedure creates truly efficient sign relations by maintaining the unifying function of conventionality while encouraging the diversifying function of representability through any media that can be devised for that purpose. In the effective conduct of science, we find the best evidence that regularity (in procedure) and inexactitude (or vagueness of reference [see CP 5.589] are not only compatible but productive, in the long run. From the semeotic perspective, the continuity of experience that supports the growth of knowledge depends on our collective capability to examine the validity (logical necessity) of related ideas (as concepts of what is possibly true) while increasing the reliability of their reference to the experienced world (as representations of what is probably true). We can *know* to the extent that we can learn to represent what we observe, usefully (to ourselves, at least), as interpretations that can always be examined for their validity (internal coherence) and their reliability (referential accuracy) so that we can continue to reconcile many observations, through time—by the most efficient media we can develop for that purpose.

We can examine our habits and consciously develop new ones, based upon what we can imagine to be possible as the consequence, continually linking the past to the future through ideas. The powerful transparent nature of our mediating symbol systems gives us this advantage—and its companion danger. The history of science demonstrates the hazards of nominalism: mistaking elaborate conceptual generalizations for what they are supposed to refer to, rather than using them as devices to be continually modified as more is learned [see Nagel and Newman's cautions for using the model method, 15-25]. In "The Bed-Rock Beneath Pragmaticism," written in 1908, Peirce makes clear that generality is a form of vagueness, that an absolutely and completely determinate sign is an impossibility [CSP-MS 300]. In the semeotic explanation of the tri-relative condition, a sign refers to something else for someone: the sign can never *be* the thing referred to (it would have no use in generalizing) and we never know for sure what someone might take it to mean. "Perfect accuracy of thought is unattainable,—*theoretically unattainable*. And undue striving for it is worse than time wasted" [*SS* 11]. Logical necessity (validity) does not establish truth, but only possibilities to test for their referential usefulness (reliability).

The Existential Graphs as an Instrument for Investigating Semeotic Continuity

Peirce began his life-long investigation with the hypothesis that the tendency or urge to generalize across the multitude of distinctions our senses are capable of

discriminating for us, is the basis of rational thought. We make sense of what would otherwise be "noise" or sheer confusion by means of our ability to create some apparent order in thought (which is communication with ourselves) and through communication with others who are capable of creating mutually recognized order. The sensory tendency to detect differences—to particularize experience—must be complemented by the cognitive (communicational) capability to relate the distinguished particulars on some basis—to generalize experience. To the extent that individuals can coordinate this capability in any sort of community, with even vague or limited relations among its members, their experience will grow more effectively.

Semeotic explains how experience can grow, based on the generalizing tendency that works to maintain the relatedness or continuity of ideas. Pragmatism can be appreciated as the methodological reminder that generalizing is not an end in itself (as nominalism assumes). The unifying cognitive capability, in turn, must serve the discriminating sensory capability, in a continuing cycle of conceiving and testing ideas against reality through experience. In this continuous (reasoning) effort—to formulate coherent ideas, to test them against sensory experience, to modify them in response, and to test them again—we rely, in semeotic terms, on mediation relations so minute and complex in the subtleties of linguistic expression, alone, that we could never be aware of or account for them all. While they are all *theoretically* explicable, we might analyze their unnoticed operation (or transparency) in relational detail only when a particular need arises. Peirce developed his Existential Graphs (in three parts: alpha, beta, and gamma) to represent and investigate mediation relations (reasoning) from the most abstract to the most precise [6].

If most mediation relations did not occur for us automatically, without our conscious thought, we would not function successfully. To the extent that we can establish relations that are trustworthy (concepts), as a result of experience, we can establish habits of thought and behavior (by training and learning)—which operate uncritically unless disturbed by new experience in which they are recognized as dysfunctional. By means of such complex mediation, we establish (more or less successful) mediated relations with the world around us. To the extent that these relations are habitual, we tend not to notice them and examine their effectiveness. We learn languages but do not readily examine their "fitness" in representing our experience. We establish habitual relations through tools and technological devices of all kinds that release us from routine, on which we may build to create new pursuits. The human-computer relation may epitomize our capability to establish habitual relations and increasingly build them into the machine itself, once we can define a habit in terms of an algorithm, or routine of interpretation for executing some operation.

The human semeotic capability to generalize—to relate objects (sensed or imagined) through mediation in experience, learn habits of thought, and automate productive behavior—requires human consciousness, or self-awareness, or the ability to "take perspective": to use the objective self to view the subjective self. Peirce clearly enunciated his dialogical concept of cognition in "What Pragmatism Is" (1905): "A person is not absolutely an individual. His thoughts are what 'he is saying to himself', that is, is saying to that other self that is just coming into life in the flow of time" [*CP* 5.421]. Five years later, he expressed the point as follows:

In reasoning, one is obliged to *think to oneself.* In order to recognize what is needful for doing this it is necessary to recognize, first of all, what "oneself" is. One is not twice in precisely the same mental state. One is virtually (i.e. for pertinent purposes, the same as if one were) a somewhat different person, to whom one's present thought has to be communicated. [*CP* 7.103]

Semeosis explains our experience as something more than moment-to-moment brute reaction to objects; our mediating experience progresses through time relating events and conditions—building concepts that might more or less vaguely indicate regularities in the future. To the extent that our expectations are fulfilled, we continue operating on the basis of those conceptions (as if they were true) in our habits. In a 1907 unpublished letter to the editor of *The Nation*, Peirce describes the "kernel of pragmaticism" in these conditional terms: "The *whole* meaning of an intellectual predicate is that certain *kinds* of events would happen, once in so often, in the course of experience, under certain kinds of existential conditions" [CSP-MS 318—*CP* 5.468; my italics].

In terms of his semeotic, Peirce considered what twentieth-century physicists and philosophers call the problem of indeterminacy to be a circumstance of representational multiplicity, to which his pragmatism responds. Any particular expression or interpretation might well lead to a definite response, which then can be evaluated for its usefulness in that context; but no particular representation can possibly be the end of inquiry or claim to be absolute. Determining meaning, for any particular circumstance, and testing it in further experience is the procedure for maintaining a potential indefinite determinability, in which every proposition (sign) would be part of an endless continuum that never reaches, but approaches the limit of, perfect representation. As Searle explains,

> While this Pragmaticist maxim appears to leave meaning infinitely deferred, it would be more accurate to say that it accepts meaning (as it does thought and reality itself) as a continuous process, which we determine, with arbitrary precision (depending on "different circumstances and desires"), in communities of inquiry. Finally, Peirce's pragmaticism, with its debt to Duns Scotus, reflects Peirce's sense that thinking is normative and in its deepest reaches ethical and aesthetic; it must be these if it is to be scientific (*CP* 5.36, 8.242). According to the title phrase of one of his most widely read essays, it is by inquiry and experiment that we seek the "fixation of belief" (*CP* 5.358 ff.), while the ethics of the process is profoundly summarized in the slogan that Peirce would have on "every wall of the city of philosophy: Do not block the way of inquiry" (*CP* 1.135)—which is to say, no belief is ever ultimate, and no one ever gets the last word. [562]

Having gained the metaphysical perspective of semeotic continuity, Peirce was particularly concerned about the dominance of deterministic materialism in the science of his time. He proposed that phenomena such as growth, diversity, generalization, and feeling do not simply defy the conservation law of physics, but they require a new law of "an intimate connection between growth and habit" that builds on what the conservative laws describe, as an advancement. All living organisms require the ordering negentropic

(habit-taking) tendency along with the entropic (habit-breaking) tendency in order to conduct themselves successfully in the mechanistic world of chance (where regularities have some probability of occurring): "I make use of chance chiefly to make room for a principle of generalization or tendency to form habits, which I hold has produced all regularities" [*CP* 6.63, 606].

Peirce's concept of continuity characterizes the negentropic tendency of living matter (evolution in the biological realm; sense of purpose in intellectual) [see *CP* 4.121], whereby the possibility of systematicity (or regularity) results from conditions of chance, or irregularity:

> Supposing matter to be but mind under the slavery of inveterate habit, the law of mind still applies to it. According to that law, consciousness subsides as habit becomes established, and is excited again at the breaking up of habit. But the highest quality of mind involves a great readiness to take habits, and a great readiness to lose them. [*CP* 6.613]

Peirce's theory tries to explain this quality of mind: how our feelings (intuitions) become effectively related to what (without this mediation capability) would be the brute-force objects in a world of simple reaction, by means of our power to contemplate and converse, which makes it possible for us to "know" (to gain some control of what happens in our experience). Self-critical, collective reasoning is the scientific method—and science is not a body of certified truths or systematized knowledge. He even suggested that knowledge is not the point of science at all: knowledge though systematized may be dead memory (hide-bound). The scientific inquirer is a member of a community of those who disinterestedly pursue the truth, which none can know as a matter of fact and must be conceived as an ideal or limit. The pursuit advances, essentially, through dialog and is successful to the extent that it can produce testable representations of what is observed or interpreted. Knowing is entirely a collective achievement, based on each contributor's ability to provide testable expressions that may be incorporated by a community for further development.

In such endeavor, the powerful and transparent operations of our mediating symbol systems give us the capability to represent, without being aware of how a particular medium determines what we can express. What we approve as knowledge tends to conform to what we have been able to express in such a conventional system, and we cannot use a particular system to examine its own limitations. Without semeotic perspective of the mediating conditions in our use of language, it reinforces the nominalist claim (and our modern intellectual behavior) that abstract terms have no material reference; we need a theory of experience (as continuity) to explain the conduct that makes this reference possible. Peirce's Existential Graphs [7] provide a (meta-linguistic) means of observing the semeotic growth of language, where the existence of anything referred to remains permanently hypothetical (never absolutely confirmed or denied) and only our continued attempts (as pragmatism describes) to make it intelligible are examined as the means by which we understand it in some measure that continues to grow. Ultimately, knowing is continuing to represent what we learn, through observation and expression, in our conduct—which is the most efficient relation to existence possible.

Peirce's description (quoted at some length, below) indicates how such a semeotic instrument should contribute to the efficiency of mediation, demonstrating the nature and necessity of communication in achieving self-critical control. Two characters in dialogue (grapheus and graphist) may be considered to portray the dialogic experience of coming to comprehend through coordinated reasoning.

Our purpose, then, is to study the workings of necessary inference. What we want, in order to do this, is a method of representing diagrammatically any possible set of premises, this diagram to be such that we can observe the transformation of these premises into the conclusion by a series of steps each of the utmost possible simplicity.

What we have to do, therefore, is to form a perfectly consistent method of expressing any assertion diagrammatically. The diagram must then evidently be something that we can see and contemplate. Now what we see appears spread out as upon a sheet. We must appropriate a sheet to the purpose, and the diagram drawn or written on the sheet is to express an assertion. We can, then, approximately call this sheet our *sheet of assertion.* The *entire graph,* or all that is drawn on the sheet, is to express a proposition, which the act of writing is to assert.

But what are our assertions to be about? The answer must be that they are to be about an arbitrarily hypothetical universe, a creation of a mind. For it is *necessary* reasoning alone that we intend to study; and the necessity of such reasoning consists in this, that not only does the conclusion happen to be true of a pre-determined universe, but *will* be true, so long as the premises are true, howsoever the universe may subsequently turn out to be determined. Thus, conformity to an *existing,* that is, entirely determinate, universe does not make necessity, which consists in what always *will be,* that is, what is determinately true of a universe not yet entirely determinate. Physical necessity consists in the fact that whatever may happen will conform to a law of nature; and logical necessity, which is what we have here to deal with, consists of something being determinately true of a universe not entirely determinate as to what is true, and thus not *existent.* In order to fix our ideas, we may imagine that there are two persons, one of whom, called the *grapheus,* creates the universe by the continuous development of his idea of it. . . .

The other of the two persons concerned, called the *graphist,* is occupied during the process of creation in making *successive* modifications . . . of the entire graph. Remembering that the entire graph is *whatever* is, at any time, expressed in this system on the sheet of assertion, we may note that before anything has been drawn on the sheet, the *blank* is, by that definition, a graph. It may be considered as the expression of whatever must be well-understood between the graphist and the interpreter of the graph before the latter can understand what to expect of the graph. There must be an interpreter, since the graph, like every sign founded on convention, only has the sort of being that it has if it is interpreted; for a conventional sign is neither a mass of ink on a piece of paper or any other individual existence, nor is it an image present to consciousness, but is a special habit or rule of interpretation and consists precisely in the fact that certain sorts of ink spots—which I call its *replicas*—will have certain effects on the conduct, mental and bodily, of the interpreter. [*CP* 4.429-4.431]

His system of graphs was never finished, and we have only indications of how he hoped it would ultimately contribute to his philosophical perspective. In a letter, he writes: "I wish you would study my Existential Graphs, for in my opinion it quite wonderfully opens up the true nature and method of logical analysis;—that is to say, of definition; though *how* it does so is not easy to make out, until I shall have written my exposition of that art. I am now working desperately to get written before I die a book on Logic that shall attract some good minds through whom I may do some real good" (*SS* 86).

Peirce expanded logic "to cover the whole range of intelligent inquiry or associative thought for any 'intelligence capable of learning by experience' [*CP* 2.227], without losing the precision that made him one of the fathers of modern formal logic," so that his metaphysics "does not issue in a simple ontology, nor does it lead to radical skepticism because the crucial (and subtle) question hinges on the character and function of representability, not being or existence" [Searle: 559-60]. Peirce himself described the results of his efforts, in 1907:

> I am, as far as I know, a pioneer, or rather a backwoodsman, in the work of clearing and opening up what I call *semiotic* that is, the doctrine of the essential nature and fundamental varieties of possible semiosis; and I find the field too vast, the labor too great, for a first-comer. (CSP-MS 318; *CP* 5.448)

Notes

1. All "MS" and "L" references are to Peirce's manuscripts and letters. "CP" (with paragraph numbers following) refers to the *Collected Papers*, "SS" to *Semiotic and Significs*, "EP" to *The Essential Peirce*, and "NEM" to the *New Elements of Mathematics*, all of which may be found in the References under "Peirce."

2. Hookway says: "Peirce's project extends beyond providing a 'formal' non-psychological account of the validity of different forms of deductive inference. He wants to provide an explanation of the inferences that are central to the growth of scientific knowledge, to classify the different kinds of ampliative argument and provide an objective explanation of their validity" (17-18). He quotes Peirce: "According to Kant, the central question of philosophy is 'How are synthetical judgments *a priori* possible?' But antecendently to this comes the question how synthetical judgments in general, and still more generally, how synthetical reasoning is possible at all. When the answer to the general problem has been obtained, the particular one will be comparatively simple. This is the lock upon the door of philosophy" (*CP* 5.348).

3. (Peirce explains deductive reasoning and the traditional misconception of its nature.) Deductive logic can really not be understood without the study of the logic of relatives, which corrects innumerable serious errors into which not merely logicians, but people who never opened a logic book, fall from confining their attention to non-relative logic. One such error is that demonstrative reasoning is something altogether unlike

observation. But the intricate forms of inference of relative logic call for such studied scrutiny of the representations of the facts, which representations are of an *iconic* kind, in that they represent relations in the fact by analogous relations in the representation, that we cannot fail to remark that it is by *observation* of diagrams that the reasoning proceeds in such cases. We successively simplify them and are always able to remark that such observation is required, and that it is even thus, and not otherwise, that the conclusion of a simple syllogism is seen to follow from its premises. Again, non-relative logic has given logicians the idea that deductive inference was a following out of a rigid rule, so that machines have been constructed to draw conclusions. But this conception is not borne out by relative logic. People commonly talk of *the* conclusion from a pair of premises, as if there were but one inference to be drawn. But relative logic shows that from any proposition whatever, without a second, an endless series of necessary consequences can be deduced; and it very frequently happens that a number of distinct lines of inference may be taken, none leading into another. That this must be the case is indeed evident without going into the logic of relatives, from the vast multitude of theorems deducible from the few incomplex premises of the theory of numbers. But ordinary logic has nothing but barren sorites to explain how this can be. Since Kant, especially, it has been customary to say that deduction only elicits what was implicitly thought in the premises; and the famous distinction of analytical and synthetic judgments is based upon that notion. But the logic of relatives shows that this is not the case in any other sense than one which reduces it to an empty form of words. . . . In minor points the doctrines of ordinary logic are so constantly modified or reversed that it is no exaggeration to say the deductive logic is completely metamorphosed by the study of relatives. (*CP* 3.641)

4. (Hookway comments on what Peirce, who—with Augustus DeMorgan and George Boole—developed the logic of relations, hoped his Graphs would demonstrate.)
[J]ust as modern logicians stress that it is the presence of relational predicates that renders elementary logic undecidable, so Peirce insists that it is only with the development of the logic of relations that the character of theorematic reasoning becomes readily discernible (*NEM,* iv.: 58). Given Peirce's interest in whether the future work of necessary reasoning could be left to machines, it is tempting to construe Peirce's doctrine as an early dim anticipation of the undecidability of the logic of relations (199).

5. (Peirce gives the following introduction to define the diagrammatic character of his existential graphs.)
A *diagram* is a representamen which is predominantly an icon of relations and is aided to be so by conventions. Indices are also more or less used. It should be carried out in a perfectly consistent system of representation, founded upon a simple and easily intelligible basic idea.
A *graph* is a superficial diagram composed of the sheet upon which it is written or drawn, of spots or their equivalents, of lines of connection, and (if need be) of enclosures. The type, which it is supposed more or less to resemble, is the structural formula of the chemist.
A *logical graph* is a graph representing logical relations iconically, so as to be an aid to logical analysis.

An *existential graph* is a logical graph governed by a system of representation founded upon the idea that the sheet upon which it is written, as well as every portion of that sheet, represents one recognized universe, real or fictive, and that every graph drawn on that sheet, and not cut off from the main body of it by an enclosure, represents some fact existing in that universe, and represents it independently of the representation of another such fact by any other graph written upon another part of the sheet, these graphs, however, forming one composite graph. (*CP* 4.418)

6. (In his "Lowell Lectures" of 1903, Peirce explains the parts of his existential graphs and their specific purposes in the following way.)

The alpha part of graphs . . . is able to represent no reasonings except those which turn upon the logical relations of general terms. (*CP* 4.510)

The beta part . . . is able to handle with facility and dispatch reasoning of a very intricate kind, and propositions which ordinary language can only express by means of long and confusing circumlocutions. A person who has learned to think in beta graphs has ideas of the utmost clearness and precision which it is practically impossible to communicate to the mind of a person who has not that advantage. Its reasonings generally turn upon the properties of the relations of individual object to one another.

But it is able to do nothing at all with many ideas which we are all perfectly familiar with. Generally speaking it is unable to reason about abstractions. It cannot reason for example about qualities nor about relations as subjects to be reasoned about. It cannot reason about ideas. It is to supply that defect that the gamma part of the subject has been invented. But the gamma part is still in its infancy. It will be many years before my successors will be able to bring it to the perfection to which the alpha and beta parts have been brought. For logical investigation is very slow, involving as it does the taking up of a confused mass of ordinary ideas, embracing we know not what and going through with a great quantity of analyses and generalizations and experiments before one can so much as get a new branch fairly inaugurated. (*CP* 4.511)

The gamma part of graphs, in its present condition, is characterized by a great wealth of new signs; but it has no sign of an essentially different kind from those of the alpha and beta part. The alpha part has three distinct kinds of signs, the *graphs,* the *sheet of assertion,* and the *cuts.* The beta part adds two quite different kinds of signs, *spots,* or *lexeis,* and *ligatures* with *selectives.* It is true that a line of identity is a graph; but the terminal of such a line, especially a terminal on a cut where two lines of identity have a common point, is radically different. So far, all the gamma graphs that have presented themselves, are of those same kinds. . . . But in the gamma part of the subject all the old kinds of signs take new forms. . . . Thus in place of a sheet of assertion, we have a book of separate sheets, tacked together at points, if not otherwise connected. For our alpha sheet, as a whole, represents simply a universe of existent individuals, and the different parts of the sheet represent facts or true assertions made concerning that universe. At the cuts we pass into other areas, areas of conceived propositions which are not realized. (*CP* 4.512)

(Peirce goes on to discuss the development of graphical logic for examining the universe of existential fact vs the universe of logical possibility; *CP* 4.514).

7. (Peirce was aware of misexpectations based on graphical algebras and other diagrammatic schemes and here tries to clarify the limited purpose for the alpha part of his graphs.)

In order to understand why this system of expression has the construction it has, it is indispensable to grasp the precise purpose of it, and not to confuse this with four other purposes, to wit:

First, although the study of it and practice with it will be highly useful in helping to train the mind to accurate thinking, still that consideration has not had any influence in determining the characters of the signs employed; and an exposition of it, which should have that aim, ought to be based upon psychological researches of which it is impossible here to take account.

Second, this system is not intended to serve as a universal language for mathematicians or other reasoners, like that of Peano.

Third, this system is not intended as a calculus, or apparatus by which conclusions can be reached and problems solved with greater facility than by more familiar systems of expression. Although some writers [Schröder] have studied the logical algebras invented by me with that end apparently in view, in my own opinion their structure, as well as that of the present system, is quite antagonistic to much utility of that sort. The principal desideratum in a calculus is that it should be able to pass with security at one bound over a series of difficult inferential steps. What these abbreviated inferences may best be, will depend upon the special nature of the subject under discussion. But in my algebras and graphs, far from anything of that sort being attempted, the whole effort has been to dissect the operations of inference into as many distinct steps as possible.

Fourth, although there is a certain fascination about these graphs, and the way they work is pretty enough, yet the system is not intended for a plaything, as logical algebra has sometimes been made, but has a very serious purpose which I proceed to explain. (*CP* 4.424)

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