Logic or Semiotic : Musement on a 1882 Peirce Lecture*

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> Logic, in its general sense, is, as I believe I have shown, only another name for *semiotic* (Σημειωτιχή), the quasi-necessary, or formal, doctrine of signs.
> CHARLES SANDERS PEIRCE: CP 2.227 (1897)

This is not a typical kind of editorial or essay. For the next few pages I hope to have your cooperation, dear reader, in a kind of experiment in communication. The communication I mean is of course something between you and me, but also between us and our scientific ancestors, and (in a way) with our successors as well. Let us call it an exercise in scientific fiction, by which term I suggest a kind of free-floating play of the intellect, in which (after an initial informational input) we let our minds find their own way, without any particular controlling purpose specified in advance. The input I shall offer for this musement[1] is Peirce's *Introductory Lecture on the Study of Logic*, which he delivered at The Johns Hopkins University in 1882, before a general audience. Peirce's abstract for that lecture, reproduced here in a slightly modified form, appeared in *The Johns Hopkins University Circular* for 1883 (item no. P 225 in the *Bibliography* of Peirce's publications). I am grateful to The Milton S. Eisenhower Library, at Johns Hopkins, for permission to use this item.

In presenting this input for you, I shall also be offering you some results of my own musement, as well as providing some background materials which you might find useful. In view of that, I hope you will read the annotations in the order they are given. But, of course let no details of my own reporting stand in the way of your free thought.

The first result of my own musing was terminological. In working on another project involving CP 2.227, the force of the strong equivalence mentioned there (see the motto above) impressed me as being a significant claim. Peirce believed (apparently) that he had *shown* (where, I cannot now say, except that probably in

*This essay is inscribed in academic friendship to Robert Georges, who once asked me, 'What is semiotic, anyway?' I wish also to remember the late Claude V. Bridges who directed my attention to some vital themes in the philosophy of education. I am grateful to Dr. Carolyn Eisele for conversations on some of these matters.

many places) that for every one and for all times, logic in a general sense and semiotic are equivalent, that they are one and the same thing (presupposing that semiotic be understood as Peirce understood it). This sentence is *not* a statement that only for Peirce, semiotic and logic are equivalent. And, since Peirce's semiotic is not identical with what is today called semiotics, logic would not be equivalent to semiotics.

Semiotic, said Peirce, was composed of Speculative Grammar, Critic, and Methodeutic (sometimes given equivalent alternate names). In his system, semiotic is a science which is preceded by (and therefore it presupposes) several other sciences (see Ketner 1982c), to wit:

MATHEMATICS
PHILOSOPHY
    Phenomenology
    Normative Science
        Esthetics
        Ethics
        Semiotic [logic in the general sense]
            Speculative Grammar
            Critic [logic in the narrow sense]
            Methodeutic
    SPECIAL SCIENCES [Physics, etc.; Psychics, etc.]

It is important to note that Esthetics and Ethics are sciences not in the usual sense now associated with those words. Perhaps an inattention to these and related points was part of the reason why so distinguished a critic as Richard Rorty, in his recent (1979) presidential address to the Eastern Division of the American Philosophical Association, could so badly misunderstand the nature of Peirce's semiotic. This is worthy of a moment's consideration. First, Rorty's comment (which he must take seriously, for he let it stand in a recent republication of the address):

> One symptom of this incorrect focus [neglect of the pragmatism of James and Dewey] is a tendency to overpraise Peirce. Peirce is praised partly because he developed various logical notions and various technical problems (such as the counterfactual conditional) which was taken up by the logical empiricists. But the main reason for Peirce's undeserved apotheosis is that his talk about a general theory of signs looks like an early discovery of the importance of language. For all his genius, however, Peirce never made up his mind what he wanted a general theory of signs *for*, nor what it might look like, nor what its relation to either logic or epistemology was supposed to be. His contribution to pragmatism was merely to have given it a name, and to have stimulated James. (Rorty 1980: 720).

At the least, this is an exceptionally uninformed statement, leading one to ask on what it was constructed. When one begins to examine the possible bases, one finds that the evidence supports the opposite of Rorty's claims. I have space only to give an outline. First, consider the relation of semiotic to logic. Peirce stated clearly in his mature thought that indeed logic in the general sense and semiotic are the same. The above

remark at CP 2.227 is only one of a number of similar expressions to be found. Other evidence on this point is given throughout the present work. Fisch's 1978 essay gives extensive documentation. Secondly, there is no *single* thing which a theory of signs is *for*, and indeed it is called the general theory of signs; however, one of the things it is for, is to provide a truthful account of the methods of science. This theme is one of the most consistent and complete aspects of the Peircean corpus, and is a very clearly worked out version of methodeutic, one of the sub-branches of semiotic. That Rorty might not perceive Peirce's discussion of scientific method as being semiotic is not a flaw to be laid on Peirce's hearth. That Peirce regarded (and made powerful contributions to) stechiology and critic, as yet two other sub-divisions of semiotic, seems also to have been missed by Rorty, despite the fact that all three of these sub-departments of semiotic are to be found in many places in Peirce's works. The last part of the statement quoted, concerning Peirce's contributions to pragmatism, is so erroneous that it is difficult to see how a serious scholar could entertain it, especially as just a bald, unsupported assertion. Without pursuing that historical issue, I want to call your attention to another important and related matter – pragmatism as first enunciated by Peirce, was a part of methodeutic, which means it is part of semiotic. Indeed, Peirce spoke of this relationship many times: for example, 'by pragmatism I meant a philosophy which should regard thinking as manipulating signs ... .' (Eisele 1979: 301) Both Dewey and James, as is well known, acknowledged on multiple occasions their indebtedness to Peirce on this and related points. It may not be quite so well known that Royce also did the same, and explicitly in regard to semiotic, in his *The Problem of Christianity*. Royce plainly saw in that book that Peirce's semiotic is to be found everywhere in his works, and that his efforts in logic in the narrow sense (critic) and methodology (methodeutic) were but well-planned aspects of semiotic. Finally, as Peirce constantly iterated, one needs a laboratory frame of mind to grasp his works. It seems to me that Rorty's recent essays beautifully illustrate a seminarian frame of mind.

Having had the above sketched reflections, I wondered how P 225 would read if one used the equivalence Peirce claimed. Thus, I replaced all instances of 'logic' and relevant forms with 'semiotic' and related forms, to produce the 'Introductory Lecture on the Study of Semiotic.' I found the resulting essay to be quite striking. For one thing, it provides an amazingly accurate account of semiotic in a short scope, providing most of the significant elements of the science, in the forms I knew them to exist, but in comparison with other such brief accounts, clearly and effectively. Thus, one result might be to have produced a fine short account of semiotic. In my opinion this is so.

Second, this experiment led me to ponder what effect a lifelong identity in terminology might have had for a more perspicuous presentation of Peirce's semiotic. Peirce was not inconsistent (in the sense of using differing terminologies to make contradictory statements), but throughout his career he did often describe the same (or almost the same) matter with different nomenclature, while always trying to be loyal to terminological systems left by previous generations of scientists. This and related issues comprised an *Ethics of Terminology*, a matter he regarded very

seriously (see Ketner, 1981b). Part of the remaining tasks of Peirce scholarship is to select the best single set of terms for his hypotheses, thus allowing his system to stand forth clearly, in its best dress, so that it can be objectively examined.

A second line of study might be possible if, as the notes for this piece playfully propose, we consider what the world would be like if not only had Peirce employed the same terminology throughout his life, but persons following him had continued in that terminological tradition. Readers will surely forgive me, then, for changing a word or two in a book title or a quoted passage. After all, musement is fiction, and poetic licenses are granted. Such musings seem to me to lead immediately into the question of a uniform and scientifically based terminology for semiotic in this era.

INTRODUCTORY LECTURE ON THE STUDY OF SEMIOTIC

Outline of the Remarks made by Prof. C.S. Peirce, at the beginning of his Course, September, 1882.

Professor C.S. Peirce began his instruction for the current session by a lecture in Hopkins Hall, on the underlying methods of modern semiotic. It was attended by instructors as well as students. In compliance with a request for an abstract of his address, which was delivered without notes, the speaker has given the following outline.

Mr. Peirce said that he had requested the instructors to do him the favor to listen to his observations, because he thought that a clear understanding of the purpose of the study of semiotic might remove some prejudices by leading to a true estimate of its nature.

It might be supposed that semiotic taught that much was to be accomplished by mere rumination, though everyone knows that experiment, observation, comparison, active scrutiny of facts, is what is wanted, and that mere thinking *will accomplish nothing even in mathematics. Semiotic has certainly been defined as the 'art of thinking,' and as the 'science of the normative laws of thought.' But those are not true definitions. 'Dialectic,' says the semiotic text-book of the middle ages, 'is the art of arts, the science of sciences, being the way toward finding the principles of all other sciences,' and although the semiotic of our day must naturally be utterly different from that of the Plantagenet epoch, yet this general conception that it is the* art of devising methods of research, – the method of methods, – *is the true and worthy idea of the science. Semiotic will not undertake to inform you what kind of experiments you ought to make in order to best determine the acceleration of gravity, or the value of the Ohm: but it will tell you how to proceed to form a plan of experimentation.*[2]

It is impossible to maintain that the superiority of the science of the moderns over that of the ancients is due to anything but a better semiotic.[3] *No one can think that*

the Greeks were inferior to any modern people whatever in natural aptitude for science. We may grant that their opportunities for research were less: and it may be said that ancient astronomy could make no progress beyond the Ptolemaic system until sufficient time had elapsed to prove the insufficiency of Ptolemy's tables. The ancients could have no dynamics so long as no important dynamical problem had presented itself; they could have no theory of heat without the steam-engine, etc. Of course, these causes had their influence, and of course they were not the main reason of the defects of the ancient civilization. Ten years astronomical observations with instruments such as the ancients could have constructed would have sufficed to overthrow the old astronomy. The great mechanical discoveries of Galileo were made with no apparatus to speak of. If, in any direction whatever, the ancients had once commenced research by right methods, opportunities for new advances would have been brought along in the train of those that went before. But read the semiotical treatise of Philodemus;[4] see how he strenuously argues that inductive reasoning is not utterly without value, and you see where the fault lay. When such an elementary point as that needed serious argumentation it is clear that the conception of scientific method was almost entirely wanting.

Modern methods have created modern science; and this century, and especially the last twenty-five years, have done more to create new methods than any former equal period. We live in the very age of methods. Even mathematics and astronomy have put on new faces. Chemistry and physics are on completely new tracks. Linguistic, history, mythology, sociology, biology, are all getting studied in new ways. Jurisprudence and law have begun to feel the impulse, and must in the future be more and more rapidly influenced by it.

This is the age of methods; and the university which is to be the exponent of the living condition of the human mind, must be the university of methods.

Now I grant you to say that this is the age of the development of new methods of research is so far from saying that it is the age of the theory of methods, that it is almost to say the reverse. Unfortunately practice generally precedes theory, and it is the usual fate of mankind to get things done in some boggling way first, and find out afterward how they could have been done much more easily and perfectly. And it must be confessed that we students of the science of modern methods[5] are as yet but a voice crying in the wilderness, and saying prepare ye the way for this lord of the sciences which is to come.

Yet even now we can do a little more than that. The theory of any act in no wise aids the doing of it, so long as what is to be done is of a narrow description, so that it can be governed by the unconscious part of our organism. For such purposes, rules of thumb or no rules at all are the best. You cannot play billiards by analytical mechanics nor keep shop by political economy. But when new paths have to be struck out, a spinal cord is not enough; a brain is needed, and that brain an organ of mind, and that mind perfected by a liberal education. And a liberal education – so far as its relation to the understanding goes – means semiotic. That is indispensable to it, and no other one thing is.[6]

I do not need to be told that science consists of specialities. I know all that, for I belong to the guild of science, have learned one of its trades and am saturated with its current notions. But in my judgment there are scientific men, all whose training has only served to belittle them, and I do not see that a mere scientific specialist stands intellectually much higher than an artisan. I am quite sure that a young man who spends his time exclusively in the laboratory of physics or chemistry or biology, is in danger of profiting but little more from his work than if he were an apprentice in a machine shop.[7]

The scientific specialists – pendulum swingers[8] *and the like – are doing a great and useful work; each one very little, but altogether something vast. But the higher places in science in the coming years are for those who succeed in adapting the methods of one science to the investigation of another. That is what the greatest progress of the passing generation has consisted in. Darwin adapted to biology the methods of Malthus and the economists; Maxwell adapted to the theory of gasses the methods of the doctrine of chances, and to electricity the methods of hydrodynamics. Wundt adapts to psychology the methods of physiology; Galton adapts to the same study the methods of the theory of errors; Morgan adapted to history a method from biology; Cournot adapted to political economy the calculus of variations. The philologists have adapted to their science the methods of the decipherers of dispatches. The astronomers have learned the methods of chemistry; radiant heat is investigated with an ear trumpet; the mental temperament is read off on a vernier.*[9]

Now although a man needs not the theory of a method in order to apply it as it has been applied already, yet in order to adapt to his own science the method of another with which he is less familiar, and to properly modify it so as to suit it to its new use, an acquaintance with the principles upon which it depends will be of the greatest benefit. For that sort of work a man needs to be more than a specialist; he needs a general training of his mind, and such knowledge as shall show him how to make his powers most effective in a new direction. That knowledge is semiotic.[10]

In short, if my view is the true one, a young man wants a physical education and an aesthetic education, an education in the ways of the world and a moral education, and with all these semiotic has nothing in particular to do; but so far as he wants an intellectual education, it is precisely semiotic that he wants; and whether he be in one lecture-room or another, his ultimate purpose is to improve his semiotical power and his knowledge of methods. To this great end a young man's attention ought to be directed when he first comes to the university; he ought to keep it steadily in view during the whole period of his studies; and finally, he will do well to review his whole work in the light which an education in semiotic throws upon it.

I should be the very first to insist that semiotic can never be learned from semiotic-books or semiotic-lectures. The material of positive science must form its basis and its vehicle. Only relatively little could be done by the lecturer on method even were he master of the whole circle of sciences. Nevertheless, I do think I can impart to you something of real utility, and that the theory of method will shed much light on all your other studies.[11]

The impression is rife that success in semiotic requires a mathematical head. But

this is not true.[12] *The habit of looking at questions in a mathematical way is, I must say, of great advantage, and thus a turn for mathematics is of more or less service in any science, physical or moral. But no brilliant talent for mathematics is at all necessary for the study of semiotic.*

The course I am about to give this year begins with some necessary preliminaries upon the theory of cognition.[13] *For it is requisite to form a clear idea at the outset of what knowledge consists of, and to consider a little what are the operations of the mind by which it is produced. But I abridge this part of the course as much as possible, partly because it will be treated by other instructors, and partly because I desire to push on to my main subject, the method of science.*

I next take up syllogism, the lowest and most rudimentary of all forms of reasoning, but very fundamental because it is rudimentary. I first treat this after the style of DeMorgan, with references to the old traditional doctrine. Next comes the semiotical algebra[14] *of Boole, a subject in itself extremely easy, but very useful both from a theoretical point of view and also as giving a method of solving certain rather frequently occurring and puzzling problems. From this subject, I am naturally led to the consideration of relative terms. The semiotic of relatives, so far as it has been investigated, is clear and easy, and at the same time it furnishes the key to many of the difficulties of semiotic*[15] *and has already served as the instrument of some discoveries in mathematics. An easy application of this branch of semiotic is to the doctrine of breadth and depth or the relations between objects and characters. I next introduce the conception of number, and after showing how to treat certain statistical problems, I take up the doctrine of chances. A very simple and elegant mathematical method of treating equations of finite differences puts the student into possession of a powerful instrument for the solution of all problems of probability that do not impart difficulties extraneous to the theory of probability itself.*

We thus arrive at the study of that kind of probable inference that is really distinctive; that is to say, Induction in its broadest sense – Scientific Reasoning. The general theory of the subject is carefuly worked out with the aid of real examples in great variety, and rules for the performance of the operation are given. These rules have not been picked up by hazard, nor are they merely such as experience recommends; they are deduced mathematically from the general theory.[16]

Finally, it is desirable to illustrate a long concatenation of scientific inferences. For this purpose, we take up Kepler's great work, De Motu Stellae Martis, *the greatest piece of inductive reasoning ever produced. Owing to the admirable and exceptional manner in which the work is written, it is possible to follow Kepler's whole course of investigation from beginning to end, and to show the application of all the maxims of induction already laid down.*

In order to illustrate the method of reasoning about a subject of a more metaphysical kind, I shall then take up the scientific theories of the construction of matter.[17]

Last of all, I shall give a few lectures to show what are the lessons[18] *that a study of scientific procedure teaches with reference to philosophical questions, such as the conception of causation and the like.*

COMMENTARY

1. Musement is another of Peirce's coinages, conveying a playful and free-floating state of mind in which likely hypotheses present themselves for test. For an introduction to this and related topics, see Sebeok and Umiker-Sebeok 1980, as well as P 1166.

2. Peirce concluded that each science, even mathematics, requires and uses observation and experiment. Semiotic, too, is an experimental and observational science in which scientific intelligences (semioticists) observe and experiment upon the activities of other scientific intelligences in order to achieve a natural philosophy of the semiosis of scientific intelligence. This natural philosophy will include such things as basic terminology and distinctions, formal laws, and an understanding of method. Since mathematics is the most basic science, important clues about how to proceed in gaining this natural philosophy (this science) of semiotic can be gained from a close acquaintance with mathematics and its methods, from (in other words) a familiarity with the mathematical instantiation of scientific intelligence. All this was not an idle prediction or promise or speculation on Peirce's part. (For evidence in support of this last statement, see volume three of the *Collected Papers of Charles Sanders Peirce*, which volume could have been given the title 'Exact Semiotic' by its editors.) He actually produced experimentally based results. Some contemporary students of Peirce's semiotic think of his work as only promissory, but his various algebras of semiotic, and his Existential Graph system of semiotic, are concrete results of his scientific study of semiosis, results that can be confirmed and reconfirmed objectively. Certainly these algebras and other graphical techniques do not exhaust the science, or the results it can achieve, but they do show that Peirce's conclusion that semiotic is an experimental science was not just a boast or a prediction, but a description of an actual procedure, an actual accomplishment. If these results are not in a form that nonscientists can appreciate, that cannot be said to be Peirce's fault.

3. As Paul Bouissac observed in a presentation to the Deutsche Gesellschaft für Semiotik (note the admirable accuracy of Germanic terminologists) meeting in Hamburg in 1981, semiotics can have no history for the plain reason that it is not a unitary thing, but is really an aggregate of a number of similar (or even dissimilar) approaches to sign theory or to communication. Although Bouissac did not say it, the same observation would not apply to semiotic, which is a unitary item – namely Peirce's work – with a deep and detailed epistemological foundation. This foundation cannot presently be easily displayed, partly because much of it lies unprinted in convenient book format (a matter soon to be rectified through the work of centers such as the Peirce Edition Project and the Institute for Studies in Pragmaticism). Because it is unified and well-founded, with a set of experimental results already published, it does have a distinct history, as well as a distinct future. This history has not yet been fully written, but epistemic conditions are such that it could be, and the way to do it would be to work back from Peirce to the scholars in various sciences on

whose shoulders he (scientifically) stood. This would not be an overly difficult task because Peirce, as a loyal member of the scientific community, vigorously sought his scientific forebearers, and gave his sources clearly in most instances. One would, however, need to be willing to conduct the study through several sciences. And, one would need to drop the kind of blinders that often cause philosophers to overlook their scientific surroundings. One might even exclude philosophy, in such an undertaking, if one means by that word something like the contemporary sense – a nonscience, one of the humanities. That sense Peirce called 'Philodoxy' (see P 779): the sense he accepted is synonymous with science in the broader meaning.

4. Alan Marquand was (apparently) Peirce's only Ph.D. student at Hopkins. His dissertation was on the treatise of Philodemus (see Fisch 1971: this treatise has been translated by DeLacy and DeLacy 1941). Marquand later joined the faculty at Princeton University where he experimented with semiotic machines (a matter summarized by Gardner in his well-known monograph, *Semiotic Machines and Diagrams*). He constructed at least one mechanical unit which could deal with elementary syllogisms. With Peirce's advice, in a letter now famous as the first known circuit for an electrical semiosis machine (Eames 1973 gives a very useful account of the early history of computers), Peirce advised Marquand that instead of mechanisms, he might make better progress using electrical circuits – switches in series to represent semiotical multiplication and switches in parallel to represent semiotical addition. This incident, the direct result of the science of semiotic, is a tremendous instance of an objective observational experimental outcome of the science of semiosis – I refer of course to the advent of machine semiosis, or artificial semiosis, or in other words, computers (artificial intelligences), or better, artificial scientific intelligence, which is now being studied scientifically in both brain and machine by 'cognitive scientists,' who don't yet realize perhaps that they are studying semioses. Again, we have semiotic appearing in its form of scientific intelligence studying scientific intelligence.

5. Methodeutic was the word Peirce often used to describe the science of methods, a branch of semiotic. Typically today it is described as methodology, and is well exemplified in the efforts of Sir Karl Popper and associates (see Radnitzsky 1979). That there are emerging grounds for a theoretical convergence of the work of Peirce and Popper is the opinion of some students of the matter.

6. That semiotic (or its equivalent, general logic) should be the heart of a liberal education is an assertion deserving re-examination in our day. It would be especially interesting to consider the argument in terms of semiotic with its emphasis upon method. In my opinion, to be trained in semiotic in Peirce's sense would provide one with an account of, and actual skill in the use of, the principal means for objective reasoning. This would involve students learning *how to learn* in a very broad sense. This is a skill which can best be imparted by generalists such as semioticians, logicians, or philosophers. An academic or vocational speciality would not be an adequate basis from which to advance such a program.

7. Perhaps one of the problems that has led to our contemporary educational malaise is the understanding of science in a narrow sense, as indicated by Peirce in this passage. He understood it very broadly. Another possible source of our presentday educational dilemma might be described as a departure from science in Peirce's wide sense, while replacing it with a kind of attitude often found voiced in the so-called humanities, namely the assumption or belief that a scholar (or academic, or student, or essayist) is entitled to have, to hold, to voice, or to advocate whatever 'theory' (view, position, standpoint) that person desires, that this is even some kind of 'right,' and that there is no means for others to criticize legitimately the theory so held. This approach leads to factors such as fame, position, following, public speaking skill, or press relations being the means by which such a person's importance or even correctness is assessed. Such an attitude, which I like to call the Charismatic Method, leads to discouragement of testing, observing, experimenting, plus the all-important scientific operation of vigorously seeking disconfirmation of dearly-held hypotheses, and its corollarial operation of joyfully tossing aside disconfirmed theses. Sometimes this idea is generalized from the case of an individual person to that of a 'school.' Thus, we have differing 'schools of thought' assuming such 'rights' for the school in opposition to other schools. Much of the contemporary 'humanities' is captured by this picture, with the excuse being given that one could not apply science to such subject matter even if one wanted to do so. But, by and large, nobody has *tried* to make such an application, and without such an effort and its subsequent failure, we really have no objective basis for saying it won't succeed. And indeed, those within the 'humanities' who have tried generalized science have made some progress – that is, the effort did not fail. The disciplines of archeology and history are convincing examples. We might say that the claim that objective methods cannot be applied to the 'humanities' is a self-fulfilling prophecy, in that if one decides not to try X, it will most likely be true that X will not be a viable course of action. Perhaps the semiotics of the present, in thinking that it is a member of the 'humanities,' has fallen under the spell of the charismatic method. If so, the counter curse that will break this bewitchment is to kiss the frog named semiotic, with its emphasis upon generalized science as the basis of *all* human knowledge.

Even practicing scientists, as Peirce pointed out in the passage to which this note is appended, can be overcome by the charismatic method and its charm, and thus become a scientist in name only. Peirce, having been an internationally active geodicist for thirty-two years in the employ of the United States Coast and Geodetic Survey (employed temporarily starting 1859, regularly during 1861–1891: see Eisele 1979), knew from experience that even in the oldest scientific disciplines, the charismatic method could occur.

Remembering that in this essay there is a solid argument for revision of education along semiotic lines, one can now appreciate that this would have its salutory effects upon disciplines called scientific as well as those described as arts or as humanities.

8. Peirce's principal assignment at the U.S. Coast and Geodetic Survey was that of determining the relative value of gravity at various points on the Earth's surface to

obtain a more accurate account of the figure of the globe. This would in turn enable one to draw more accurate maps. The value of gravity was of course also important in theoretical physics. The means used for determining the force of gravity was through swinging specially designed pendulums. Peirce perfected these methods, achieving values for G that compete in accuracy with contemporary results. For further information about this and related matters, see the special issue of the *Transactions of the Charles S. Peirce Society*, 1975, vol. II, no. 3; Eisele 1979.

9. One could add to this list: Peirce adapted to philosophy the methods of mathematics. Before he did that, he analysed in original ways just what the methods of mathematics were. Thus, semiotic is the direct result of application of mathematical method (Eisele 1979; Ketner 1982b). This application of mathematics took place roughly in the years 1860–1885. In later years Peirce seemed to take the account of semiotic thus achieved through mathematical means as a starting point for a more general kind of understanding of semiosis. But of course, this is still but one more aspect of mathematical method – namely, the last step in it: generalize your results.

10. One may wish to compare the pattern of this argument with the ingenious argument pattern in 'Questions Concerning Certain Faculties Claimed for Man,' P 26, or with the analysis of methods in 'The Fixation of Belief,' P 107. One might restate it in part by saying that as long as one's beliefs (principles, habits, rules of thumb, techniques, methods, maxims of living, etc.) are functioning in known and predictable ways, with known and predictable situations, no theory of methods (method of methods) is needed. But if there be a new or strange or puzzling or unpredictable situation not covered by the present belief (etc.), then a general knowledge of methods by which one can acquire a new method (belief, etc.) is REQUIRED, not just helpful. Now since humans have a kind of rough, natural, instinctive method of methods (a rough semiotic, or a semiotica utens), we can muddle through the hard way in gaining a new method to handle a strange situation.

But, we could use the worked-out details of semiotic, the method of methods, to quickly achieve, in the shortest possible time, a method of dealing objectively with the new difficulty.

It is well known that while he was teaching in Baltimore, Peirce sang a song similar to that later warbled by one of his Hopkins students, John Dewey. That fact might lead one to muse about the true foundations of, and the true nature of, Dewey's philosophy of education. Moreover, it is quite noteworthy that Dewey wrote what is probably the only account of semiotic understood as methodeutic done since Peirce or before Popper, and that being Dewey's famous work, *Semiotic: The Theory of Inquiry*. In particular see the note on page nine of that work/~~part of which reads: in~~ 5–5.

The readers who are acquainted with the semiotical writings of Peirce will note my great indebtedness to him in the general position taken. As far as I am aware, he was the first writer on semiotic to make inquiry and its methods the primary and ultimate source of semiotical subject-matter.

11. One of the rays of light thus shed by semiotic and its component methodeutic is that learning is the application and acquisition of methods, all of which is a skill. That is, Peirce's conclusions here are counter to the well-entrenched theory of education as 'systematized knowledge,' or even as 'things remembered.' The implications of this for the conduct of educational institutions are vast, and cannot be discussed here except by hints.

12. This is a well-turned phrase which one should take care in interpreting. Peirce was not saying that mathematics is not needed in semiotic. He was saying that even those persons who lack a special talent for mathematics may derive great benefit from semiotic.

13. One may readily see what those 'preliminaries upon the theory of cognition' were by studying the following three articles by Peirce: 'Questions Concerning Certain Faculties Claimed for Man' P 26; 'Further Consequences for Four Incapacities' P 27; 'Grounds of Validity of the Laws of Semiotic' P 41. Peirce gave lectures based upon these three essays at the Metaphysical Club (and at other places) while in residence at Hopkins (see Fisch and Cope in Wiener, 1952).

14. The name of George Boole is well known, but the fact that he was a semiotician may come as a surprise. If one looks into Boole's immortal *An Investigation of the Laws of Thought on which are founded the Mathematical Theories of Semiotic and Probabilities*, one finds – especially in chapter II – discussions of sign theory almost in contemporary language. Chapter II is entitled 'Of Signs in General, and of the Signs Appropriate to the Science of Semiotic in Particular; Also of the Laws to which that class of signs are subject.' Boole continued by giving an account of the nature of signs. Especially important to him was acquisition of a correct description of what signs would be necessary to conduct reasoning, and in particular in order to conduct mathematical reasoning. So, a special goal of Boole's work was to ascertain what signs and operations would be needed in order to conduct the kind of reasoning mathematicians undertake. Peirce was a disciple of Boole, and shared this goal for his semiotic, at least in his earlier years; and, indeed Peirce's later and broader semiotic might simply be the result of generalizing what he first developed as a mathematical semiotic. Although a complete tracing of this hypothesis would be beyond the scope of this project, I can give some hints that might make the idea plausible for you.

First, early in his career, as is well known, Charles received a rigorous mathematical education from his father Benjamin (Eisele 1979: 1–10). The following description of the mature phase of that education reinforces my idea that Charles began by considering what account of signs would be adequate to an account of the reasoning, the method, of mathematics, the most fundamental science.

The philosophical mathematician, Dr. Richard Dedekind, holds mathematics to be a branch of semiotic. This would not result from my father's definition, which runs not that mathematics is the science of *drawing* necessary conclusions – which would be deductive reasoning – but that it is the science which

draws necessary conclusions. It is evident, and I know as a fact, that he had this distinction in view. At the time when he thought out this definition, he, a mathematician, and I, a semiotician, held daily discussions about a large subject which interested us both; and he was struck, as I was, with the contrary nature of his interest and mine in the same propositions. The semiotician does not care particularly about this or that hypothesis or its consequences, except so far as these things may throw a light upon the nature of the semiosis. The mathematician is intensely interested in efficient methods of reasoning, with a view to their possible extension to new problems; but he does not, *qua* mathematician, trouble himself minutely to dissect those parts of his method whose correctness is a matter of course. (CP 4.239)

Second, in one of his better essays, published three years after this 'Introductory Lecture' was given at Hopkins, Peirce stated (CP 3.363) 'I have taken pains to make my distinction[1] of icons, indices, and tokens [symbols] clear, in order to enunciate this proposition: in a perfect system of notation for the study of reasoning, signs of these several kinds must be employed.' The title of this paper, appropriately, was 'On the Algebra of semiotic: A Contribution to the Philosophy of Notation.' It was an exercise in the first branch of semiotic, speculative grammar (or stechiology – definition science). Peirce's footnote 1 in the above passage refers to a specific paragraph in 'On a New List of Categories.' (CP 1.558) The distinction reads as follows:

It follows then that there are three kinds of representations.

First. Those whose relation to their objects is a mere community in some quality, and these representations may be termed *likenesses* [icons].

Second. Those whose relation to their objects consist in a correspondence to fact, and these may be termed *indices* or *signs* [later, just indices].

Third. Those the ground of whose relation to their objects is an imputed character, which are the same as *general signs*, and these may be termed *symbols*.

I shall now show how the three conceptions of reference to a ground, reference to an object, and reference to an interpretant are the fundamental ones of at least one universal science, that of semiotic.

Later in the introduction of 'On the Algebra of Semiotic,' just before launching into algebraic, Peirce tipped his hand fully concerning what he was about. Here it is.

In this paper, I propose to develop an algebra adequate to the treatment of all problems of deductive semiosis, showing as I proceed what kind of signs have necessarily to be employed at each stage of development. I shall thus attain three objects. The first is the extension of the power of semiotical algebra over the whole of its proper realm. The second is the illustration of principles which underlie all algebraic notation. The third is the enumeration of the essentially different kinds of necessary inference; for when the notation which suffices for exhibiting one inference is found inadequate for explaining another, it is clear that the latter involves an inferential element not present to the former. Accordingly, the procedure contemplated should result in a list of categories of reasoning, the interest of which is not dependent upon

the algebraic way of considering the subject. I shall not be able to perfect the algebra sufficiently to give facile methods of reaching logical conclusions: I can only give a method by which any legitimate conclusion may be reached and any fallacious one avoided. But I cannot doubt that others, if they will take up the subject, will succeed in giving the notation a form in which it will be highly useful in mathematical work. I even hope that what I have done may prove a first step toward the resolution of one of the main problems of semiotic, that of producing a method for the discovery of methods in mathematics. [Or, translated, producing a semiotic of mathematics]. (CP 3.364)

These themes are echoed in a contemporary classic of the subject, *Mathematical Semiotic*, by W.V. Quine. I have space only to call your attention to Quine's repetition of some of the topics Peirce highlighted above: the basic semiotical vocabulary (Peirce's Stechiology, or signs necessary for semiosis, or 'notation') at Quine page 2; semiotic underlies the special sciences (compare Peirce's classification of science in which this is the case) at page 2; semiotic as revealing the reasoning of mathematics at pages 6–7; and production of a method of methods in mathematics at page 11.

Having found these parallels between Peirce's semiotic and that of Quine, I have been led to wonder if a popularly held belief – that semiotic died with Peirce and was only revived in the last decade or so – might be false. I have undertaken some preliminary checking by trying to follow only the themes Peirce enunciated, and I have discovered them to exist in at least the following volumes (thus giving doubt to the above popularly held belief): I.M. Bochenski, *A History of Formal Semiotic*; C.I. Lewis and C.H. Langford, *Symbolic Semiotic*; G. Peano, *Studii di semiotica matematica* (1897); Victoria Lady Welby, *What is Semiosis?*; L.O. Kattsoff, *Philosophy of Mathematics* (on the problem of mathematical semiosis); and of course, the well-known work of L.J.W. Wittgenstein, *Tractatus Semiotico-Philosophicus*.

15. The semiotic of relatives (of relations) was a major effort throughout Peirce's long career. That this topic is fundamental for the study of his semiotic is quite clear, in that semiosis itself is a relational process. It remains as a major task of Peircean scholarship to organize and study in a systematic way his many contributions to the subject of relations, and to place it into a historical context.

16. For a beginning toward understanding Peirce's account of induction, see Miller 1981.

17. Tychism, according to Peirce's own account in MS L 107 (see Ketner 1982c) is summarized in P 439, 474, 477, 480, 521, 525. There is a strong likelihood that Tychism is a major historical precursor of Einstein's Relativity Theory and related matters (Eisele, personal communication). Again, tracing the connections here is a major desideratum of Peircean scholarship. And, Tychism is very likely a kind of semiotic of physics (as indeed Einstein's work may also be).

18. There are many of these lessons, among them being pragmaticism (a key methodological tool), and the ethics of terminology. One could make a long list. This list would further confirm that, contrary to presentday expectations, for Peirce it was science that is philosophy's schoolmaster. There are those among the philosophical fraternity today who cry that 'philosophy is dead' (for example, Rorty in *The Mirror of Nature*, an anti-semiotic treatise if ever there was one): if so, perhaps it is because philosophy either forgot its teacher's identity, or forgot how to learn from that teacher. If this idea is correct, it would be an easy matter to decide once again to report for lessons. In doing so, no better motto than the following from Peirce could be found: 'Each chief step in science is a lesson in semiotic.'

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Quotations from the *Collected Papers of Charles Sanders Peirce*, Harvard University Press: Cambridge, 1935, 1958, are indicated by means of the letters CP followed by volume and paragraph number.

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