KENNETH LAINE KETNER (Lubbock, Texas)

Peirce on Diagrammatic Thought: Some Consequences for Contemporary Semiotic Science

I have [recently] done a great deal of hard mathematical work on the development of my philosophy.

Peirce to Judge F. C. Russell
8 September 1894, p. 2 (L 387)*

I am grateful to the Board of the Deutsche Gesellschaft für Semiotik for inviting me to present a workshop on Peirce's Existential Graphs (materials used in the workshop published as Ketner 1981 A) plus this lecture at this, the third of its triennial semiotic colloquia. As usual, these meetings are efficiently and intelligently organized. I am also fortunate to attend because, in my opinion, the Deutsche Gesellschaft is presently the leading semiotic organization in the world, if one reckons in terms of criteria of evaluation such as organizational strength, organs of communication, distinguished works authored by its members, and the stimulating conversations to be found in hallways as well as in lecture halls during congresses. No doubt another contributing factor is the hospitality and charming surroundings that always accompany these Kolloquia; this meeting, supported as it was by the Universität Hamburg and the Freien und Hansestadt Hamburg, has been exceptional in this regard.

I mention these matters because as I began to participate in these distinguished conferences, I quickly noticed that the name of my countryman, Charles Peirce, was to be heard coming from many quarters. He was frequently spoken of as a key founder of Semiotikwissenschaft, as it is vigorously evolving in Germany. By way of nostalgia, during one of his official field trips for the U. S. Coast and Geodetic Survey (1875–1876), Peirce was in Germany and specifically in Hamburg in part to take delivery, from the firm of Repsold und Söhne, of a pendulum for his gravity research (Fisch 1981). He also often explained that he first came to the science of philosophy

* This statement is among the many to be found that emphasizes the importance of mathematics for gaining a proper understanding of Peirce. Other evidence suggests that a principal part of this hard work was mathematics in the form of diagrammatic thought as applied to philosophy. I am grateful to Dr. Eisele for calling this sentence to my attention.

Klaus Oehler (Hrsg.), Zeichen und Realität
Tübingen 1984 (Stauffenburg Verlag)

through German writers, especially Schiller and Kant. One of the better descriptions of this is given by Peirce in an intellectual autobiography he drew up in 1904, MS L107, a redaction of which will appear in 1982 in the special Peirce issue of the "American Journal of Semiotics" (Ketner 1982D; see also Esposito 1980). It then seems but natural that contemporary German scholars would be among the first to begin to appreciate and mobilize Peirce's insights and results. In order to make some contribution to this process, I want to present a small sketch of the current state of utility of the Peircean corpus and our knowledge of it, followed by an attempt to expand that knowledge in reference to his notion of diagrammatic thought and consequences that might have for semiotik.

Presently we do not have a correct complete interpretation of Peirce's work in general, nor of his semiotic in particular. One of the reasons this has been slow in coming is that our textual resources have been inadequate. This prerequisite is now being provided (for a guide, see "Peirce Studies" no. 1). The end of the necessary phase of arranging and presenting the huge Peirce corpus is now in sight, and on that firm basis we can begin to seek a defensible overall interpretation. In order to achieve this goal, I have suggested several principles which can be summarized briefly (see also Ketner 1982A). First, and most important, we need an account of Peirce's position that can be confirmed and defended in a public way, in the spirit of science. That is, we should not permit a situation in which any given interpretational hypothesis is accepted as being as sound as any other competing hypothesis. Here are some additional procedural principles. Peirce's own self descriptions, of which there are many, can serve as guides for initial hypotheses, only to be abandoned in the face of strong evidence. Close attention must be paid to the intellectual atmosphere of his era, a difficult (or perhaps rare) attitude in our ahistorical time. One should try to be aware of all of Peirce's work, not just conveniently accessible parts of it. Avoid preconceived notions about what Peirce is "supposed to be like," especially avoid a popular but false assumption of several commentators that Peirce was an interesting failure, whose thought was fragmentary, incomplete, only seminal, etc. We now know enough to see that the various forms of the "interesting failure" thesis are incorrect.

Perhaps a related suggestion is now beginning to appear. Those of us who are seeking, in a scientific spirit, for a complete and correct account of Peirce's work (and who have been instrumental in bringing forth new textual resources) are sometimes described as "worshipping Peirce as a deity." Colleagues in Germany, who enjoy a long distinguished tradition of adequate preparation of the writings of important native thinkers prior to undertaking more final interpretations, will recognize such statements for what they are – glib determinations to avoid careful scholarship. Sometimes critics also say that although it is acknowledged that Peirce was a founder of semiotik, still in our day, we should "go beyond him." Again this is bad advice, because lacking a complete and defensible interpretation of Peirce's semiotic, we do not yet fully understand him, as I think the later portion of

this essay will show in part. And since semioticians will recognize that a necessary presupposition of the motto "Go beyond Peirce" is that we do already understand him, lacking this understanding, the proposed "going beyond" could only be a thinly disguised "going around," or bypassing, which is an antiscientific procedure. It is such because it ignores the economy of research, overlooks important work by a predecessor relevant to contemporary problems, and even perhaps represents a belief that our understanding of a problem is automatically better than that of any historical figure.

As a test case, let us focus these principles upon a passage from the "Collected Papers" which is a favorite among semioticians, paragraphs 227–229 from volume two. Instead of wasting space by printing it out here, I ask you, dear reader, if you are serious, to obtain a copy of this passage to have before you. First, in the time-proven tradition of Germanic scholarship, let us ask what the textual basis of this passage is. It is but part of manuscript 798 (using the numbers of Robin's "Catalogue"); but MS 738 is now known to also be a continuous part of this piece (the editors of CP left out MS 738). Combining MS 798 and 738 once again into their original unified and continuous state provides enough evidence to make plausible the hypothesis that the writing from which CP 2.227–229 was lifted was an unused variant passage for a section of P 637, The Logic of Relatives, "Monist" 7, 1897, 161–217. The passage for which MSS 798/738 is probably a variant can be seen at CP 3.472. Notice that the editors of CP provided their own title for the extract, and they state in a footnote that it is "From an unidentified fragment, c. 1897." The date is good, but it is not unidentified, and it is not a fragment in MS, but is probably an unused passage associated with drafting a larger and complete and (especially for semioticians) interesting article, P 637. Since other parts of MS 798 were placed by the editors of CP some 135 pages away from 2.277-229, in a "footnote" for some other piece (see page 269 of CP 2, note 1), we can only conclude that it became a fragment through editorial manipulation. Probably the correct textual conclusion here is that 2.227–229 should be studied in conjunction with P 637, the finished and published piece with which it was most likely connected. As separated by the editors of CP, 2.227–229 does not seem to be associated with the logic of relatives. But we now have a reasonably probable case that it was so associated in Peirce's mind. Perhaps he didn't use the material in MSS 798/738 for some expositional reason. Or perhaps Carus (the editor of the "Monist") didn't want it used. Further research will tell us the answer here, but the point presently is that even the context of 2.227–229 is spoiled by the way it was presented. More could be said on this topic, but perhaps it is sufficiently clear that this kind of study is important for obtaining a correct interpretation of Peirce. I ask fellow scholars to imagine what their attitude would be if, 200 years from now, they look down from their heavenly seat to find their own carefully constructed essays presented for study in bits and pieces.

According to some students of Peirce's work, he did not have a system of

philosophy. I think there is good reason to agree with this, if by 'philosophy' is meant something like the contemporary usage – "a nonscience, one of the humanities." This sense of philosophy was repudiated by Peirce (see P 779, Ketner 1981B), so he did not have a system or nonsystem of philosophy in that sense. But he did have a system. Of what? Of science: his life work was to present a system of science, and it is science understood from the standpoint of methodology (Ketner, 1982A) – Peirce's preferred term was methodeutic. An important key for understanding his system is his classification of science. I will use the brief account given in MS L107 (published in Ketner 1982D). Similar classifications with more detail are found elsewhere in the post-1900 period. In understanding them, it is crucial to appreciate that they are classifications of *science* as a living activity. Moreover, each science earlier in the classification provides principles and methods to those later in the classification. In L107, the classification runs: I. Science; Ia. Science of Review, Ib. Practical Science, Ic. Science of Research. It is this last category that most interests us, and it is divided as:

Mathematics
Philosophy
    Phenomenology
    Normative Science
        Esthetics
        Ethics
        Logic
            Speculative Grammar
            Critic
            Methodeutic
    Metaphysics
Special Sciences (Physics and Psychics)

Where does semiotic fit in here? We have the answer from the first sentence of CP 2.227: "Logic, in its general sense, is, as I believe I have shown, only another name for *semiotic* [....]" This licenses us to remove the word "logic" from the foregoing table and replace it with its equivalent, "semiotic." By the way, semiotic is the name of Peirce's creation, and in that sense is a closed but full book to which we can refer in a unitary way. We now know that semiotic, because it is in a classification based upon scientific method, is an activity having a scientific method. And, the scientific activity named semiotic presupposes the methods and principles of mathematics, the most basic science, one which all other sciences of research use. Semiotic also presupposes the principles and results of philosophy (again, not the contemporary meaning), the kind of science which needs no special instruments to proceed, the science based upon the kind of experiences that are open to all normal human beings. Within scientific philosophy, phenomenology studies the categories of experience. Normative science is the study of the phenomena of control: esthetics (here not necessarily the

study of beauty or of art, but a special use, as is Peirce's ethics) studies the characters of that which is controllable, while ethics studies the act and process of control of controllable things. And within normative science, semiotic (logic) studies the special normative problem of the "relation of the phenomenon to the essential character of the phenomenon as controllable, that is, its reasonableness, or embodying an idea." And, we are told, "That which embodies an idea is a sign, and it is best to make logic the science of the general properties of signs" (L107: 21, in Ketner 1982D).

Some of the principles of interpretation mentioned earlier are at work here, emerging now in the form of following Peirce's Ethics of Terminology (discussed in Ketner 1981B and Oehler 1981A). We can now see that the Ethics of Terminology is a phrase that can be translated as "Normative science for fixing and controlling the meaning of special terms for scientific use, thereby avoiding confusion and promoting sound communication." Since Peirce's own work is science, he applied these terminological principles throughout, so a reader of his material should be on guard not to automatically assume that his terms are the same as some contemporary concept. Already we can make progress with this principle in regard to such Peircean terms as science, philosophy, phenomenology, ethics.

Continuing with our reading of CP 2.227, we find next that semiotic is the "quasi-necessary, or formal, doctrine of signs." and by 'formal' Peirce went on to explain that he meant "we observe the characters of such signs as we know, and from such an observation, by a process which I will not object to naming Abstraction, we are led to statements, eminently fallible, and therefore in one sense by no means necessary, as to what *must be* the characters of all signs used by a 'scientific' intelligence, that is to say, by an intelligence capable of learning by experience." I have presented arguments elsewhere (Ketner 1982A) concerning one aspect of this, namely that only scientific intelligences can be semioticians, and that semiotic is a kind of self-observation by scientific intelligences. This is counter to an interpretation of this passage as meaning that a philosopher (Peirce himself, acting as a philosopher in the nonscience sense) is supposed to be able to tell scientific intelligences what the characters of all signs must be, as if the scientific intelligence, upon hearing the orders from the philosophic intelligence and not obeying, would then be struck by logical lightning. Since Peirce was not such a philosopher, this counter proposal cannot be correct.

But there is another aspect of the above quoted sentence and the rest of 2.227–229 which might also puzzle – the reference to observation. Persons who quote this passage as a definition of semiotic often omit even noticing this aspect. The distinct claim is made here that semiotic is an observational, fallible, and even experimental science. For someone who wants only to see semiotic as a part of the humanities, this is a doctrine well to be blotted out of consciousness via the technique of selective reading. But since I have been invited to your conference on the basis of trying to show the importance of this factor in semiotik, I shall not look away from it, and will attempt to explain why I think it is one of Peirce's better contributions, and one which

is rarely used, not to mention using it to its fullest capacity. Later in the paragraph we are studying, he called it "Abstractive observation." What then can that be, if nothing other than the nonsense of a silly Pike County recluse?

The first step in abstractive observation is to construct a diagram of that which is under study. Therefore, before continuing, it would be wise to ask what Peirce meant by 'diagram'. From NEM 3:869–870 consider the following, which is from a letter to William James in 1909.

"Dec. 28. I have been suffering horribly for 2 days and am now like a drowned rat. Juliette was also ill all last night and it sometimes seems all but hopeless to keep her alive through the winter if it is going to keep on as it has begun with 50°F only attainable for a couple of hours. My ink will freeze in a few days I hear and then what shall I do, I wonder. The second warrant [foregoing discussion was of the first warrant of a belief: namely, being disposed to believe it] is in case one's inference is from some state of things capable of expression in a proposition (generally a copulative proposition of some complexity) and when every state of things not denied by this proposition is a state of things in which the conclusion is true. Such inference is Deduction, or Necessary Inference. There are two kinds of Deduction; and it is truly significant that it should have been left for me to discover this. I first found, and subsequently *proved* [perhaps P 296], that every Deduction involves the observation of a Diagram (whether Optical, Tactical, or Acoustic) and having drawn the diagram (for I myself always work with Optical Diagrams) one finds the conclusion to be represented in it. Of course, a diagram is required to comprehend any assertion. My two genera of Deductions are 1st those in which any Diagram of a state of things in which the premisses are true represent the conclusion to be true and such reasoning I call *Corollarial* because all the corollaries that different editors have added to Euclid's Elements are of this nature. 2nd Kind. To the diagram of the truth of the Premisses something else has to be added, which is usually a mere May-be and then the conclusion appears. I call this *Theorematic* reasoning because all the most important theorems are of this nature."

Elsewhere (CP 3.418–419) we find that auditory diagrams separate their parts in time, whereas visual diagrams separate them in space, and that algebra is a kind of diagram, and that speech is such an algebra, from which we can infer that Peirce regarded speech as a kind of diagram. In this same paragraph, he alludes that he has discovered a method better than algebra for forming a diagram, and that it takes a graphical form. This he eventually called the Existential Graphs (EG), for information about which I refer you to the contents of my workshop presented at this conference (since then published in Ketner 1981A). Another useful statement shedding light upon this issue was part of the 1903 lectures on pragmatism (NEM 4:164). "I am satisfied that all necessary reasoning is of the nature of mathematical reasoning. It is always diagrammatic in a broad sense although the wordy and loose deductions of the philosophers may make use rather of auditory diagrams, if I may be allowed the expression, than [of] visual ones." In many other places, early and late, Peirce stated that all mathematical reasoning is diagrammatic. Here is a good instance (NEM 4:47–48):

"*The Reasoning of Mathematics* ... The first things I found out [again, possibly P 296 and related works] were that all mathematical reasoning is diagrammatic and that all necessary

reasoning is mathematical reasoning, no matter how simple it may be. By diagrammatic reasoning, I mean reasoning which constructs a diagram according to a precept expressed in general terms, performs experiments upon this diagram, notes their results, and expresses this in general terms. This was a discovery of no little importance, showing as it does, that all knowledge comes from observation."

Something about the nature of observation can be gleaned from the article on Index in Baldwin's "Dictionary" (P 770):

"The above considerations might lead the reader to suppose that indices have exclusive reference to objects of experience, and that there would be no use for them in pure mathematics, dealing as it does, with ideal creations, without regard to whether they are anywhere realized or not. But the imaginary constructions of the mathematician, and even dreams, so far approximate to reality as to have a certain degree of fixity, in consequence of which they can be recognized and identified as individuals. In short, there is a degenerate form of observation which is directed to the creations of our own minds – using the word observation in its full sense as implying some degree of fixity and quasi-reality in the object to which it endeavors to conform. Accordingly, we find that indices are absolutely indispensable in mathematics [...]"

Perhaps we are now in a position to understand most of CP 2.227, with the possible exception of the use of the notion of abstraction. To many minds today, abstraction is a concept indicating the very opposite of scientific or realistic procedure. In those terms, one may well wonder why Peirce, in stating that semiotic is a science, had recourse to a concept such as abstraction. Again, the Ethics of Terminology comes to the rescue. Citing wighty historical evidence, Peirce distinguished two kinds of abstraction (NEM 3:917). "One is [...] leaving something out of account in order to attend to something else. That is *precissive abstraction*. The other consists in making a subject out of a predicate [*hypostatic abstraction*]. Instead of saying, Opium puts people to sleep, you say it has a dormitive virtue. This is an all important proceeding in mathematics." We have seen earlier that theorematic reasoning is essential in mathematical reasoning. Now, it seems, abstraction is vitally important in that procedure (NEM 4:56):

"I also find that the most effective kind of theorematic demonstration always involves the long despised operation of *abstraction*, which has been a common topic of ridicule. This is the operation by which we transform the proposition that "Opium puts people to sleep" into the proposition that "Opium has a soporific virtue." Like every other logical transformation, it can be applied in a futile manner. But I show that, without it, the mathematician would be shut off from operations upon lines, surfaces, differentials, funtions, operations, – and even from the consideration of cardinal numbers."

Let us now try to find an account of how all this is to go together in mathematical procedure. A fine example from many such passages is two paragraphs from an article entitled "Mathematical Logic," MS 1147, written for Baldwin's "Dictionary", but from which Baldwin used only the first five words.

"The procedure of the mathematician is, first, to state his hypothesis in general terms; second to construct a diagram, whether an array of letters and symbols with which conventional "rules", or permissions to transform, are associated, or a geometrical figure, which not only secures him against any confusion of *all* and *some*, but puts before him an icon by the observation of which he detects relations between the parts of the diagram other than those which were used in its construction. This observation is the third step. The fourth step is to assure himself that the relation observed would be found in every iconic representation of the hypothesis. The fifth, and final, step is to state the matter in general terms.

Among the general peculiarities of methematical reasoning may be mentioned the great use it makes of extreme cases, which are here often the key of the problem. Thus, almost the whole theory of functions lies in ascertaining where they become *zero* or infinite. Another peculiarity is the extraordinary generalizations it forms. Of still greater importance is the practice of making operations and relations of all kinds objects to be operated on [hypostatic abstraction]." (NEM 3: 749–750)

One final element is needed, and it was omitted from CP 2.227–229, although it was a continuous part of MS 798. An excerpt of this deleted part was placed in a footnote at CP 2.444 n 1, at which place you may inspect it (it continues the last sentence of 2.229). But an even better version of the matter is to be found in a variant start of 2.227 at MS 738:4, which I cite below.

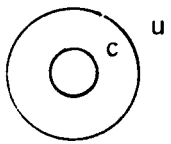
"Logic, in the general sense, is another name for *semiotic*, the necessary doctrine of signs; and semiotic forms a trivium, universal speculative grammar, logic [logic in the narrow sense, or what Peirce later called Critic], and universal speculative rhetoric. The purpose of signs is to convey the *truth*, and hence it is that logic proper [Critic], or the science of the necessary conditions of the *truth* of signs, is the central and paramount doctrine of the trivium of semiotic. Now a representation, to be true by formal necessity, must *follow* from some other representation; and thus the illlative relation becomes the relation of paramount importance in logic."

Here we can see why it is especially significant that CP 2.227–229 was originally (probably) part of an article on the logic of relations. The principal semiotic relation is the illative relation, which is studied, along with other relations, in Peirce's Logic of Relatives.

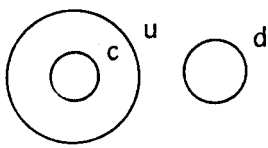
Perhaps it is time for an example to show how all this can function. Following Peirce's claim that the illative relation is an important one for semiotic, I shall base the example upon argument. First it is helpful to notice that the very notion of an argument is a hypostatic abstraction. "Argument" is a way of discussing with one noun what is actually a fairly complex communicational process in which one scientific intelligence presents a claim that some evidence supports the truth of a conclusion, all that being addressed to another scientific intelligence that is to understand it and evaluate the claim. The claim of an argument presenter will be correct or incorrect based upon the exact nature of the illative relation in the sign. So to try observe the relations embodied in an actual argument by means of a scientific procedure is exactly for one or more scientific intelligences (us, for instance) to observe other scientific intelligences (the presenter and

evaluator of an argument) to try to find formal or necessary laws about that semiosis.

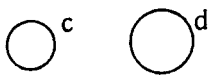
Let us begin with this argument: "All crocodile wrestlers are unusual persons; No unusual persons are welcome at Mrs. Dixwell's school; therefore, No crocodile wrestlers are welcome at Mrs. Dixwell's school." We now follow the five steps of mathematical method, as outlined by Peirce. The hypothesis in this case is whether, if the premisses of this argument were true, the conclusion would also be true. We can construct a diagram, using the method of Euler, in which the interior of a circle or similar figure in two dimensions represents a class, and inclusion or exclusion of classes are represented as inclusion or exclusion of circles labelled with class names (C, U, and D in this example). Now we create, according to these principles, a diagram of the premisses of this argument on the hypothesis that they are true (they may actually be true or false, but our original question or hypothesis asks whether the conclusion has to be true just in case the premisses are both true). This diagram will be a hypostatic abstraction of the original semiosis between argument presenter and evaluator. Here is a diagram of premiss one as true.



Now a diagram of premiss one and premiss two as true.



This last diagram is an icon of the argument in that the relations in the diagram are, due to the method of its construction, similar to, or identical to in structure, the relations in the argument under study. By having the diagram (the abstraction) we have a new advantage in that we can now observe them with our most competent sense, sight. As the third step, we observe the diagram, and it is easy to see that the last diagram above exactly fits Peirce's description of a corollarial deduction, for it suffices merely to inspect visually (using a precissive abstractive technique) the relations in the diagram of the premisses to see that the conclusion's diagram



is directly presented in it, with no other step being needed to bring it forth. The fourth step is to be sure that every such representation of the hypothesis would produce identical results, something which in this case is guaranteed by the techniques of forming the Euler diagram. The fifth step is to generalize the results. This we can easily do by reflecting that these relations would hold no matter what the particular classes were (precissive abstraction again). That is, we can now generalize to conclude that any argument that exhibits the relational pattern "All 1 is 2, No 2 is 3, therefore, No 1 is 3" (where 1, 2, and 3 are classes) will be a valid deductive argument. Thus, we have through abstractive observation, established a general law of semiotic, a formal law about one kind of illative relation.

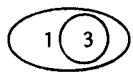
The last generalizing step of mathematical procedure reveals a type, working initially from a token. Thus, mathematics is able to give us, through observation, knowledge of a real general type. In this example we gained knowledge of the real general type traditionally known as Celarent among logicians. This type is an ens rationis (hypostatic abstraction). It is not just a name – to conclude that it is only a name would be to fall into the error of nominalism. On the nominalistic hypothesis that it is a mere name, it would follow that since it is not an individual existence or an actual happening, the only modes of being nominalists recognize, then it can be changed at will (arbitrarily, egocentrically), and nothing turns on it. On the realist hypothesis, its reality consists in its having properties independently of any person's will or desire (again, arbitrariness, egocentricity) as creating those properties. That Celarent does have such properties is seen in that with it one can make predictions, or with it one can gain control of a very large number of argument tokens. In short, Celarent has pragmaticistic consequences. And these consequences are matters of public and repeatable record (as are the steps leading to its discovery), both now and for the future, open for any human to see without the need of special apparatus. For instance, when met with an argument that is a token of the type Celarent, I can predict that this token is deductively valid without performing a test – all I need do is recognize the law, the type, in it in order to know that the token is valid. Now this procedure is hardly different from what occurs in many sciences of research (including those that *do* use instruments), so perhaps one can see why Peirce always thought that nominalism was a dangerous antiscientific doctrine.

We turn to a second example, this time looking specifically for an instance of theorematic reasoning. The other distinctions – type-token, realism, nominalism, reality of laws or generals, ens rationis – are present here too, but there is no need to repeat a discussion of them. Let us use Existential Graphs (EG) to study this argument: "If one is a truffle-hunter, one will have muddy boots; If one has muddy boots, one cannot enter the Blue Ox Pub; therefore, If one is a truffle-hunter, one cannot enter the Blue Ox Pub." Here I must ask my reader to be aware of the principles of the alpha portion of Peirce's EG, and to remind the reader that it creates its diagrams in a way considerably different from Euler's method (see Ketner 1981A for

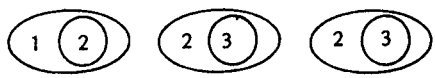
the basics of EG). Following Peirce's mathematical procedure, we state the hypothesis in general terms: it is whether, if the premisses were true, the conclusion would also be true, and we generalize the argument pattern as "If 1 then 2, If 2 then 3, therefore, If 1 then 3," where 1, 2, and 3 are propositions. Second, we construct a diagram according to the procedures of EG, creating an icon of the relations in the argument. Here is such a diagram of the premisses represented as true (letters will be used at the left of graphs as mere labels to facilitate reference).

A. 

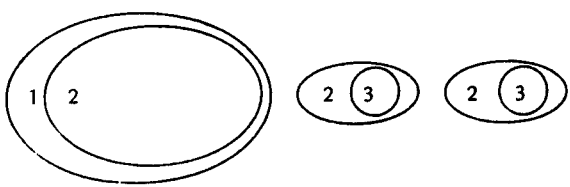
Notice we cannot observe the conclusion in diagram A – the conclusion looks like this in EG.



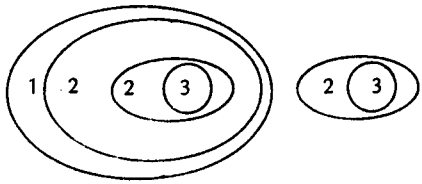
We cannot observe the conclusion directly in the premisses as we were able to do in the Euler example. Therefore, simple observation by inspection will not suffice. For the third observational step, we must also experiment and observe the results of that experiment. So, not knowing in advance that the next few steps will produce anything but a blind alley or a failed strategy, we might begin by transforming the premiss diagram (line A) into this diagram.

B. 

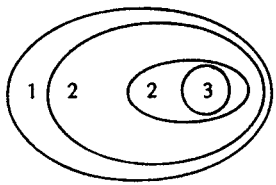
This transformation is known to be truth-preserving by means of the EG rule Iteration. While we know that the transformation from line A to line B is truth-preserving, we still do not know that it is part of a way of showing that the conclusion follows from the premisses. The move to line B is a theorematic step (or part of such a step). Next, we know that by means of the conventions of EG, any graph can be enlarged, provided no relations between circles and proposition labels (other than distance) are changed. This yields (enlarging the left-hand graph)

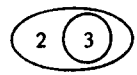
C. 

The transformation from line B to line C is also truth-preserving and is also theorematic. Now, by means of the Iteration rule, I can place the copy made in line B into the innermost circle of the left-hand graph recently enlarged, thus

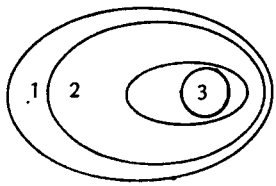
D. 

This is also a truth-preserving process, and theorematic. The steps thus far are indeed theorematic, in that an auxiliary construction, a mere "maybe", has been built up. One who is knowledgeable in the workings and conventions of EG can now look at line D and virtually see that the conclusion is present there, if a bit of "garbage" is cleared away by means of corollarial reasoning (the remaining steps are each corollarial).

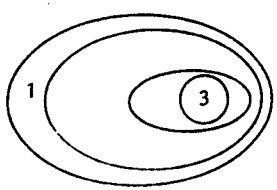
E. 

erase 

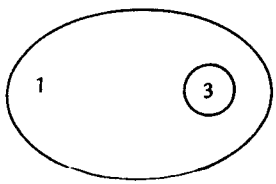
in D

F. 

deiterate right-hand 2

G. 

erase remaining 2

H. 

remove double cut

The fourth step is to insure that this is a general result, and the fifth step is to generalize to the type. In this case the type found is traditionally known among logicians as "Hypothetical Syllogism" and its structure is to be found in many token arguments.

I will not offend my kind hosts by trying to turn this scheduled presentation into the long dissertation needed to make this whole thing clear in every respect. Maybe enough has been presented, however, to show that there is a great goldmine here. We can see that notions from Peirce's analysis of the nature of mathematical science will be vital for semiotic, and chief among them will be techniques of diagrammatic observation, experimentation, and reasoning. Perhaps we can now appreciate more fully the force of Peirce's remark in a letter to Christine Ladd-Franklin, his student from Johns Hopkins University, that "[...] my study of the formal laws of signs [...] [is] [...] a study guided by mathematics and by the familiar facts of everyday experience and by no other science whatever" (Eisele 1979). I think that we can learn from CP 2.227–229, a passage that semioticians have found attractive, that it is telling us that scientific methodology and discipline, including mathematical experimentation and observation, is crucial for a science of semiotic. A chief tool, one much neglected by students of semiotic, is Peirce's Existential Graphs, which he seems to have considered to be the best example of semiosis.

Let me summarize by offering a reading of 2.227 in something like the reverse order in which it was written, based upon the foregoing presentation.

Just as diagrams of a parade, or of a battle, or of a piece of land (etc. – imagine the huge list!) can be created, diagrams of semioses may be constructed by using abstractive techniques. In conjunction with corollarial or theorematic deduction, these may be observed in order to produce inferences from them. These inferences will not be infallible, but will be necessary in that the diagrams will represent the semioses of scientific intelligences, and our scientific observation of those diagrams will proceed by evident steps based upon simple omissions or insertions of marks under control of reliable transformation rules. Moreover, the correctness of our observations will be checked by the standard procedures of scientific method, among which are publicity and repeatability of results, plus the phenomenon of being brought to an agreement, through discussion and argumentation, through the control of the reality of the matter under investigation. Eventually this process will give us the necessary or formal laws of semioses, the matter of the normative science called semiotic.

In conclusion, I hope you will consider that some of Peirce's finest discussions of topics of vital importance for semiotic are deliberately expressed in the context of diagrammatic thought, Existential Graphs, and related topics. It seems to me to follow from this fact that we who would like to develop an accurate understanding of what Peirce accomplished (in preparation for taking that research further, in the best scientific spirit) should then ensure that we have learned our way around in this special material. It is

even possible that Peirce was right when he said, in 1909 (NEM 3:875) that Existential Graphs "ought to be the Logic of the Future." He was in a solid position from which to make such a prediction, having developed a sizeable portion of the algebra of logic which we presently use.

Notes

In this essay, citations of Peirce's published works follows a method employed in "A Comprehensive Bibliography and Index of the Published Works of Charles Sanders Peirce", Ed. K. L. Ketner et. al. Kraus Microforms 1977. In this bibliography, numbers preceeded by P refer to works by Peirce.

Citation of Peirce's works that remained in manuscript or typescript form at the time of his death follows the numbering system employed in "Annotated Catalogue of the Papers of Charles S. Peirce". By Richard S. Robin, Amherst: University of Massachusetts Press, 1967, as supplemented by "The Peirce Papers: A Supplementary Catalogue". By Richard S. Robin, in "Transactions of the Charles S. Peirce Society" 7: 37–57. 1971. Peirce's manuscripts are readily available for study through their publication in a microfilm set offered for sale by Harvard University as "The Charles S. Peirce Papers", Harvard University Library, Photographic Service: Cambridge, 1966, 32 reels. An additional 12 reel set of professional correspondence is available from the same source. A set of these films is available for scholarly use in Europe at the Philosophisches Seminar, Universität Hamburg.

References to standard editions of Peirce's works will employ the following conventions. The initials NEM followed by a number (for volume and page) refers to Carolyn Eisele's edition of "The New Elements of Mathematics by Charles S. Peirce". The Hague: Mouton. 1976. References to the "Collected Papers of Charles Sanders Peirce". Cambridge: Harvard University Press, 1935, 1958 are by the initials CP followed by volume and paragraph number. A complete account of the recent availability of these and several other major new tools of Peirce scholarship may be found in "Peirce Studies" no. 1, Institute for Studies in Pragmaticism, PO Box 4530, Lubbock, TX 79409.

Peirce manuscripts quoted here are published by permission of the Department of Philosophy, Harvard University, for which courtesy I am grateful.

Bibliography

Eisele, Carolyn (1979), Studies in the Scientific and Mathematical Philosophy of Charles S. Peirce. Ed. R. M. Martin. The Hague: Mouton.

Esposito, Joseph L. (1980), Evolutionary Metaphysics: The Development of Peirce's Theory of Categories. Athens: Ohio University Press.

Fisch, Max H. (1978), "Peirce's General Theory of Signs", in Sight, Sound, and Sense. Bloomington: Indiana University Press. (1981), "Peirce as Scientist, Mathematician, Historian, Logician, and Philosopher", in Proceedings of the C. S. Peirce Bicentennial International Congress. Lubbock: Texas Tech Press.

Ketner, Kenneth Laine (1972), An Essay on the Nature of World Views. Ann Arbor: University Microfilms. (1981A), "The Best Example of Semiosis and its Use in Teaching Semiotics", American Journal of Semiotics 1, 47–84. (1981B), "Peirce's Ethics of Terminology", Transactions of the Charles S. Peirce Society 17, 327–347. (1981C), "Peirce as an Interesting Failure?" in Proceedings of the C. S. Peirce Bicentennial International Congress. Lubbock: Texas Tech Press. (1982A), "Who was Charles Peirce, and does he deserve a Homage?" forthcoming in Krisis, Journal of the Interna-

tional Circle for Research in Philosophy, Houston. (1982B), "Carolyn Eisele's Place in Peirce Studies", forthcoming in Historia Mathematica. (1982C), "Peirce's Existential Graphs as the Basis for an Introduction to Logic: Semiosis in the logic Classroom", forthcoming in Semiotics 1980 (Proceedings of the 1980 meeting of the Semiotic Society of America). (1982D), "A Brief Intellectual Autobiography by Charles Sanders Peirce", forthcoming in American Journal of Semiotics (an edition, with introduction, of Peirce MS L107).

Oehler, Klaus (1981A), "The Significance of Peirce's Ethics of Terminology for Contemporary Lexicography in Semiotics", Transactions of the Charles S. Peirce Society 17, 348–357. (1981B), "Idee und Grundriss der Peirceschen Semiotik", in Die Welt als Zeichen: Klassiker der modernen Semiotik. Berlin: Severin und Siedler.

Roberts, Don D. (1973), The Existential Graphs of Charles S. Peirce. The Hague: Mouton.

Zeman, J. Jay (1965), The Graphical Logic of C. S. Peirce. Diss.: Chicago.

CIP-Kurztitelaufnahme der Deutschen Bibliothek

Zeichen und Realität : Akten d. 3. Semiot. Kolloquiums
d. Dt. Ges. für Semiotik e. V., Hamburg 1981 /
hrsg. von Klaus Oehler. – Tübingen : Stauffenburg-Verlag
(Probleme der Semiotik ; Bd. 1)
ISBN 3-923721-81-1

NE: Oehler, Klaus [Hrsg.]; Semiotisches Kolloquium
<03, 1981, Hamburg>; Deutsche Gesellschaft für Semiotik; GT

Bd. 1 (1984).

Gedruckt mit Unterstützung der Deutschen Forschungsgemeinschaft

Signet: J. P. Mardersteig, Malente-Gremsmühlen
Satz und Druck: Laupp & Göbel, Kilchberg
Buchbinderei: Braun + Lamparter, Reutlingen
Printed in Germany

ISBN 3-923721-81-1

GERHARD PRINZ

in memoriam