Chapter 13

PEIRCE'S THEORY OF COMMUNICATION AND ITS CONTEMPORARY RELEVANCE

O MONSTROUS, dead, unprofitable world,
That thou canst hear, and hearing, hold thy way!
— Matthew Arnold, *Sonnets: Written in Emerson's Essays*, 1849

THIS PROBLEM OF THE CLASSIFICATION OF SIGNS is at present occupying the attention of one of the greatest minds of the day, Dr C. S. Peirce, and it is likely that anything attempted prematurely will be rendered obsolete by his long delayed work on Semeiotic.
— C. K. Ogden, *The Progress of Significs*, 1911

1. Introduction

Our mobile era of electronic communication has created a huge dynamic and semeiotic system of information flow, constructed out of the triadic components envisaged by Peirce, such as icons, indices and symbols, and signs, objects and interpretants. Iconic signs bear some semblance or likeness, whatever that is, to what they represent. Indices point at something and say "there!", and symbols signify objects by conventions of a community. In fact, according to Peirce: "The only way of directly communicating an idea is by means of an icon; and every indirect method of communicating an idea must depend for its establishment upon the use of an icon".[1] And signs give rise to interpretants in the minds of the interpreters.

Regrettably, this somewhat simplistic triadic exposé of Peirce's theory of signs has persisted in semeiotics or in one of its neighbouring disciplines as the somehow exhaustive and final description of what he intended. I believe that the more fascinating and richer structure of the signs comes out of their character of "intercommunication" and "interaction" (Peirce's terms, EP 2:389), which has been acknowledged much less frequently.

Despite this shortcoming, the full Peircean road to inquiry — as travelled by the dynamic community of inquisitive learners, or the "community of quasi-minds" consisting of "liquid in a number of bottles which are ~~connected~~ [in

intricate connexion] by tubes filled with liquid",[2] or the scientific communities of users of the data that is being provided by Nature, or the vastly increasing electronic sources — reflects the contemporary weight put on all kinds of multi-agent systems in computation. I will discuss multi-agent systems in the next chapter. However, this weight ought still to be strengthened by incorporating Peirce's view of communication into the semeiotic picture emerging from a transdisciplinary multi-agent research. The agents are not only abstract communicators, they are also signs, and thus also minds and in a bona fide relationship with objects. As some signs are phenomenal, they are apt for framing the electronic communication of machine-like quasi-minds. The correlates of Peirce's concepts of representamen (a sign put forward by the utterer), interpretant (what the sign determines within the mind of the interpreter), and various subspecies of the interpretant (e.g., the intentional, the effectual and the communicational) in the context of contemporary media-driven communication and learning need to be determined in the general amalgamation of his sign-theoretic triadism and communication as sign transmission. This is yet to be accomplished. Its importance is evident, for instance, from Peirce's unexpected late idea of the *commens* as the locus at which the thoughts of all minds that participated in the creation of the common ground congregate.

Appendix provides a diplomatic transcription of one of Peirce's central previously unpublished manuscript on the common ground, written in November 1908. Peirce intended it to be the opening chapter for his book entitled simply Logic, which was never completed.

The creation of the common ground by continuous intercommunication and interaction reflects the computational desire to furnish multi-agent systems with properties that would enable them to entertain appropriate interoperation. Thus the initiatives of semantic and pragmatic webs are also given increased semeiotic motivation as soon as adjoined with an understanding of Peirce's open-systems theory of communication (sect. 5). Above all, the phrase "medium of communication" was taken by Peirce to illustrate a broader notion than just the noun *sign*, namely a species of thirdness, a category of mediation, the synthetic consciousness, a prediction of future courses of events, continuity, learning, and growth (MS 283: 106).

A rewarding possibility to evaluate the interplay between technological growth and philosophy is to draw focal parallels and to make comparisons between the notions used in both fields, rather than to seek some overarching foundation for some particular set of technological innovations. Technological advancements have often been made, and sometimes rightfully so, quite regardless of philosophical problems. This has entailed the invention as well as the reinvention of some philosophical concepts. In some cases, terminology has just been hijacked by hackers. This happened with the all-pervading use of ontology in computer science, which has hardly anything to do with its

metaphysical homograph. There is no single ontology in web technology, only a library of possible modes of being. It is up to the users to make queries and pick relevant ontologies to be the shared formal specifications of the conceptualisations of what there is. Ontologies tend to reflect interpretations of terms of logical or representational languages, and thus become dependent on the universes of discourse that are common and shared between the agents who operate in them. No self-sustaining substances prevail in user-independent reality.

In the long run, we may witness some convergence of these vocabularies. This is likely to happen as a result of the recently-emerged ideas that aim at new approaches to the organisation, acquisition and evolution of the data contained in the web, namely the 'semantic' and 'pragmatic' renderings of the web concept (the scare quotes will become evident as I proceed). The aim that has been announced quite openly is to ensure that these systems are, or will be, built on the sign-theoretic principles of pragmatic philosophy, most notably on the principles that Peirce is claimed to have envisioned.

I want to know why. My purpose is to concentrate on two interrelated issues. First, my aim is not to unravel Peirce's overall and certainly very complex pragmatist and sign-theoretic philosophy, aspects of which were exposed in earlier chapters, but rather to understand his theory of communication. Of course, this theory cannot be severed from other parts of his thinking, such as his categories, pragmaticism, semeiotics, or the logic of EGs, but as I hope will become clear, the essentials can be understood without overkill from phaneroscopy, evolutionary metaphysics, or his mature theory of signs.

My other aim in this and the next chapter is to assess the relevance of Peirce's theory of communication to some of the emerging contemporary issues in computer science, web technology, and the overall modern era of communicating systems. I have no interest in presenting details of these innovations; I hope that many of them will be familiar. As it turns out, a number of technological and computational innovations have roots in Peirce's scientific method. Being semeiotic, his philosophical and logical concepts are widely applicable and not limited to human users or inquirers. For that reason they are not limited to the linguistic notion of communication either, but reach over virtually all that communication is or would be, now or in the future, including what AI, neuroscience, quantum theory or bioinformatics are able to provide.

My second task is easier. Even if there is as yet nothing like a full picture of Peirce's theory of communication, I believe that we understand it well enough to perceive its relevance to a host of issues, from general systems theory to the applied sciences of computation, communication and information.

2. Triangulate them all

What, then, is Peirce's theory of communication? There is no simple answer to this, and the question has become ever more widespread (Bergman 2000;

Habermas 1995; Johansen 1993; Ransdell 1977). I made some remarks concerning it in Chapter 2. The topic is indispensable in attempts to understand his philosophy from the perspective that aims at strengthening the coherence of his writings, and avoids fragmenting and isolating his boundless fields of interests.

A curious aspect of Peirce's communicative approach to signs is its seemingly dyadic, two-place nature. Prima facie, one may think that the approach is related to the transmissional idea of signs between two (possibly interpersonal) agents, the utterer and the interpreter, in a suitable medium of communication — not unlike Shannon's and others' later syntactic theories that focus on the question of how and via what media information should be propagated. This does, I submit, hardly any justice to Peirce's own intentions.

Second, Peirce's theory of communication is logical. This is the reason why some researchers, including Richard J. Parmentier, have dismissed it as unsuitable for inquiries involving social and cultural issues (Parmentier, 1994). The truth, I believe, is rather that the concepts of what is social and what is cultural are more liable to be stretched and given Peircean twists. For instance, a broad understanding of the social transpires in the currently popular research on multi-agent systems in computation. I will argue in the next chapter that one rarely noted virtue of multi-agent systems is that they provide a much more precise sociological analysis of social codes and practices than the semi-formal notions of social inquiry resorting to 'games' or the 'games people play' (Combs, 2000). Whether such attribution is justified in the end I do not seek to address here (for a masterful study of related questions, see Tuomela 2000). Likewise, the 20th-century concept of logic, set apart from the semeiotics, is limited and not representative of Peirce's overall aims. For, according to Peirce, "Logic is rooted in the social principle" (2.654).[3] In opening up this sentiment, it is essential to recognise that, for Peirce, logical research should also take in the considerations of what one's rational action would be in situations that called for moral judgements. This is of course connected with the fact that his logic is a normative science in the sense that the notion of truth in logic conceals a normative component.

Peirce laid out practically all his divisions in a triadic, three-place format. He did this for many reasons, the most notable being mathematical: Given his assumptions concerning mathematical relations (he was one of the founders of the algebraic logic of relations), no non-degenerate three-place relation can be constructed out of just one- and two-place ones. Therefore, it seems that his overall method of communicating via signs is in some way discrepant or in disagreement with the triadic nature of the other parts of his theory.

The question is: how does the idea of communication between two agents fit into this triadic picture? The answer is, in fact, to be found in his MS 318 (partially reprinted in EP 2), in which he explains his sign theory from the communicational perspective. First of all, there are signs that have no

utterers. These are the signs found in nature. Then there are signs that have no interpreters, such as encrypted messages, or the golden plate on the side of the Pioneer 11 probe at the moment of uttering this sentence. The utterers and the interpreters associated with these kinds of signs will receive the prefix "quasi", and they could be thought of as positions, phases of the thinking mind, or semeiotic roles in the process of semiosis. In other words, they are theoretical entities devoid of actual minds connected to brains.[4] In the special case of signs that are symbolic natural-language assertions, the utterers and the interpreters are characteristically human beings. In that interpersonal situation, the utterers and the interpreters are, to a degree, distinct from those of the object and the interpretant.

What, then, are we to say about the residual cases? According to Peirce, the object-interpretant axis represents a continuum that is not meant to demarcate objects and interpretants in any non-fuzzy, clear-cut manner. Some utterers may be assimilated or equated with objects, and some interpreters may likewise be assimilated with interpretants. There are two dynamic scales within the triadic division of signs, one representing the object-interpretant continuum and the other representing the utterer-interpreter continuum. Depending on the nature of the signs, these two scales may coincide, as is the case with non-linguistic signs that have utterers and interpreters, for instance.

The general picture that emerges is schematised in Figure 13.1. There are two main trichotomies, the sign (representamen)-object-interpretant and the sign (representamen)-utterer-interpreter. By moving along the base of the latter triangle towards interpretants and the interpreter, the utterer's state of information increases. Conversely, by moving from the interpreter towards the object and the utterer, the state of the information of the interpreter increases. The dashed arrows show the increase and decrease in the states of information of the utterers and the interpreters. The overlapping area is the common ground in which the communicational interpretants are determined. The α-angle measures the degree to which the objects and utterers converge, and the β-angle measures the degree to which the interpretants and their interpreters converge. Both angles measure the degree of interpersonality in communicational sign-theoretic situations. It may also be concluded from this figure that it is the breadth of the base of the sign-object-interpretant triangle that measures the distance between objects and their interpretants.[5]

Peirce calls what there is in the gravitation between the utterer and its object "the essential ingredient of the utterer", or the utterer's "*quaesitum*" (MS 318: 22), its right to enquire further the components of its object. The *quaesitum* involves the open-ended, dynamic and diachronic model of logical semiosis moving through both historical and real time. Notions of general equilibria may well constitute its parts, but is not exhausted by them. It is found in the utterer's delineation of the class of the universe of discourse that is understood

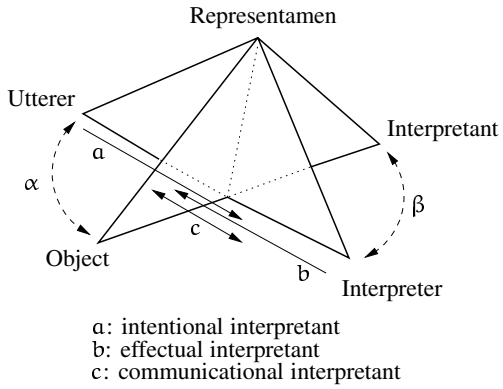

Figure 13.1. The semeiotic pyramid

to be at issue in the dialogue.[6] The utterer chooses the object, sample or its instance from the domain as intended by the utterance and as understood to be predicable by the the rhemas of the proposition in question. I will not delve into the issue of how such choices are made (see Chapter 4): I can override comprehensive explanation by noting that in the case the act of uttering and the object intended by the utterance amount to one and the same thing, there is no decision to be made. If not, the purpose and strategic considerations of the utterer and the interpreter are of prime importance. These are, in turn, related to Peirce's notion of a habit and its cultivation in possibly infinitely repeated runs of semeiotic plays, discussed in Part I of this book.

An open question that has not been posed before is whether Peirce intended this interpretation to supply an objectual interpretation of the quantifiers Σ and Π in the sense of choosing objects from the domain, and intending the names of these objects to function as values of the rhemas and the quantifiers. Or alternatively, did he espouse substitutional interpretation, namely the participants in the dialogue picking out names that are instances of some given substitution-class of non-logical constants?[7] His typical choice of the term was a selection of "instances" as proper values for logical and non-logical constants, and they typically referred to objects, but often he just left unspecified what he the selections can be. For instance, as I noted in Chapter 1, his improvement on Kantian logical analysis ordained that sometimes, some instances need to interpret indefinite expressions.[8] A question that arises is, to what extent are we justified in taking them as corresponding to model-theoretical entities? Or, is the contemporary conception of what model-theoretical entities may be too narrow and inadequate?

Quite another aspect of Peirce's theory of communication is that, if the interpretant is what he termed the (ultimate) logical interpretant, then, in representing

a state of perfect knowledge, the ontological and epistemological distinctions make no difference in scientific inquiry. The object merges with its interpretant, disintegrating the triangle into a dyadic relation between the sign and its ultimation. In other words, the maximal state of information leaves no latitude for interpretation because there is no longer any difference between objects and interpretants.

Many interpretant triads exist in Peirce's writings, which I will not go on to review here (see Chapter 1). They are all intended to make negligible distinctions in order to broaden the base of the relevant triad in the semeiotic pyramid.

Because Peirce was keen to repudiate all psychological influence on the province of logic and semeiotics, he might have wished to eliminate the concept of utterers and interpreters from the dominion of sign action. This is evidenced in his frequent tendency, I submit, to assimilate utterers and objects on the one hand, and interpreters and interpretants on the other. Upon closer inspection, this assimilation does not mean reduction at all. The concepts of the utterers and the interpreters are, as Peirce puts it, "welded" into one sign (4.551), but they move along the distinct scale from that of the objects and the interpretants, as the bases of the triangles have independently variable breadths. It is the 'gravitational' force between the utterer and the object, and between the interpreter and the interpretant, provided by the utterer's or interpreter's *quaesitum* of meeting the obligations concerning the object or the interpretant.

Since every thought is a sign, no thought can evolve unless conceived of as dialogic, either between multiple, interpersonal parties or as a quasi-dialogue within one mind. This quasi-dialogical perspective offers a method of assigning semantic values to logical propositions, whereas person-to-person dialogues work for pragmatic theories of communication and discourse.[9]

According to Peirce, however, there is little difference between multi-party interaction in, say, a social setting and the intrapersonal reasoning and action in logic, because "a person is not absolutely an individual" (5.421).[10]

Peirce's theory of communication comes extraordinarily close to the dialogical and game-theoretic interpretations of logic. These interpretations could be considered formal (logical) and strategic regimentations of relevant parts of Peircean semiosis. Although invented quite independently, they endorse elements of communal or social approaches to meaning in that the idea is to check the truth-values of the propositions of a logical language. For the most part, they lurk behind his diagrammatic and iconic systems of EGs, and point towards ways of extending these systems. The difference between dialogue games and GTS is that dialogues aim at validity of propositions, whereas semantic games seek to establishing when the propositions are true in a model and when they are false in a model. These theories both distinguish players' roles in terms of the polarity of the logical constant encountered in the formula, including logical connectives, and switch the roles when negation is encountered. Dia-

logue games and GTS are also both strategic in that the notion of a winning strategy represents the concrete concept that agrees with the notions of validity (dialogues) and truth (semantic games) of propositions. Peirce had most of the features of both in his system of logic, although he did not come to endorse any unequivocal game-theoretic terminology.

Even so, his theory is somewhat richer still. Its all-important concepts of the common ground and the universe of discourse are not limited to logical or model-theoretic domains. His theory is applicable beyond proof theories and game semantics, placing pragmatic and discourse-related phenomena in linguistics under logical and semeiotic scrutiny. As was seen in the previous chapter, it also contained the origins of speech-acts and theories of relevance.

The collaterally-acquired common ground secures the very success of communication in semeiotic dialogues. The ground refers to what is mutually understood and shared between dialogue participants, determined in their common mind as the common communicational interpretant, which allows them to understand each other's utterances. As noted, Peirce once gave this common mind the special name of *commens*.

The title of this section is not coincidental. The emerging idea which was never explained in full by Peirce, is not unlike what ensues from Donald Davidson's triangulation scheme (Davidson, 2001). According to it, whereas individually and communally the speakers and hearers of language may go wrong in their interpretations, in a broader context, for any communication to be successful, the beliefs of others are not to be taken to be radically different from our own. Anyone having a belief must be interpreted as having a true belief, even if the belief in question would turn out to be false. Peirce's guarantee of a similar outcome was the inevitability of collateral observation and mutual experience plus the normative maxim of *summum bonum* that the communities of inquirers share in communication. The main idea is thus also similar to Davidson's principle of charity in interpretation.

However, there are points in which Davidson's triangulation may be insufficient for Peircean purposes. Apart from the communicational link between two or more subjects, which Davidson considers to be essentially richer than any monological incident, the 'third' in this theory is simply the object, of which the conversations are intended to be about within the subjects in question. To make this picture richer, and to account for its multi-culturalised versions that have been argued as being consistent with the original scheme (van Braakel, 2003), one would be well advised to replace the notion of the object and the associated concept of objectivity with the Peircean understanding of the sign, with the more phenomenological undertones of the latter.

This, mutatis mutandis, gives rise to a 'double triangulation' a version of which is depicted in Figure 13.1. What accompanies this understanding is the extent to which the two corners of the bases of both triangulations are related,

in other words the affinity of the object with its utterer and the interpretant with its interpreter.

Furthermore, the presence of two similarity responses, which Davidson assumed to be persons, may be replaced by the pragmatic concepts of the ego and non-ego, the interaction of which gives rise to existence. In Davidson's view, similarity responses evoked by the two parties also give rise to objectivity of what exists.

Such a semeiotic enrichment of triangulation ipso facto accounts for all the cultural differences that language users may exhibit, and the ensuing 'multiple-worlds views' that examples of peculiar ways of conceptualising the world may imply.[11]

The universe, or multiple universes of discourse, is thus a key element in Peirce's theory of communication. In dialogues, they are not just total domains in that overworned logistic sense, but encompass also presuppositions shared in the conversation and established by the same principles as the existence of mutually-gained collaterality of the common ground.

What, then, are the practical outcomes of Peirce's concept of communication?

3. Applications and complications

Interoperability Interoperability is a boast recently made in all corners of computing. Dictionaries tend to define it as 'compatible software or hardware', but it does not merely represent the technical challenge of some coding or manufacturing problem. On the contrary, it has been described as "the ongoing process of ensuring that the systems, procedures and culture of an organisation are managed in such a way as to maximise opportunities for exchange and re-use of information, whether internally or externally" (Miller, 2001).

This pragmatic definition focuses on what goes on in communities of engineers, researchers, managers, and other users of knowledge. It is also reminiscent of utilitarism, implying the maximising of something (here: opportunities to exchange information). Intentions to do this clearly depend on the scope of common interest in having interoperative systems and products in the first place. Indeed, humans can be stunningly interoperable at will.

Interoperability also has linguistic, social/communal, legal and normative aspects, and so it is a good example of Peircean inquiry as an indefinitely extendible and inexhaustible activity. The goal is to create communicational interpretants in a variety of cases, across the boundaries of what is artificial and what is human, whatever entities the subjects engaged in communication are taken to be.[12]

Weave this: semantic and pragmatic webs The goal of next-generation web technology is to define meaning in web documents. The increasingly popular

albeit not yet very widely implemented approach known as the semantic web uses mark-up methods instead of plain keywords, which define the class and subclass hierarchies and the relations between the concepts that appear on the page (Bernes-Lee, 1999; Fensel & Musen, 2001; Bernes-Lee & Miller, 2002; The Semantic Web Agreement Group, 2001). This metadata information provides the 'semantics' (or in this restricted sense the 'meaning') of the document. According to this project, it is hoped that the increased production of metadata for ontology languages will create a network of documents, the content of which could be automatically processed in a much more elastic and adaptable manner than in standard syntax-driven string-matching search methods.

One might think that this approach really has nothing to do with semantics. However, as a practical present-day version of the Peircean notion, it provides the meaning of the data or of a code by translation. Peircean semantics is, after all, a theory of translation, a rendition of a given symbolic statement into some other statement, diction, or paraphrase, or into some other language, or perhaps a dictionary-like definition of it.

However, this understanding of semantics lacks the semeiotic components of the utterers and the interpreters of the data. We still need to understand how the metadata, such as that provided by the Resource Description Framework (RDFS), is connected to the interpreters and objects of data. This connection defines the pragmatic meaning of data. However, as such it does not fulfil the vision of a pragmatic web, as announced, for instance, in de Moor et al. (2002). The pragmatic web draws the community of inquirers, most notably web users, into issues to do with the purpose of information. While such intentions and contexts of users surely play a significant role in pragmatic accounts of meaning, and while these researchers are certainly right in criticising the semantic-web approach for its limitation to the metadata idea and neglect of the communities of human users and engineers, the approach sidesteps the perhaps more profitable possibility of incorporating truly semeiotic pragmatics into the automatised and computational level of the web. Rightly, it points out that a semantic web devoid of human users is insufficient. It asserts that new meanings or concepts do not simply emerge by adding more and more structural features to the web pages or by linking them more and more efficiently. Even so, there is still a need for a methodeutic here, making contact with the third main class of normative logic beyond grammar and logical semantics, to fosted the methods of communication between human users, computerised agents as well as humans and computers.

Multi-agent systems We can only hope that from the ashes of the vast amount of research done on multi-agent systems will rise precisely this pragmatic web challenge. The challenge involves an attempt to build agents, or pieces of advanced software, that are designed to play the different semeiotic roles of quasi-utterers and quasi-interpreters. In other words, they would play the different

positions in the cycles of dialogic semiosis as prescribed in Peirce's theory. This is the way in which they are intended to contribute to the generation of new objects and the evolution of new meanings in the web.

Agent systems still lack the truly goal-directed specifications of processes. Only when that is accomplished could they be considered to create habits and produce the wherewithal for revision. This is a long way off. Autonomous and proactive agents need to build second-order evaluations of their own strategies, noting when a habit-change occurs, namely when the logical interpretants considered in Chapter 1 are produced in the quasi-minds of agents as the end products of the process of semiosis that terminates or is about to terminate. They need to learn whenever they 'feel' pain, whenever something meaningful happens to one of the individual agents. Knowing when that is to happen depends on the correct evaluation of the habits that are already in the agent's possession. The next chapter takes up this theme of Peirce's thought.

Questioning the web Elements of goal-directed agent systems are emerging in the vision of the knowledge web. The aim is to overcome these shortcomings and supersede both semantic and pragmatic web enterprises by taking agents as constructors building a huge question-answering system on the web data, and responding to queries on an information-need basis. This is certainly also a long way off, because one needs to accomplish two things: (i) a comprehensive logic of questions and answers, and (ii) a definition of a workable possible-worlds structure of the web. Neither has been accomplished as yet.

On the first point, the quest for a logical relation between questions and answers stands upon the edge of theories of presuppositions, because requests for information can be viewed as epistemic statements. (This task is also related to the separate question of how to extend Peirce's theory of abduction.) The command 'Bring it about so that S' has root in the non-imperative epistemic sentence 'I know that S'. As to the second point, web nodes should be viewed as knowledge providers, and via that emerging structure epistemic statements are translated to mean, 'The user knows S in the information state w if and only if S holds in all the web nodes accessible from w'.

Initial states for the users of information then need to be agreed. As they are software agents querying other software agents, w codifies the knowledge in the position they have reached within a "model-checking" game on the web.

An alternative, and I believe complementary, way of building a knowledge web is to use conceptual graphs (Mineau, 2002), which closely resemble Peirce's EGs. Their purpose in the web domain is to provide good representational formalisms to describe the workings of software agents. Many of Peirce's ideas, however, especially those related to the gamma part and their extensions are still to be incorporated into the conceptual-graph framework.

The semantic + pragmatic web = the semeiotic web? Both semantic and pragmatic web visions share a mutual concern about the inadequacy of the current architectonics of the web. The semantic web aims at providing a 'logical analysis' of data, while the pragmatic component adds the human perspective. Both of these approaches are somewhat inadequate, but in their combination, and from the perspective of the semeiotic and logical approach to inquiry, they have rich emergent features and promising applications to the web context, in which semantic and pragmatic initiatives are inadequate alone. The outcome of these considerations the truly semeiotic web. This combines both semantic-web and pragmatic-web initiatives, but exceeds them in that it takes both in a way that is faithful to Peirce's pragmatic approach to inquiry, its methodeutic.

Unlike the related concepts of semantic and pragmatic webs, such plans need also to be operationalised in an effective and thorough fashion. Hence a new approach to multi-agent systems is needed that addresses the weaknesses of both semantic and pragmatic webs by the new logic of questioning and answering and by taking agents as roles in the dialogical, semeiotic inquiry of signs in the universe of the web. This task is taken up in the next chapter. The upshot is that semantic and pragmatic conceptions cannot and should not be separated (Pietarinen, 2003f).

4. Pragmatism from a communicational perspective

In the light of previous remarks, the common ground of pragmatically-inclined software agents is bound to be quite different from that of humans. Software agents do not have similar self-awareness, such as what it is to be a member of the common genus of *homo*. It is also quite clear that knowledge of the language and knowledge of the universal aspects of grammar or specifications of a code lies in the hands of the programmer. It is equally obvious that experience of the world differs.

Nevertheless, agents do not need to be taken as fundamentally different from humans in all their aspects. For instance, common knowledge of rationality and common knowledge, essential in the creation of communicational interpretants, are definable on the logical level. Linking languages to the world presupposes that there is a great deal of common experience shared by their utterers and interpreters. In Peirce's system, it is typically the copula that ties predicate terms to the elements of the domains of discourse. Nowadays, the interpretation of languages is given by the static valuation function that assigns values to their non-logical constants (functions, predicates and symbols). This provides the boundary conditions upon which the semantic clauses are defined. However, from the semeiotic perspective such a valuation is itself subservient to dynamic and dialogical reinterpretations. A way to spell out the difference is in terms of closed vs. open systems (Chapter 3; sect. 5 below), in which for the latter, no function or law exists that associates the system with its environment.

The characteristics of the latter system are emblematic of non-deterministic functions, relations with non-unique outputs.

The upshot is that two main components of being pragmatic should equally be taken into account in semantic/pragmatic web enterprises.

The first is the contextual/situational/environmental dependency of signs. There are logical ways of tackling this, witness the conceptual-graph research anchored in the diagrammatisation of assertions. Logics based on diagrammatic reasoning plus other heterogeneous representation formalisms are typically context-dependent by their very nature.

The second component is the utterer's meaning as distinct from the literal meaning of the utterance. Recalling the divisions between triadic interpretants, we say that the utterer's meaning is in the intentional interpretant, mediated in as meaning-preserving a way as possible to the receiving effectual interpretant created in the mind of the interpreter. In contrast, the literal meaning is in the immediate interpretant of the sign. The immediate interpretant is then that which is created even if there is no interpreter.

These points relate to the Peircean concept of the universe of discourse, which can be conceived in the following two ways.

First, there is the contextualisation task, which is made easier by there being collateral observation and mutual experience shared by agents. This is the task of 'model-building'. It is described in the presuppositions of EGs by way of collaboration between the Graphist and the Grapheus, namely between the agent who proposes modifications to the graphs and the agent who creates the universe and decides the truth of atomic expressions. The Grapheus does this by either authorising or refuting the actions proposed by the Graphist. Peirce held that there is no opponency or competition in this description. The aim is to capture and agree on what the relevant aspects of the system are that are to be modelled and the properties of which are to be studied.

Tableaux methods are examples of model building in which the aim is to search for a counterexample to the proposed assertion. In a similar vein, to check consistency of the assertion is to perform a satisfiability check, which means that one tries is engaged in building a model for the assertion. These modern approaches introduce competition in the sense that a set of assertions having a model is tantamount to the existence of a winning strategy for the Graphist (the Builder, the Proponent). Likewise, the existence of the winning strategy for the Grapheus (the Critic, the Opponent) is tantamount to the demonstration that the negation of a given assertion holds. What the Grapheus is doing is to search for counterexamples that would show the invalidity of initial assertions.

In the Scottish Book from 1930s Ulam and others proposed that the game-like idea of forcing (Banach-Mazur games) applies to building of a model. The game is one of teamwork and cooperation. Peirce's anticipation of this was the idea that the Graphist and the Grapheus "collaborate" in building a "Pheme"

(a model) for assertions (4.538; 4.552). In that game, the Graphist "proposes modifications to the graphs", while the Grapheus "creates the universe" and decides upon the "determinations", namely the interpretations of atomic formulas by "authorising" or "refuting" the "actions" of the Graphist (4.538; 4.552).

After building, the semantic game on assertions commences. Second, therefore, the sign-theoretic communicative phase takes prcedence. In that phase, signs represent objects, and their instances are chosen from the mutually observed domain of discourse by the dialogue participants. This is the task of model-interpreting or model-checking. Peirce described it in the constitutive rules of interpretation and considerations pertaining to the education of partakers' habits towards stableness. The participants will now have conflicting purposes. This description antedated the modern methods of semantic games.

Both tasks are of great concern for those working on formal methods: logicians in their model-theoretic activities, econometricians in their attempt to identify relevant parts of economic systems, and natural language semanticists in their judgements concerning the amount of non-truth-conditional material that infiltrates linguistic theories of meaning.

In a closer relation to the topics of the present chapter, the aforementioned points give rise to the following general observations and suggestions:

(i) The easier it has become to transmit data through computerised networks, the more difficult it has become to share data for mutual processing and understanding. This is not as much a shortcoming due to technological challenges as the failure to admit non-individualistic Peircean persons. This concern was recognised by the early significians, who wished to facilitate improved understanding through post-Peircean analysis of communication. In our day and age, it appears almost as if multi-agent systems were the proxy forces that have been set out to do what humans have failed to accomplish.

(ii) What is more important than the complex attempt to make incompatible vocabularies of databases and web documents understand each other is to refurbish methodologies for sharing meaningful information. Peirce laid emphasis on the importance of methodeutic for the community of inquirers in their study of "the methods that ought to be pursued in the investigation, in the exposition, and in the application of truth" (1.191). This is essential in communication, for "it is the doctrine of the general conditions of the reference of Symbols and other Signs to the Interpretants which they aim to determine".[13] Ultimately, there is then a need for finding a "method of discovering methods" (2.108, 1902), a logical task that would enable inquiries to manage the ever-increasing streams of computerised information.

5. Towards open-systems philosophy

To bend the perspective somewhat, we may think of communication as the abstract activity in any open system that receives persistent streams of through-

put and is not yet in the state of equilibrium or in the state of maximum negative entropy. Accordingly, information may be held to be whatever there is that is needed in such activities to ascertain that the system is not in such a state. The meaning of signs would, according to this view, when arrived at in their final, ultimate state of interpretation, have reached an equilibrium in which much of the information has been consumed. In a well-defined logical sense, tautologies (analytic logical truths) are uninformative in not giving away any new information that agents could make genuine use by means other than those of logical information processing, including theorem proving. All in all, languages may be viewed as open systems that operate with specific kinds of signs. Maybe logic, too, has taken tendencies to reflect such systems increasingly more.[14]

Information plays a similar role in biological and physical systems. They start with some random state or a distribution of values and weights such as a priori probabilities for different alternative states of the world. As these primordial states gradually evolve, together with the law-like features that govern them, they tend to states that reduce the need for the consumption and exchange of information in order for the agent or the experimenter to measure the approximate distance from that goal state. There are various parameters that the notion of information may denote in such processes, including symmetry constraints, various conservation principles and degrees of freedom of physical systems.

Logically and mathematically, information may mark those boundary conditions that are fixed in any particular local system under investigation, such as in a particular model in the mathematical sense of model theory. As the tendency of model theory is to study what is similar and what is dissimilar between classes of structures that are parts of some large homogeneous structure, the role of information is even more crucial. Such propensity suggests one to regard models as systems that possess the kinds of characteristics that define openness in the sense of general systems theory, the large homogeneous structures playing the role of the environment.

Systems or models of that kind, like organisations, institutions, economies, social groups and sets of conventions and laws, however man-made or natural, may be seen as maintaining systemic habits with adaptability, self-organisation and change as their core features. There are countless examples of the usefulness of this way of looking at interactive systems. Chapter 14 provides one parallel between those of games and multi-agent systems, recently employed in computation and AI. This parallel has several points of contact between Peirce. From the general systems perspective, the concept of a habit appears as particularly appealing. Among other things, it may be seen as a reflection of aspects of the logica utens of open systems (Chapter 1), whereas its companion of logica docens refers to the compartment of logic by which we, as engineers or system modellers, come to understand these things.[15]

That open systems are closer to game-theoretic ways of thinking than static transition systems (such as automata) is shown by the closed and inactive nature of transitions in their process-like notion of producing outputs, in which the behaviour of the system is unable to cope with the variability of input, such as its timing, pace, quality and the methods of feeding. This observation serves to support my thesis that large portions of Peirce's philosophy may be productively conceived through a game-theoretic lens.

A slogan says that 'evolution is chaos with feedback'. This is Peirce's evolutionary metaphysics in a nutshell. Chaos is his firstness, tychism that prevails in the universe of unorganised substance. Feedback provides a law, secondness that flows from input to produce output that is of certain value. Finally, evolution is the habit-taking tendency of the universe, which brings the law of feedback and the payoff values it provides in continuous relation with chaotic ripples of chance. Peirce expressed this view in his *A Guess at the Riddle*, written in 1887–88 in his attempt to summarise the answer to the puzzle of the cause and origins of the universe (reprinted in W6). That article outlines a grand philosophical agenda for 'general informatics', ranging from information-processing sciences to general systems theory, still awaiting full-bodied investigation.

6. Conclusions

Having identified some main issues involved in a general amalgamation of communicative and triadic viewpoints on signs, and assessed the contribution it has made to the emerging contour of a full Peircean notion of communication as sculpted by the recent era of intercommunicating computational systems, what are the repercussions? Peirce's philosophy represents a drastic departure from the Cartesian view, the one-time programme of those who were trying to understand the discourse of the distinction between mind and matter on the one hand, and the discourse of the interaction between them on the other. Peirce presents all interaction as triadic between signs, objects and interpretants. His thinking may be reproduced as open-systems philosophy in which systems, be they artefacts or human beings, react to environments in a non-programmed, habitual manner.

For that reason, some may regard it as a never-never philosophy, a Peircean would-be, a hypostatically abstracted metaphilosophical *Erewhon*. Nevertheless, it is strictly rational, adhering to principles of logic, while keeping a critical eye on other socio-logical principles of inquiry, including the much less logical post-Marxist utopias of global communication communities, or dystopias of all-pervading power relations. It denounces skepticism. It emphasises the positive role of the community of inquirers, be they quasi-minds of software agents or human interpreters, in creating new objects and events, developing new meanings and concepts, and ultimately achieving the main goal of scientific inquiry, namely the attainment of the truth.

It is remarkable how well Peirce's never-never philosophy has kept its promises in the light of current technological advances — I see this as a self-returning pragmatic maxim. I predict prosperity for Peirce's philosophy as the 21st century kicks off, not only because of its pragmatic solutions to ever-increasing pragmatic questions, but also because we are only beginning to see the grave limitations of the last century's conceptions of logic and the impasse of analytic philosophy.

Notes

1 2.278, 1895, *Speculative Grammar: The Icon, Index and Symbol*. Peirce's *chef d'œuvre* came into being shortly after these remarks were made, in the form of his diagrammatic system of EGs. As I noted in Part I, this was a thoroughly iconic representation of and reasoning about 'moving pictures of thought', which encompassed not only propositional and predicate logic, but also modalities, higher-order notions, abstraction and category-theoretic notions. The importance of iconic representation in scientific and everyday communication has frequently been noted, starting with the works of Russell, Wittgenstein and Neurath, although as logics they had to await the heterogeneous systems of the late 20th century.

2 MS 318: 133. Peirce's attempt was to explain what it means for a sign to be "a determination of a quasi-mind" (MS 318: 131) by the synechist metaphor of the chemical continuity of fluids, for "a pure idea without metaphor or other significant clothing is an onion without a peel" (MS 318: 132).

3 There is a somewhat converse declaration elsewhere, "The social principle is rooted intrinsically in logic", 5.354.

4 This may be related to the concept of 'natural intelligence' that has been deployed in AI, especially in automated reasoning research (Pietarinen, 2004a).

5 Johansen (1993) has studied interactions between sign-theoretic triads from the communicational point of view. My interpretation of Peirce's theory differs from those suggestions, however.

6 MS 318: 29: "Pronouns are words whose whole object is to indicate what kind of collateral observation must be made in order to determine the significance of some other part of the sentence. 'Which' directs us to ~~turn our attention in what has been said,~~ [seek the quaesitum in the previous context;] the personal pronouns to observe who is the speaker, who the hearer, etc. The demonstrative pronouns usually direct ~~attention~~ [this sort of] observation to the circumstances of the utterance (perhaps to the way a finger points) rather than to words."

7 This is the interpretation that was so named mainly after Kripke (1976).

8 Some passages suggest that Peirce came close to the 'discourse referent' idea in DRT (see Chapters 4 and 6).

9 Strategic versions of such dialogues give rise to optimality-based theories for phonological, syntactic, semantic and pragmatic inquiries in linguistics (Dekker & van Rooy, 2000), and various conversational and dialogue games for actual language users (Carlson, 1983), for instance.

10 The multi-agent nature of communities has multiple contact points with Peirce's theological, cosmological, evolutionary and agapistic metaphysics. That he was caught between the two fires of exact sciences and religious thought prevented him from presenting his systems in a sustained, unitary form.

11 Such cross-cultural issues are the key ingredients in historical research on pragmatic change (Chapter 12).

12 Shared ontologies are good examples of communicational interpretants in artificial systems.

13 2.93, 1902, *Partial Synopsis of a Proposed Work in Logic*.

14 Such tendencies would, among others, (i) endorse the return to pictorial and graphical methods of expressing logical assertions instead of symbolic predicates, (ii) refer to semeiotic processes instead of interpretations of non-logical constants, (iii) manipulate logical relations in a Gestalt, context-dependent manner rather than compositionally, and (iv) refer to indefinite and indeterminate objects and events in addition to well-defined individuals (Pietarinen, 2004f, 2005a,c).

15 
so curious to note the Peircean premonition that in many difference equations for logistical examples, if the growth factor increases beyond three, the systems do not tend to stable equilibria.

Appendix 13.A: Manuscript 614 on Common Ground

Logic. Book I. Analysis of Thought.

Chapter I. Common Ground.

18 November 1908

Your purpose in reading these pages ~~was~~ [has been] mine in writing them, namely that you should be enabled to reach the truth the more surely and expeditiously for having studied them. If we succeed it will be a great achievement for us both. For my part I shall feel ~~as if I could~~ [that having so succeeded with one, I may hope to succeed with so many that all of us together shall] move the world. But as Archimedes said he could do that with his lever only if he had a πο῀υ στ῀ω, a where to stand, so I am obliged to remember that no man can communicate the smallest item of information to his brother-man unless they have a πο῀υ στ῀ωσι of common familiar knowledge; where the word 'familiar' refers less to how well the object is known than to the manner of the knowing.[1] ~~that is, directly in the object~~ [p. 2] This manner is such that when one knows anything familiarly, one familiarly knows that one knows it and can also distinguish it from other things. Common familiar knowledge is such that each knower knows that every other familiarly knows it, and familiarly knows that every other one of the knowers has a familiar knowledge of all this. Of course, two endless series of knowings are involved; but knowing is not an action but a habit, which may remain passive for an indefinite time.

You have an advantage over me in this matter, since you know something about me, while I do not even know that you exist. Nevertheless I know that if you exist you have some acquaintance with the English language, and that you have some notion of the grammar of our Aryan languages; and it will be safe to assume that we have a common familiar knowledge of the ordinary truths of human life. I shall risk the assumption that you [p. 3] are neither a child nor a dullard, but are a normal adult of sufficient intelligence to be interested in methods and their adaption to ends and not to confine your admirations to successful results, ~~which are~~ (these being actually more or less fortuitous), a character which places your intelligence, in my estimation, in a class decidedly above that of the average of mankind.

Such being the case, I risk nothing in assuming that you are well aware that the exercize ~~over our~~ of control over our habits, if it is not the most important business of life, is at least very near to being so, and I dare say you have taken some pains to discover just how that control is effected. The word 'habit', as it is ordinarily used, ~~is not~~ does not convey ~~the precise~~ [quite the] idea that I seek to convey. It is, I think, usually taken to denote any character of a [p. 4] person which conforms to these two conditions: firstly, that it ~~has~~ [shall have] resulted from that person's having many times behaved in one general way under circumstances of one general kind; and secondly, it shall consist in a tendency, on the part of that person after the fulfilment of the first condition, to behave in the same general way under circumstances of the same general kind. This makes the habit to consist in an impulse or psychic cause of a resemblance between a person's actions after repetitions and his actions during those repetitions. The sense in which I use the word but slightly differs from that, except that I disregard both the manner in which the habit has been established and the difference between the behaviour of a person and that of a thing. I mean by a habit ~~the accord of the behaviour of a person~~ a power acting through ~~the~~ [a person's] soul and tending to make his behaviour accord with, or conform to, a general idea.

[p. 5, 19 November 1908] Everybody knows that people are able to exercise some considerable control over their habits; and some day I ought to endeavour to give you some aid in tracing out the *modus operandi* of that control somewhat minutely. At present, it comes in my way to direct your attention to certain features of the process only. In doing so, I shall not meddle with the science of psychology; and this is a remark that I shall often have occasion to repeat.

Many persons, perhaps most persons have the idea that every observation about the human mind is a psychological observation. They might as well regard the sight or sound of an apple dropping from a tree as an astronomical observation in view of what is said to have befallen Isaac Newton. The notion is due to the utter want of comprehension, on the part of the public, [p. 6] of what science, in its modern sense, really consists in; and in here speaking of the public, I not only include ninety-nine per cent of the members of the most enlightened of unscientific circles, many of whom call themselves 'scientists', — a word, by the way, that very rarely drops from the

lips of a genuine man of science; — but I include not a few true scientific men, besides. No doubt, all well-educated people, — in this country, at least, — understand that 'science', in its modern sense, is neither what the ancients meant by *scientia*, or ἐπιστήμη, which was nearly what we should call 'comprehension', which a mental acquirement, nor is it what Coleridge called 'science', and defined as systematized, or organized knowledge, — ~~knowledge~~ [thus] being, in truth, the fossilized remains of science. They know, or the wisest of them do, [p. 7] that when they ~~hear~~ [overhear] mathematicians, or physicists, or chemists, or physiologists, or comparative anatomists, or astronomers, or geologists, or the like speak of 'science', what will be meant in every nine cases out of ten will be the collective activity, — the 'business', — that is being carried on in social groups each consisting of men who possess special facilities, external and internal, for the solution of problems of a certain kind, and are devoting their ~~whole power furthering such~~ [total energies to] discovering those solutions. So much, I say, the best-instructed of the public do understand; but not even they nor all scientific men of great eminence, either, seem to be aware that no man has any special facility for solving any hitherto unsolved problem he chooses of however narrow a class that is marked out by any rational characters. *He only finds himself in* [p. 8] *condition to attack this and that individual problem*; and ~~if there be a~~ if these belong to a class of problems out of which single problems come within the range of facilities of members of a social group, so that they will with competence examine his work upon the problems he attacks, and pronounce their approval of it, then, and not otherwise he is what scientific men usually mean when they speak of a person as a scientific man. The pioneer of an entirely new line of inquiry cannot be pronounced a scientific man, except by those who afterward follow in his foot-steps; and they will commonly detect grave errors in his procedure, or at any rate, will think they do. But ~~for the~~ [in] most cases, a quite new road through the dark ~~thick~~ jungle ~~virgin forest~~ of ignorance does not get broken at all until science reaches a stage in its development at which several men make the epochal discovery at once. That the best-instructed of [p. 9] the public do not understand the condition ~~whose~~ [the] statement of which I have italicized above is shown by their often demanding that the 'scientists' should investigate this or that phenomenon not to ascertain whether it accords with established principles (which can always be done), but to discover what new secret it involves; and now and then we hear scientific men themselves acknowledge the reasonableness of such demand. Yet ~~that principle~~ [that the italicized statement] is true, several ~~eminent~~ [great] discoverers have virtually declared; and a much ~~better~~ stronger argument ~~of~~ for it, as not depending upon any fallible opinions is the frequency with which, in the history of science, epochal discoveries of the most astounding ~~character~~ [novelty] have been discovered simultaneously by ~~different~~ more men than one up to half a dozen. For this is an inevitable consequence of the italicized condition, which otherwise seems inexplicable. If the substance [p. 10] of my italicized sentence had merely been an ingenious hypothesis framed to account for the strange historical series of coincidences, the latter (as I shall show you later) would have furnished no support for belief in the former: but in point of fact it was quite the other way. The former was an induction by which my life-long intimacy with many scientific men had led me to believe that what I had remarked of my own quite hap-hazard competence to attack problems was true of men of science generally, — a belief that had some additional support. Still, though that induction was quite legitimate, I remarked two elements of weakness in it, first, that it was of that crude kind to which one ought not to trust exclusively when one can avoid doing so, and secondly that the observations had not been regularly recorded but had preserved only by a treacherous memory that [p. 11] in some cases had made but vague reports. I thought, therefore, that it might be that what my inductive theory required in some exceptional case might be clearly negatived by memory of the facts, which would at once refute the theory; and therefore, as my object was to ascertain the very truth of the matter, I tried to ~~find~~ think of a case which, according to the induction, ought to present some exceptional feature. With this view ~~considered how it would be with~~ [I determined to study out] what the theory would require in the case of a problem whose solution should involve some great novelty; for I had a vague inkling that the requirement of the theory in that case would be exceptional. What I ~~had in~~ looked forward to as possible was that the facts might ~~be~~ have no such exceptional character as the theory would require, and would thus refute the latter. I began by considering the case of a scientific man [p. 12, 20 November 1908] engaged upon a problem of a familiar kind. To fix my ideas I imagined the problem to be that of determining the atomic weight of tellurium

[a.p. 3, 18 November 1908] are neither a child nor a dullard, but are a normal adult of more than average intelligence.

As such, you are well aware that the exercise of control over one's own habits is perhaps the most important business of life, meaning by a habit an object whose being lies in an enduring state of a person which consists in ~~his acting~~ ~~the~~ [a] tendency to act, mentally or bodily, in certain ~~sort of~~ [general] way, whenever he has been acted on in a certain general ~~sort of~~ [general] way, regardless of how this tendency may have been established.

[a.p. 5, 18 November 1908] Everybody knows that persons are able to exercize some considerable control over their habits. Later we shall have occasion to consider in some measuer the *modus operandi* of this control. At present, we need only note that a review, or reminiscential repetition, of one's conduct upon a given occasion often excites a feeling of repulsion, and that this leads him to imagine behaviour governed by other general ideas, and finally he will imagine a line of conduct, or controlled behaviour, on the given occasion which excites a more intense feeling of attractions than any other that occurs to him; and ~~this behav he will repe~~ behaviour goverened by the same general idea as the behaviour that is most attractive to him will be copied in imagination in more or less varied forms all governed by the same general idea. Now, it is an important law of the soul that repeated performances ~~of~~ governed by one [a.p. 6] general idea ~~to give~~ impart a power to that idea ~~be~~ alike over imaginary and over real behaviour, and that whether the performances ~~are~~ repeated ~~in~~ [be] actual or ~~in~~ merely imaginary, although the influence of actual performance is generally more powerful, owing to a secondary cause. It follows, therefore, that in a mind ~~much given~~ which has a habit of reviewing ~~conduct~~ [behaviour], there will be a constant tendency toward the formation of habits which give rise to conduct that is 'approved' on reflexion, that is which excites a feeling of attraction. ~~This is~~ [I have thus] submitted to your criticism a very slight and poverty stricken sketch of a complex phenomenon that lies at the corner-stone of morality. There is one class of habits which, "from the nature of things", — as we say of what is true by logical necessity, — [end of the manuscript]

Notes

1 ["Give me where to stand and I will move the earth", a remark by Archimedes c.235 BC quoted by Pappus of Alexandria in *Synagoge* VIII, c.340 AD, Berlin: Hultsch, 1878, p. 1060. Cf. "Give me somewhere to stand and I will move the earth", *Great Mathematical Works* II, Ivor Thomas, Loeb Classical Library, Cambridge: Harvard University Press, 1941, p. 35.]