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The Classification of the Sciences and Cross-disciplinarity

"Experience of life has taught me that the only thing
that is really desirable without a reason for being so,
is to render ideas and things reasonable."
C. S. Peirce, *Science* 20 April 1900

In a world of ever growing specialization, the idea of a unity of science is commonly discarded as an impossible ideal. Nevertheless, cooperative work involving cross-disciplinary points of view is still encouraged, both as a remedy against the conceptual poverty of the scientific reductionism inherited from the Vienna Circle, and at the same time as a way of efficiently tackling the most stubborn problems facing our society today. Within this framework, the aim of my paper is to show —with some textual support— that Charles S. Peirce not only identified this paradoxical situation a century ago, but he also mapped out some paths for reaching a successful solution. I will pay particular attention to Peirce's classification of the sciences and to his conception of science as a collective and cooperative activity of all those whose lives are animated by the desire to discover the truth.

The choice of this topic has to do with my recent research into Peirce, but also with the special circumstances of this event: the twentieth anniversary of a relatively small Philosophy Department in the bosom of a strong technical University. Thinking about what Peirce might have said if he had had the chance of being here today, there came to my mind one of his comments in his review of the volume of the Clark University Decennial Celebration, which he had attended in July 1899. I have chosen three lines of that piece as the motto for this paper, and perhaps it is worthwhile to begin by quoting here a longer section of the paragraph in which those lines appear:

> For in my youth, I wrote some articles to uphold a doctrine I called Pragmatism, namely, that the meaning and essence of every conception lies in the application that is to be made of it. That is all very well, when properly understood. I do not intend to recant it. But the question arises, *what is* the ultimate application; at that time, I seem to have been inclined to subordinate the *conception* to the *act*, knowing to doing. Subsequent experience of life has taught me that the only thing that is really desirable without a reason for being so, is to render ideas and things reasonable. One cannot well demand a reason for reasonableness itself. Logical analysis shows that reasonableness consists in association, assimilation, generalization, the bringing of items together into an organic whole — which are so many ways of regarding what is essentially the same thing. In the emotional sphere, this tendency towards union appears as Love; so that the Law of Love and the Law of Reason are quite at one (Peirce 1900, 621).

It should be apparent now that the peculiar situation of this Department in a strong technical University could be considered —in a Peircean vein— as an ideal situation for philosophers to fulfill their calling. As all of you remember,

> (...) the second reason for studying laboratory-philosophy (...) is that the special sciences are obliged to take for granted a number of most important propositions, because their ways of working afford no means of bringing these propositions to the test. In short, they always rest upon metaphysics. (...) The philosopher alone is equipped with the facilities for examining such "axioms" and for determining the degree to which confidence may safely be reposed in them. (*CP* 1.129, c.1905).

But also, for Peirce science is a cross-disciplinary process in which communication —that is to say, love— produces new knowledge. I am convinced that the philosophers of this Department not only are persons intellectually equipped to engage in the process of overcoming specialization through the examination of the 'principles' of other sciences, but also from a practical point of view they have hearts big enough to build bridges between the different fields of research studied at this university.

In order to explain this, my paper will be divided into the three following sections: 1) Charles S. Peirce as a true scientist-philosopher; 2) The natural classification of sciences; and 3) Cross disciplinarity according to Peirce.

1. Charles S. Peirce, a true scientist-philosopher

First of all, I should state clearly that, although Peirce was a philosopher and a logician, he was first and foremost a real practitioner of science. Not only was he trained as a chemist at Harvard, but for thirty years (1861-91) he worked regularly and strenuously for the U. S. Coast Survey as a metrologist and as an observer in astronomy and geodesy. His reports to the Coast Survey are an outstanding testimony to his personal experience in the hard work of measuring and obtaining empirical evidence. A glance at his official reports to the Coast Survey or at his *Photometric Researches* produced in the years 1872-75 immediately confirms the impression of a man involved in solid scientific work (*W* 3, 382-493). As Max Fisch points out, "Peirce was not merely a philosopher or a logician who had read up on science. He was a full-fledged professional scientist, who carried into all his work the concerns of the philosopher and logician" (Fisch 1993, *W* 3, xxviii-xxix). I agree with Victor Lenzen that "Peirce's scientific work is relevant to his philosophy, for his philosophical doctrines indicate the influence of his reflective thought upon the methods of science" (Lenzen 1964, 33).

Throughout all his life, but especially in his later years, Peirce insisted that the popular image of science as something finished and complete is totally opposite to what science really is, at least in its original practical intent. That which constitutes science "is not so much correct conclusions, as it is a correct method. But the method of science is itself a scientific result. It did not spring out of the brain of a beginner: it was a historic attainment and a scientific achievement" (*CP* 6.428, 1893). Scientific growth is not only the accumulation of data, of registrations, measurements or experiences, but also requires creativity. To learn the truth requires not only collecting data, but also abduction, the adoption of a hypothesis to explain surprising facts, and the deduction of probable consequences which are expected to verify the hypotheses (*CP* 7.202, 1901). Abduction consists —Peirce writes to Calderoni— in "examining a mass of facts and in allowing these facts to suggest a theory" (*CP* 8.209, 1905). Though the scientist is invariably a person who has become deeply impressed with the efficacy of minute and thorough observations, he or she knows that

observing is never enough: "Science, then, may be defined as the business whose ultimate aim is to educe the truth by means of close observation" (*HP* 1123, 1898).

Science is for Peirce "a living historic entity" (*CP* 1.44, c.1896), "a living and growing body of truth" (*CP* 6.428, 1893). Already in his early years, in "*Some Consequences of Four Incapacities"* (1868), Peirce identified the community of inquirers as essential to scientific rationality (*CP* 5.311, 1868). The flourishing of scientific reason can only take place in the context of research communities: the pursuit of truth is a corporate task and not an individual search for foundations.

Here are two beautiful texts by the mature Peirce which define what a science is. The first one is from a 1902 manuscript on the classification of the sciences (*MS* 1343, pp. 6-7, 1902):

> Science is to mean for us a mode of life whose single animating purpose is to find out the real truth, which pursues this purpose by a well-considered method, founded on thorough acquaintance with such scientific results already ascertained by others as may be available, and which seeks cooperation in the hope that the truth may be found, if not by any of the actual inquirers, yet ultimately by those who come after them and who shall make use of their results (also in *CP* 7.55, 1902).

The second text comes from the manuscript of the Adirondack Summer School Lectures and deserves to be quoted a length:

> But what I mean by a "science", both for the purpose of this classification and in general, is the life devoted to the pursuit of truth according to the best known methods on the part of a group of men who understand one another's ideas and works as no outsider can. It is not what they have already found out which makes their business a science; it is that they are pursuing a branch of truth according, I will not say, to the best methods, but according to the best methods that are known at the time. I do not call the solitary studies of a single man a science. It is only when a group of men, more or less in intercommunication, are aiding and stimulating one another by their understanding of a particular group of studies as outsiders cannot understand them, that I call their life a science. It is not necessary that they should all be at work upon the same problem, or that all should be fully acquainted with all that it is needful for another of them to know; but their studies must be so closely allied that any one of them could take up the problem of any other after some months of special preparation and that each should understand pretty minutely what it is that each one of the other's work consists in; so that any two of them meeting together shall be thoroughly conversant with each other's ideas and the language he talks and should feel each other to be brethren. In particular, one thing which commonly unites them is their common skill not possessed by outsiders in the use of certain instruments and their common skill in performing certain kinds of work (*MS* 1334, pp. 11-14, 1905).

Having done research in astronomy, mathematics, logic and philosophy and in the history of all these sciences, in spite of their very different professional labels, Peirce tried to uncover the links between the various kinds of scientific inquiry. Unfortunately methodology, the "branch of logic which teaches the general principles which ought to guide an inquiry" (Baldwin 1901, 75), has been the Cinderella of logic in the past century. To make things worse, his study of scientific methodology has often been pigeon-holed under the general title of "Classification of the Sciences", which is usually considered to be the disreputable domain of librarians or academic administrators. Nevertheless, a closer study of Peirce's classification of the sciences, and of the cooperation between them, shows him to be a forerunner of contemporary cross-disciplinarity.

2. The natural classification of the sciences

Peirce carefully studied upwards of a hundred different classifications of the sciences and made many attempts to work out his own general classification of the sciences, as so many branches and subbranches of a tree, springing out of one another (*CTN* 3, 217, 1905; *L* 75, 1902; *HP* 805, 1904 and 1124, 1899). Although he supported Auguste Comte's view of each science as a historical development, he disliked Comte's metaphor of sciences forming "a sort of ladder descending into the well of truth, each one leading on to another, those which are more concrete and special drawing their principles from those which are more abstract and general" (*CP* 2.119, c.1902; cf. *MS* 1334, 1905). The image of an epistemic ladder of sciences (*CP* 1.180ff; Kent 1987, 71-72) suggested reductionistic tendencies similar to those of the twentieth-century positivist philosophers of science.

Peirce preferred a *natural* classification of the sciences, that is, one which embodies "the chief facts of relationships between the sciences so far as they present themselves to scientific and observational study" (*MS* 1334, 1905):

> My notion is that what we call 'natural classification' is, from the nature of things limited to natural objects. Now the vast majority of classifications of the sciences are classifications of *possible* sciences, which are certainly not natural objects. What is a science as a natural object? It is the actual living occupation of an actual group of living men. It is in that sense only that I presume to attempt any classification of the sciences (*MS* 1334, 1905).

"A particular branch of science, such as Physical Chemistry or Mediterranean Archeology, is no mere word, manufactured by the arbitrary definition of some academic pedant, but is a real object, being the very concrete life of a social group constituted by real facts of interrelation." (*CP* 1.52, c.1896). Thus, a natural classification must exhibit the living relations between the different branches of the tree of knowledge, between the different traditions of inquiry, usually arranged around their special modes of observation. Following Peirce, "sciences must be classified according to the peculiar means of observation they employ" (*CP* 1.101, c.1896), because each community of scientists grows up around specific ways of perceiving, certain special methods of research. Each science corresponds then to a special kind of observation which distinguishes the mode of thought of the students of each special branch (*CP* 1.100, c.1896). The scientists are

> [m]en who spend their lives in finding out similar kinds of truth about similar things understand what one another are about better than outsiders do. They are all familiar with words which others do not know the exact meaning of, they appreciate each other's difficulties and consult one another about them. They love the same sort of things. They consort together and consider one another as brethren. They are said to pursue the same *branch* of science (*HP* 804-5, 1904).

I will not go into the details of Peirce's classification of sciences. It has been well studied by, for instance, Beverley Kent (1987), Helmut Pape (1993), Kelly Parker (1998), and most recently Tommi Vehkavaara (2003), who has compiled on the web a collection of successive versions of Peirce's classifications. Nevertheless, I want to stress that the texts I have selected are strikingly relevant to our contemporary views regarding the nature of science, because they shift the emphasis of the discussion from the view of sciences as objects to be classified towards the lives of real men and women involved in scientific research. Indeed, in Peirce's view, the sciences of discovery are to be identified with the lives of their practitioners. To illustrate this point, I need to quote another long text, also from the Adirondack Summer School Lectures:

> All human lives separate themselves and segregate themselves into three grand groups whose member understand one another in a general way, but can['t] for the life of them understand sympathetically the pursuits and aims of the others. The first group consists of the devotees of enjoyment who devote themselves to carving their bread and eating as fine bread as they can and who seek the higher enjoyments of themselves and their fellows. This is the largest and most necessary class. The second group despises such a life and cannot fully understand it. Their notion of life is to accomplish results. They build up great concerns, they go into politics (...) This group makes civilization. The men of the third group who are comparatively few cannot conceive at all a life for enjoyment and look down upon a life of action. Their purpose is to worship God in the development of ideas and of truth. These are the men of sciences (*MS* 1334, pp. 11-14, 1905).

The text continues with the division of men of science according to their different conceptions of the purpose of science. In this context, Peirce distinguishes the Practical Sciences from the Sciences of Review, and then adds a third group which he calls the *heuretics* or *heurospudists*. These are the men who endeavor to discover, and who "look upon discovery as making acquaintance with God and as the very purpose for which the human race was created" (*MS* 1334, p. 20, 1905). This may sound a little strange to our positivist modern ears, but as Kelly Parker has stressed, understanding the continuity of Peirce's thought requires dealing with Peirce's religious concerns; it seems probable to me that they are as philosophically important as his scientific concerns (Parker 1998, 231 n. 5).

Coming back to my point, I want to recall also how in his Carnegie application of 1902, Peirce writes that his natural classification of the sciences will be guided by "how scientists associate themselves into societies and what contributions are commonly admitted into one journal" (*L* 75). In sum, for Peirce sciences are living entities constituted by persons interested in the same things. Sciences are living communities of research.

3. Cross-disciplinarity

As we have seen, Peirce defined science as a diligent inquiry into truth for truth's sake, developed by a community of inquirers skilled in the manipulation of particular instruments, and trained in certain ways of perceiving or particular modes of thought. Sciences are traditions of research which have developed in both time and space. For him, "science does not advance by revolutions, warfare, and cataclysms, but by cooperation, by each researcher's taking advantage of his predecessors' achievements, and by his joining his own work in one continuous piece to that already done" (*CP* 2.157, c.1902). Science is a way of life, a craft handed down from masters to apprentices.

For this reason, the key to the advancement of knowledge and to the development of sciences is not revolution, but communication. Communication between the members of a science community is essential for scrutinizing the evidence and the results achieved in research. There is no algorithm no routine or unfailing method— for discovering the truth or knowing for sure when you have it. Thus, truth and knowledge —at least in the hard sciences— are located at the level of the scientific community rather than the individual inquirer (Ransdell 1998, 2). More specifically, Peirce clearly asserts that the scientific community, far from being an assembly or a parliament whose members fight each other with fierce arguments, should be more like a family. "A given science with a special name, a special journal, a special society, studying one group of facts, whose students understand one another in a general way and naturally associate together, forms what I call a family" (*CP* 1.238, c.1902). A scientific community is always —or at least should be, according

to Peirce— an affective community. In this respect, actual scientific practice is unfortunately quite different.

A second point of interest is the encouragement of cross-disciplinarity between sciences: "One of the most salient phenomena of the life of science is that of a student of one subject getting aid from students of other subjects" (*HP* 805, 1904). It is not only that "the higher places in science in the coming years are for those who succeed in adapting the methods of one science to the investigation of another. That is what the greatest progress of the passing generation has consisted in" (*CP* 7.66, 1882), but that new knowledge is generated wherever communication between different branches of science is enhanced.

Peirce provides an impressive amount of historical evidence. He provides an account of the cooperation between the earth sciences, astronomy and the so-called "physics of the globe" (which establishes the relative position of the elements of our planet); of the help that comes to linguistics from phonetics and from acoustics; of the historian regulating his chronology to confirm the information furnished by the astronomer, learning distances and other spatial relations from the geographer, and so on (*HP* 805-6, 1904). Of course, cross-disciplinarity can adopt several different forms:

> By far the most ordinary way in which one science extends a service to another is by furnishing it with a new fact which the aided science treats as if it were a direct observation. (...) the science which receives that fact, when it has performed its generalization of the fact, will return to the science which furnished that fact an explanation of it (*HP* 809, 1904).

Peirce also stresses the importance of

> the dynamical relations between the different sciences, by which I mean that one often acts upon another, not by bringing forward any reason or principle, but as it were with a compulsive quality of action. Thus one group may stimulate another by demanding the solution of some problem. In this way, the practical sciences incessantly egg on researches into theory (*CP* 7.52, n.d.).

But is it possible to establish genuinely communicative relations between disciplines? Peirce's texts sometimes seem to suggest a negative answer: "The men who pursue a given branch herd together. They understand one another; they live in the same world, while those who pursue another branch are for them foreigners" (*CP* 1.99, c.1896). In the following paragraph he makes a similar point:

> It will be found upon close examination that that which renders the modes of thought of the students of a special branch of science peculiar is that their experience lies in a peculiar region. And the cause of this is that they are trained and equipped to make a peculiar kind of observations. The man who is continually making chemical analyses lives in a different region of nature from other men. The same thing is even more true of men who are constantly using a microscope. (*CP* 1.100, c.1896)

My suggestion is that in a Peircean vein philosophy, pursued in the spirit of the laboratory, is precisely the tradition of research which can build bridges across disciplines. In contrast to science, which grows upon special experience, philosophy is "that science which limits itself to finding out what it can from ordinary everyday experience, without making any special observations" (*HP* 825, 1904). While special sciences grow in laboratories or in very sophisticated contexts of research, the laboratory of the philosophers is our ordinary experience, our real lives even in academic environments.

> The kind of philosophy which interests me and must, I think, interest everybody is that philosophy, which uses the most rational methods it can devise, for finding out the little that can as yet be found out about the universe of mind and matter from those observations which every person can make in every hour of his waking life. (...) (*CP* 1.126, c.1905)

> If anybody asks what there is in the study of obvious phenomena to make it particularly interesting, I will give two answers. (...) The first answer is that the spirit in which, as it seems to me, philosophy ought to be studied is the spirit in which every branch of science ought to be studied; namely, the spirit of joy in learning ourselves and in making others acquainted with the glories of God. Each person will feel this joy most in the particular branch of science to which his faculties are best adapted. It is not a sin to have no taste for philosophy as I define philosophy. As a matter of fact, however, almost everybody does feel an interest in philosophical problems, especially at that time of life at which he is spoiling for an intellectual tussle. (*CP* 1.127, c.1905).

From a Peircean perspective, communication between the branches of science is the effect of the efforts of a real community of human beings trying to share their discoveries. It involves the commitment of each scientist to be a kind of philosopher avid to learn from the other branches and, while reflecting upon the peculiar experience around which his or her own branch has grown, also trying to make sense of the entire tree of knowledge.

For this reason, we philosophers are in a better position to call for the unity of sciences, but this call should not be seen as a return to the old scientism, for instance that of Neurath's failed attempt at an *International Encyclopedia of Unified Science*. The unity of science is not achieved by the reduction of special sciences to more basic ones. The new name for the unity of the sciences is cross-disciplinarity; not the union of the sciences themselves, but rather the unity of the scientists, the real inquirers into the truth. The key to cross-disciplinarity of knowledge is not revolution, but rather sharing efforts in a unique mixture of continuity and fallibilism, of affection and reason, of the attempt to understand others as well as oneself, by putting oneself in the shoes of others and walking several miles with them.

4. By way of conclusion

Not only is philosophy classified by Peirce as a science of discovery, but also universities are considered by him as the places where the process of sharing knowledge can be developed. "The university which is to be the exponent of the living condition of the human mind, must be the university of methods." (*HP* 941, 1882). "I do not need to be told that science consists of specialties. I know all that", Peirce writes, but a scientist "needs to be more than a mere specialist; he needs such a general training of his mind, and such a knowledge as shall show him how to make his powers most effective in a new direction. That knowledge is logic." (*HP* 943, 1882).

The joyful reality of this Department of Philosophy celebrating its twentieth fruitful anniversary in the bosom of a large technically-oriented university, gives a glimpse of how logic, understood in a Peircean style, can build a real cross-disciplinary community of research. "The Law of Love and the Law of Reason are quite at one" (Peirce 1900, 621).

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NOTE

I would like to thank Rosa Mayorga for her kind invitation to take part in the Spring Conference on the occasion of the twentieth anniversary of the Virginia Tech Philosophy Department. I have kept the oral style of the presentation to make the paper more readable. I rely upon what I have previously written on this issue, especially my "A Task of Love: Cross-disciplinarity According to Peirce", presented at the *SAAP Meeting 2000, Indianapolis* and "The Law of Reason and the Law of Love" (G. Debrock 2003, 39-49).

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CTN Peirce, Charles S. *Contributions to 'The Nation'*, vols. 1-4, K. L. Ketner y J. E. Cook (eds.). Lubbock, TX: Texas Tech Press 1975-1979.

HP Eisele, Carolyn (ed.). *Historical Perspectives on Peirce's Logic of Science: A History of Science*, vols. 1-2. Berlin: Mouton 1985.

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MS *The Charles S. Peirce Papers* 32 microfilm reels of the manuscripts kept in the Houghton Library. Cambridge: Harvard University Library, Photographic Service 1966.

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