

Il Lume Naturale: Abduction and God

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"Of nobody was it ever truer than of Galileo that the style is the man."
C. S. Peirce, *CN* 2: 191 (1899)

The relatively scant attention paid in scholarship throughout the years to the religious dimensions of Peirce's thought has always seemed to me to be at least surprising. Since my first readings of Peirce I have been deeply struck by this neglect that contrasted so much with the ubiquity of religious references in his writings, especially in his mature years. In my meetings with well known Peirce scholars I used to ask them about God and religion in Peirce, and mostly the answer that I received was plainly that there was a lot of religious stuff in Peirce, but that they were not interested in it.

The aim of my paper is to highlight that for Peirce the reality of God makes sense of the whole scientific enterprise. The belief in God is a natural product of abduction, of the "rational instinct" or educated guess of the scientist or the layman, and also the abduction of God may be understood as a "proof" of pragmatism. Moreover, I want to suggest that for Peirce scientific activity is a genuine religious enterprise, perhaps even *the* religious activity *par excellence*, and that to divorce religion from science is antithetical to both the scientific spirit and the real Peirce. As most of you well know, Peirce in his mature years is championing a true *religion of science*:

Such a state of mind may properly be called a religion of science. Not that it is a religion to which science or the scientific spirit has itself given birth; for religion, in the proper sense of the term, can arise from nothing but the religious sensibility. But it is a religion, so true to itself, that it becomes animated by the scientific spirit, confident that all the conquests of science will be triumphs of its own, and accepting all the results of science, as scientific men themselves accept them, as steps toward the truth, which may appear for a time to be in conflict with other truths, but which in such cases merely await adjustments which time is sure to effect. This attitude, be it observed, is one which religion will assume not at the dictate of science, still less by way of a compromise, but simply and solely out of a bolder confidence in herself and in her own destiny. (*CP* 6.433, "The Marriage of Religion and Science", 1893)

All of this may sound a little strange to our positivistic ears, but understanding the real Peirce requires to deal with his religious concerns, which are increasingly recognized as being

¹ I want to give thanks to Giovanni Maddalena for his kind invitation to take part in the Conference "Segni e realtà. Charles S. Peirce nel dibattito filosofico attuale". In my paper I rely heavily upon what I have learnt from the research of my students, Sara F. Barrena, who did the first translation of *A Neglected Argument for the Reality of God* into Spanish and published it with a long introduction dealing in detail with the subject; Gonzalo Génova, who wrote his dissertation on abduction and Peirce's logic of discovery, available on the web (<http://www.unav.es/gep/Genova/cua45.html>), and Rolando Panesa, who wrote a doctoral dissertation on *Science and Religion in Charles S. Peirce* (1996). My present text is partially based on my oral presentation in the Symposium on the Religious Writings of Charles S. Peirce, held at Denver on March, 16-17, 2003.

perhaps as philosophically important as his scientific concerns (Parker 1998, 231 n. 5). Since a key notion in this project is the idea of "*il lume naturale*" that Peirce borrowed from Galileo, I want also to pay attention to that expression which during years I have been following through Peirce's papers and books.

In order to try to explain some of this, my paper is arranged into four brief sections after this already long introduction: 1) God and scientific inquiry; 2) The belief in God as a product of abduction; 3) Galileo and Peirce: *Il lume naturale*; and by way of conclusion 4) Some remarks on the religious framework of Peirce's approach. I will try to collect some of Peirce's texts and to quote them extensively.

1. God and scientific inquiry

First of all, it seems to me that it is useful to state clearly that, though 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 real 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).

Peirce conceived scientific inquiry as a collective and co-operative activity of all those "who are devoured by a desire to find things out" (*CP* 1.8, c.1897), of all those whose lives are animated by "the sincere desire to find out the truth, whatever it may be" (*CP* 5.84, 1903). Science is for Peirce "a living historic entity" (*CP* 1.44, c.1896), "a living and growing body of truth" (*CP* 6.428, 1893). Throughout his life, but especially in his later years, Peirce insisted that the commonly perceived image of science as something finished and complete, is totally opposite to what science really is at least in its original practical intent. In this sense, what appears to the outsider as the most solid aspect of science is seen by its practitioners as its weakest part. The brilliant hypotheses that impress the layman are seen by the trained people as no more than educated guesses which are natural to them as flying and nest-building is to ordinary birds (*CP* 6.476, 1908).

What 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. Though the scientist is invariably a man who has become deeply impressed with the efficacy of minute and thorough observations, he knows that observing is never enough: his "ultimate aim is to educe the truth" (*HP* 1123, 1898). To learn the truth requires not only collecting data, but abduction, the adoption of a hypothesis to explain the surprising facts, and the deduction of probable consequences which are expected to verify his 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).

In 1987, Kenneth L. Ketner chose a really suggestive fragment of Peirce's 1905 Adirondack Summer School Lectures (*MS 1334*)—until then almost totally unknown—to present Peirce's conception of science in the volume of John J. Stuhr *Classical American Philosophy*. Ketner gave to that fragment the title of "The Nature of Science" and in it, after offering a classification of the sciences and the groups of men, Peirce presents the purpose of the life of the men of science—"who are comparatively few [and who] cannot conceive at all a life for enjoyment and look down upon a life of action"—as "to worship God in the development of ideas and of truth" (*MS 1334*, 11-14, 1905; Stuhr 1987, 47).

This text provides textual evidence that the mature Peirce considered scientific inquiry as a kind of religious work. For Peirce the *heuretics* or *heurospudists* [from *euriskw*, "to discover", and *spoudaiw*, "diligent"] are the scientists 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". The text deserves a longer quotation:

the *heurospudists* look upon discovery as making acquaintance with God and as the very purpose for which the human race was created. Indeed as the very purpose of God in creating the world at all. [...] when I say that *God is*, I mean that the conception of a God is the highest flight toward an understanding of the original of the whole physico-psychical universe that we can make. It has the advantage over the agnostics and other views of offering to our apprehension an object to be loved. Now the *heurospudist* has an imperative need of finding in nature an object to love. His science cannot subsist without it. For science to him must be worship in order not to fall down before the feet of some idol of human workmanship. Remember that the human race is but an ephemeral thing. In a little while it will be altogether done with and cast aside. Even now is merely dominant on one small planet of one insignificant star, while all that our sight embraces on a starry night is to the universe far less than a single cell of the brain is to the whole man. (*MS 1334*, 20, 1905).

This text is deeply impressive, in particular when one realizes the huge number of hours of his life that Peirce invested in long nights looking patiently at the stars and taking careful notes of his measurements.

2. The belief in God as a product of abduction

In the last years of his life in Milford, PA, Peirce is looking backwards and is trying in his writings to make sense of his life, of his great experience as a scientist, of his excellent knowledge of the history of philosophy and logic, and also of the vitally important topics of life, in particular the belief in God. Let me quote him again, now from "Answers to Questions Concerning My Belief in God" (1906):

I have often occasion to walk at night, for about a mile, over an entirely untravelled road, much of it between open fields without a house in sight. The circumstances are not favorable to severe study, but are so to calm meditation. If the sky is clear, I look at the stars in the silence, thinking how each successive increase in the aperture of a telescope makes many more of them visible than all that had been visible before. (...) Let a man drink in such thoughts as come to him in contemplating the physico-psychical universe without any special purpose of his own; especially the universe of mind which coincides with the universe of matter. The idea of there being a God over it all of course will be often suggested; and the more he considers it, the more he will be enwrapt with Love of this idea. He will ask himself whether or not there really is a God. If he allows instinct to speak, and searches his own heart, he will at length find that he cannot help believing it (*CP 6.501*, c1906)

This is the soil out of which Peirce's paper "A Neglected Argument for the Reality of God" (1908) grew. I think it is not far from the truth to consider this paper to be the keystone of the arch of his life (cf. *CP* 8.257), which articulates "Peirce's ongoing dual interests in the practice of religion and the thinking of science, logic and philosophy" (Anderson 1995, 137). As Anderson writes, "the more time one spends with C. S. Peirce 'A Neglected Argument for the Reality of God,' the more one realizes that there are few essays in the American tradition than can match its richness" (Anderson 1990, 349). I cannot hope to develop a thorough analysis of this text here, but rather only to describe—in this and the following section—two significant aspects of it.

For Peirce the belief in the reality of God is a natural product of abduction, or educated guess of the scientist or the layman:

in the Pure Play of Musement the idea of God's Reality will be sure sooner or later to be found an attractive fancy, which the Muser will develop in various ways. The more he ponders it, the more it will find response in every part of his mind, for its beauty, for its supplying an ideal of life, and for its thoroughly satisfactory explanation of his whole threefold environment. (*CP* 6.465, 1908)

The spontaneous discovery of the idea of God's Reality that appears in the activity of Musement is the "Humble Argument", and it is the first step for the argument really neglected by theologians, which consists of

showing that the humble argument is the *natural* fruit of free meditation since every heart will be ravished by the beauty and adorability of the Idea, when it is so pursued. Were the theologians able to perceive the force of this argument, they would make it such a presentation of *universal human nature as to show that a latent tendency toward belief in God is a fundamental ingredient of the soul*, and that, far from being a vicious or superstitious ingredient, it is simply *the natural precipitate of meditation* upon the origin of the Three Universes." (My italics. *CP* 6.487, 1910).

We are now at the heart of the argument. The key is the peculiar affinity between mind and matter. The Neglected Argument presupposes that certain kinds of human mental activity can be identified as "natural", and that "natural" beliefs are especially plausible (Behrens 1995, 203). For Peirce abduction is the expression of a "rational instinct" (Ayim 1974) and "every plank of its advance is first laid by Retroduction alone, that is to say, by the spontaneous conjectures of instinctive reason" (*CP* 6.475, 1908). Science itself is a development of natural instincts: "My long investigation of the logical process of scientific reasoning led me many years ago to the conclusion that science is nothing but a development of our natural instincts" (*CP* 6.604, 1891).

The central question at the heart of the scientific enterprise is precisely why we abduce correctly and easily in a relative few number of attempts? Why this instinct of guessing right is so efficient? This question appears once and again in Peirce's texts. Let me quote only one of the most well-known passages:

A man must be downright crazy to deny that science has made many true discoveries. But every single item of scientific theory which stands established today has been due to Abduction. But how is it that all this truth has ever been lit up by a process in which there is no compulsiveness nor tendency toward compulsiveness? Is it by chance? Consider the multitude of theories that might have been suggested. A physicist comes across some new phenomenon in his laboratory. How does he know but the conjunctions of the planets have

something to do with it or that it is not perhaps because the dowager empress of China has at that same time a year ago chanced to pronounce some word of mystical power or some invisible jinnee may be present. Think of what trillions of trillions of hypotheses might be made of which one only is true; and yet after two or three or at the very most a dozen guesses, the physicist hits pretty nearly on the correct hypothesis. By chance he would not have been likely to do so in the whole time that has elapsed since the earth was solidified. (CP 5.172, 1903)

For Peirce the explanation of this surprising phenomenon of the human ability to choose easily and rightly between those innumerable hypotheses lies in "that man's mind must have been attuned to the truth of things in order to discover what he has discovered. It is the very bedrock of logical truth" (CP 6.476, 1908). Peirce appeals in the Neglected Argument to *il lume naturale* —saying expressly that he is borrowing the term from Galileo— in order to explain this surprising ability to guess the right answer in a relative few number of attempts. Let us revise this with more detail.

3. Galileo and Peirce: *Il lume naturale*

The first time I paid attention to Peirce's usage of Galileo's expression "*il lume naturale*" was ten years ago when my student Sara Barrena translated into Spanish Peirce's "A Neglected Argument for the Reality of God" (1908). Let me quote the paragraph 6.477

Modern science has been builded after the model of Galileo, who founded it, on *il lume naturale*. That truly inspired prophet had said that, of two hypotheses, the simpler is to be preferred;* but I was formerly one of those who, in our dull self-conceit fancying ourselves more sly than he, twisted the maxim to mean the logically simpler, the one that adds the least to what has been observed, in spite of three obvious objections: first, that so there was no support for any hypothesis; secondly, that by the same token we ought to content ourselves with simply formulating the special observations actually made; and thirdly, that every advance of science that further opens the truth to our view discloses a world of unexpected complications. It was not until long experience forced me to realize that subsequent discoveries were every time showing I had been wrong, while those who understood the maxim as Galileo had done, early unlocked the secret, that the scales fell from my eyes and my mind awoke to the broad and flaming daylight that *it is the simpler Hypothesis in the sense of the more facile and natural, the one that instinct suggests, that must be preferred; for the reason that, unless man have a natural bent in accordance with nature's, he has no chance of understanding nature at all.* [my italics].

The text is clear, but what intrigued me in a first moment was the source of Galileo that the editors of the *Collected Papers* put in a footnote:

*See "Dialogues Concerning the Two Great Systems of the World," in *Mathematical Collections and Translations* of Thomas Salisbury, vol. 1. p. 301, London (1661).

That old edition was not in my library, but I looked in *I Due Massimi Sistemi del Mondo* in the seventh volume of the Firenze edition of *Le Opere di Galileo Galilei*, and I was totally unable to find there that expression of "*il lume naturale*". This surprised me a lot, and I started a search that has not yet finished. Years later I was able to check Salisbury's book of 1661 in the Houghton Library (there are three copies of volume 1 there, but none of volume 2 because most of the copies "were destroyed in the great fire of London", the catalogue

explains). One of them has the old seal of "Harvard College Library", and probably it was the copy used by the editors of the *Collected Papers* to prepare that footnote, but in the page 301 there was nothing clearly related with "*il lume naturale*".

In fact, it took me some time to learn that the phrase "*il lume naturale*" was rarely used by Galileo, and also that translators of Galileo have sometimes misrepresented it rendering for instance as "my good sense". The exception is William Wallace, who in his *Galileo's Logic of Discovery and Proof* establishes with clarity the history and scope of Galileo's notion of *lume naturale* throughout his career (Wallace 1992, 40, 45-6, 89, 91).

Three years ago, not without emotion, I discovered Peirce's copy of the fifteen volume edition of *Le Opere di Galileo Galilei*, that had been lost in the Robbins Library during years. On the left side of page 164 of volume XIII *Dialoghi delle Nuove Scienze* there is a pencil line a few lines below of one of the few occurrences of "*il lume naturale*" throughout all the volumes. When I informed Nathan Houser of my "discovery" he put me in touch with the geologist Victor Baker who has studied carefully the links between Peirce and Galileo in relation with that expression (Baker 1996, 75-80).

Contrary to Galileo, Peirce uses "*il lume naturale*" very often (for instance, *CP* 1.80, c.1896; 6.10, 1891; 6.567, 1905; *RLT* 111, 176, 1898). Peirce is not interested in Galileo's expression, but in Galileo's scientific practice. Peirce found in Galileo's first steps in an investigation "the cornerstone of his own epistemology" (Eisele 1979, 169):

A modern physicist on examining Galileo's works is surprised to find how little experiment had to do with the establishment of the foundations of mechanics. His principal appeal is to common sense and *il lume naturale*. He always assumes that the true theory will be found to be a simple and natural one." (*CP* 6.10, 1891)

Peirce assumed that Galileo in his researches first postulates the existence of a natural law, and later tries to ascertain what it was. In all of his writings one finds Peirce referring to the Galilean appeal to *il lume naturale*, "identifying Galileo's belief with his own. And that was that man's intellect, though very fallible in many respects, contains a revelation of divine truth, especially in mechanics" (Eisele 1979, 173).

This comment from Carolyn Eisele brings us naturally back to the main line of my exposition. In the long paragraph quoted above from "A Neglected Argument" Peirce describes two types of simplicity. The first one, logical simplicity, moves to identify the simpler hypothesis as the one that adds the least to what has been observed. On the contrary, according to Peirce the genuine Galilean type of simplicity means that the hypothesis to be preferred is the one more *natural or facile*, the one that instinct suggests.

That instinct is "*il lume naturale*", the natural light that has little to do with logical simplicity, but with affinity between mind and nature:

In this way, general considerations concerning the universe, strictly philosophical considerations, all but demonstrate that if the universe conforms, with any approach to accuracy, to certain highly pervasive laws, and if man's mind has been developed under the influence of those laws, it is to be expected that he should have a natural light, or light of nature, or instinctive insight, or genius, tending to make him guess those laws aright, or nearly aright (*CP* 5.604, 1903)

Peirce firmly believes that human mind has "a natural bent in accordance with nature's" (*CP* 6.477, 1908), but this naturalism is not the usual form of that doctrine (Baker 1996, 76): it does not exclude God, on the contrary it is the best "proof" of God's reality. For Peirce the hypothesis of the reality of God has a *natural* simplicity to the highest degree (Pence 1997).

It is important to realize that this does not mean that when doing science God illuminates mystically human minds through grace or inspiration, but on the contrary that human being is naturally oriented to perceive the lessons which God, through the three Universes of experience, is continually teaching (Smith 1979, 415; *CP* 2.769, 1905). In Peirce's view, the creatural nature of matter and the continuity between matter and mind explain the surprising success of the sciences.

In my view, here is the place to look for the real "proof" ("an argument which suffices to remove all real doubt from a mind that apprehends it", *CP* 2.782, 1902) of pragmatism (cf. Robin 1997, Roberts, 1978). It is a "Big Abduction" that might be put in the following terms according to the pattern of abduction of *CP* 5.189, 1903:

The efficiency of the scientist (guessing right between innumerable hypotheses) is a really surprising fact

If God were the creator of human cognitive abilities and of nature this efficiency would be a matter of course

Hence, there is reason to suspect that God is the creator of human minds and nature

In this sense I am suggesting that for Peirce the best sign of the reality of God is not only the capacity of that belief to change the conduct of the believer (cf. Raposa 1989, 133), but the surprising efficiency of our scientific enterprise, which would be totally improbable by mere chance: it requires God's creation as the common source of knower and known, that is, it requires "the ancient hypothesis that man has been made in the image of his Maker, so far as his Reason goes" (*CP* 2.22, 1902).

4. Final remarks on the religious framework of Peirce's approach

I want to make very briefly two final remarks. The first one is to recall that Peirce learnt this frame of mind from his father Benjamin, which brings also to our memory the "Grand Book of Nature" of Galileo:

The divine image, photographed upon the soul of man from the centre of light, is everywhere reflected from the works of creation. (...) 'In the beginning God created the heavens and the earth.' Without this treasure of faith, the omnipresent ideality of science terminates in an impoverished and powerless pantheism. With it, the observed ideality is the divine thought, and the book of Nature is the divine record." (Benjamin Peirce 1881, 31 and 36).

This was the common belief amongst Unitarians of the time (Hookway 1985, 4-5, Kuklick 1977, 6-7) and —it is my second final remark— it is also the framework of Roman Catholic approach to the relations between science and religion, reason and faith. In this sense, it may be said that Peirce's framework is closer and more congenial than expected to the Roman Catholic tradition. One last quotation,

The day has come, however, when the man whom religious experience most devoutly moves can recognize the state of the case. While adhering to the essence of religion, and so far as possible to the church, which is all but essential, say, penessential, to it, he will cast aside that religious timidity that is forever prompting the church to recoil from the paths into which the Governor of history is leading the minds of men, a cowardice that has stood through the ages as the landmark and limit of her little faith, and will gladly go forward, sure that truth is not split into two warring doctrines, and that any change that knowledge can work in his faith can only affect its expression, but not the deep mystery expressed. (CP 6.432, 1892)

This text from Peirce is finely attuned with the teachings of the Second Vatican Council (*Gaudium et Spes* 36, 2), the *Catechism* (1992, n. 159) and the important document of John Paul II *Fides et ratio* (1998). For this reason, I was pleasantly surprised by Walker Percy when in his correspondence with Ken Ketner he considered himself as "a thief of Peirce", intending "to use CSP as one of the pillars of a Christian apologetic" (Samway 1995, 130). It seems to me that Percy was in some sense nearer to the real Peirce than those scholars whom I had asked about God and religion in Peirce.

Bibliographic references

- Anderson, D. *Creativity and the Philosophy of C. S. Peirce*. Dordrecht: Nijhoff 1987.
- Anderson, D. "Three Appeals in Peirce's Neglected Argument", *Transactions of the Charles S. Peirce Society* 26 (1990), 349-362.
- Anderson, D. *Strands of System. The Philosophy of Charles Peirce*. West Lafayette, IN: Purdue University Press 1995.
- Ayim, M. "Retroduction: The Rational Instinct", *Transactions of the Charles S. Peirce Society* 10 (1974), 34-43.
- Baker, V. "Hypotheses and Geomorphological Reasoning", in B. L. Rhoads and C. E. Thorn (eds.), *The Scientific Nature of Geomorphology*, New York: Wiley 1996, 57-85.
- Barrena, S. F. "Introducción", in Charles S. Peirce, *Un argumento olvidado en favor de la realidad de Dios*, Cuadernos de Anuario Filosófico, nº 34, Pamplona, 1996, 9-65.
- Behrens, G. "Peirce's 'Third Argument' for the Reality of God and Its Relation to Scientific Inquiry", *Journal of Religion* 75 (1995), 200-218.
- Bonfantini, M. A. and A. Martone (eds.), *Peirce in Italia*, Napoles: Liguori 1993.
- Eisele, C. "The Influence of Galileo on Peirce", in R. M. Martin (ed.), *Studies in the Scientific and Mathematical Philosophy of Charles S. Peirce. Essays by Carolyn Eisele*, The Hague: Mouton 1979, 169-176.
- Fisch, M. H. "Introduction", in *W* 3, 1993, xxi-xxxvii.
- Génova, G. *Charles S. Peirce: La lógica del descubrimiento*, Cuadernos Anuario Filosófico, nº 45, Pamplona, 1997.
- Hookway, C. *Peirce*. London: Routledge & Kegan Paul 1985.
- Kuklick, B. *The Rise of American Philosophy*. New Haven, CT: Yale University Press 1977.

- Panesa, R. T. *Science and Religion in Charles S. Peirce*, Doctoral Dissertation, University of Navarre, Spain, 1996.
- Parker, K. A. *The Continuity of Peirce's Thought*. Nashville, TN: Vanderbilt University Press 1998.
- Peirce, B. *Ideality in the Physical Sciences*, Little, Brown: Boston 1881.
- Pence, T. G. "Charles S. Peirce, Scientific Method, and God", *Perspectives on Science and Christian Faith* 49 (1997), 156-161.
- Raposa, M. L. *Peirce's Philosophy of Religion*, Indiana University Press: Bloomington 1989.
- Roberts, D. D. "An Introduction to Peirce's Proof of Pragmatism", *Transactions of the Charles S. Peirce Society* XIV (1978), 120-131.
- Robin, R. S. "Classical Pragmatism and Pragmatism's Proof", in J. Brunning and P. Forster (eds.) *The Rule of Reason*, University of Toronto Press: Toronto 1997, 139-152.
- Samway, P. H. (ed.) *A Thief of Peirce. The Letters of Kenneth Laine Ketner and Walker Percy*, University Press of Mississippi: Jackson, MI, 1995.
- Smith, J. C. "Peirce's Religious Metaphysics", *International Philosophical Quarterly* 19 (1979), 407-425.
- Stuhr, J (ed.) *Classical American Philosophy*, Oxford University Press: Oxford 1987.
- Wallace, W. A. *Galileo's Logic of Discovery and Proof*, Kluwer: Dordrecht 1992.

Sources of Peirce's Texts

- CN* Peirce, Charles S. *Contributions to 'The Nation'*, vols. 1-4. Eds. K. L. Ketner and J. E. Cook. Lubbock: Texas Tech Press 1975-1979.
- CP* Peirce, Charles S. *Collected Papers of Charles Sanders Peirce*, vols. 1-8. Eds. C. Hartshorne, P. Weiss, P. and A. W. Burks. Cambridge, MA: Harvard University Press 1931-1958.
- HP* Eisele, C. *Historical Perspectives on Peirce's Logic of Science: A History of Science*, vols. 1-2. Berlin: Mouton 1985.
- MS* *The Charles S. Peirce Papers* 32 microfilm reels of the manuscripts kept in the Houghton Library. Cambridge: Harvard University Library, Photographic Service 1966.
- RLT* *Reasoning and the Logic of Things. The Cambridge Conferences Lectures of 1898*. Ed. K. Ketner. Cambridge, MA: Harvard University Press 1992.
- W* Peirce, Charles S. *Writings of Charles S. Peirce: A Chronological Edition*, vols. 1-6. Eds. M. H. Fisch et al. Bloomington: Indiana University Press 1982-99.