

Charles Sanders Peirce (1839-1914)

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Biography

Peirce was an American philosopher, probably best known as the founder of pragmatism and for his influence upon later pragmatists such as William James and John Dewey. Personal and professional difficulties interfered with his attempts to publish a statement of his overall philosophical position, but, as the texts have become more accessible, it has become clear that he was a much more wide-ranging and important thinker than his popular reputation suggests.

He claimed that his pragmatism was the philosophical outlook of an experimentalist, of someone with experience of laboratory work. His account of science was vigorously anti-Cartesian: Descartes was criticized for requiring an unreal 'pretend' doubt, and for adopting an individualist approach to knowledge which was at odds with scientific practice. 'Inquiry' is a cooperative activity, whereby fallible investigators progress towards the truth, replacing real doubts by settled beliefs which may subsequently be revised. In 'The Fixation of Belief' (1877), he compared different methods for carrying out inquiries, arguing that only the 'method of science' can be self-consciously adopted. This method makes the 'realist' assumption that there are real objects, existing independently of us, whose nature will be discovered if we investigate them for long enough and well enough.

Peirce's 'pragmatist principle' was a rule for clarifying concepts and hypotheses that guide scientific investigations. In the spirit of laboratory practice, we can completely clarify the content of a hypothesis by listing the experiential consequences we would expect our actions to have if it were true: if an object is fragile, and we were to drop it, we would probably see it break. If this is correct, propositions of a priori metaphysics are meaningless. Peirce applied his principle to explain truth in terms of the eventual agreement of responsible inquirers: a proposition is true if it would be accepted eventually by anyone who inquired into it. His detailed investigations of inductive reasoning and statistical inference attempted to explain how this convergence of opinion was achieved.

Taken together with his important contributions to formal logic and the foundations of mathematics, this verificationism encouraged early readers to interpret Peirce's work as an anticipation of twentieth-century logical positivism. The interpretation is supported by the fact that he tried to ground his logic in a systematic account of meaning and reference. Much of his most original work concerned semiotic, the general theory of signs, which provided a novel framework for understanding of language, thought and all other kinds of representation. Peirce hoped to show that his views about science, truth and pragmatism were all consequences of his semiotic. Doubts about the positivistic reading emerge, however, when we note his insistence that pragmatism could be plausible only to someone who accepted a distinctive form of metaphysical realism. And his later attempts to defend his views of science and meaning bring to the surface views which would be unacceptable to an anti-metaphysical empiricist.

From the beginning, Peirce was a systematic philosopher whose work on logic was an attempt to correct and develop Kant's philosophical vision. When his views were set out in systematic order, positions came to the surface which, he held, were required by his work on logic. These include the theory of categories which had long provided the foundations for his work on signs: all elements of reality, thought and experience can be classified into simple monadic phenomena, dyadic relations and triadic relations. Peirce called these Firstness, Secondness and Thirdness. He also spoke of them as quality, reaction and mediation, and he insisted that the error of various forms of empiricism and nominalism was the denial that mediation (or Thirdness) was an irreducible element of our experience. Peirce's 'synechism' insisted on the importance for philosophy and science of hypotheses involving continuity, which he identified as 'ultimate mediation'. This emphasis upon continuities in thought and nature was supposed to ground his realism. Furthermore, his epistemological work came to focus increasingly upon the requirements for rational self-control, for our ability to control our inquiries in accordance with norms whose validity we can acknowledge. This required a theory of norms which would explain our attachment to the search for truth and fill out the details of that concept. After 1900, Peirce began to develop such an account, claiming that logic must be grounded in ethics and aesthetics.

Although pragmatism eliminated a priori speculation about the nature of reality, it need not rule out metaphysics that uses the scientific method. From the 1880s, Peirce looked for a system of scientific metaphysics that would fill important gaps in his defence of the method of science. This led to the development of an evolutionary cosmology, an account of how the world of existent objects and scientific laws evolved out of a chaos of possibilities through an evolutionary process. His 'tychism' insisted that chance was an ineliminable component of reality, but he argued that the universe was becoming more governed by laws or habits through time. Rejecting both physicalism and dualism, he defended what he called a form of 'Objective Idealism': matter was said to be a form of 'effete mind'.

1. Life and works

Peirce's father, Benjamin Peirce, was one of the most respected American mathematicians of the nineteenth century. As well as holding chairs in mathematics and astronomy at Harvard, he was instrumental in establishing the American Academy of Arts and Sciences and served as Superintendent of the United States Coast Survey. Charles, whose remarkable intellectual abilities were soon recognized, was brought up in Cambridge, Massachusetts, in a house often visited by the leading philosophical and scientific figures of the time. Indulged and encouraged, his abilities were evident even in his most youthful writings. His undergraduate career at Harvard (1855–9) was undistinguished, but he was subsequently the first student to graduate *summa cum laude* in chemistry from the University's new Lawrence Scientific School.

By the late 1860s, Peirce's future looked bright. From 1861 he had worked as an aide to the Coast Survey. He lectured on logic at Harvard several times between 1865 and 1869. By 1867, his first important series of philosophical papers was appearing and he was elected to the American Academy of Arts and Sciences. In 1872 he founded a 'Metaphysical Club' where he discussed philosophical issues with kindred spirits, including William James, Chauncey Wright,

Francis Abbot, and Oliver Wendell Holmes Jr. Although some friends already feared that Peirce's independence of mind and his difficult and wild personality would prove obstacles to academic success, his future seemed assured when, in 1879, he obtained a lectureship in logic in the new Graduate School at Johns Hopkins University. At Johns Hopkins, Peirce and a small group of talented students made important contributions to the logic of relations and the theory of probabilistic reasoning, and (independently of Frege) Peirce and his student O.H. Mitchell introduced quantifiers into logic (see Predicate calculus).

In the mid-1880s Peirce's professional life fell apart. His post at Johns Hopkins was suddenly terminated due to his personal irregularities, and his unreliability soon led to the end of his employment with the Coast Survey. Retreating to rural Pennsylvania, Peirce built a house where he lived with his second wife, often in desperate poverty, until his death in 1914. He was not wholly cut off from the academic world. His friend William James arranged for him to give occasional series of lectures in Cambridge, Massachusetts – although he faced the widespread suspicion that he would be a bad moral influence upon the young students of Harvard. He continued to publish and he wrote many reviews for *The Nation*; and he produced eighty-thousand manuscript pages which are a major source for scholars trying to understand his later philosophical position. In 1903 he entered into an important correspondence with Victoria Lady Welby, an English scholar whose work in 'Significs' suggested a common interest with Peirce the semiotician. Lady Welby introduced Peirce's work to I.A. Richards and C.K. Ogden, whose account of them, *The Meaning of Meaning*, helped bring them to the attention of the wider philosophical community.

A finished statement of Peirce's philosophical system was never completed, but his published writings and manuscripts are extensive and range widely. During the late 1860s, a series of papers appeared, in the *Journal of Speculative Philosophy* and elsewhere, which summarized his early ideas on cognition, inference, logic, signs and the theory of categories. Attempts to incorporate this material into a textbook on logic in the early 1870s were thwarted, in part because of intractable problems about reference. However, material intended for this text surfaced, in a less systematic form, in Peirce's most famous series of papers, *Illustrations of the Logic of Science*, which appeared in the *Popular Science Monthly* in 1877–9. This included his best-known papers, 'The Fixation of Belief' and 'How to Make Our Ideas Clear', the standard source for his pragmatism. The most important work from the early 1880s was in formal logic, and *Studies in Logic*, a book of essays by Peirce and his students at Johns Hopkins, contained the Peircean version of the logic of quantification – which provided the key to solving his problems about reference.

The second half of the 1880s saw Peirce's interest turn to metaphysics and the revision of his theory of categories. An important series of five papers on metaphysical topics appeared in *The Monist* in 1891–3. Several attempts to collect his earlier papers in book form and to write a logic text survive from the following decade, including the important *Grand Logic* of 1893. Constantly seeking funding to support various grandiose publishing ventures, Peirce made a very useful application to the Carnegie Foundation for support to write thirty-six 'memoirs' summing up his philosophical position in 1902. Although unsuccessful, the surviving drafts of the application

cast invaluable light upon the structure of his thought. Also useful are lectures delivered at or around Harvard during this period. A fascinating series dealing with logical and metaphysical topics was given to the Cambridge Conferences in 1898 and has been published as *Reasoning and the Logic of Things*. After William James had made pragmatism famous, Peirce devoted much energy to displaying the superiority of his version of the doctrine, and he valuably seized the opportunity when invited to lecture on pragmatism at Harvard in 1903. He returned to the task of proving pragmatism in an incomplete series of papers published in *The Monist* a few years later. And it was around this time, in 1908, that he offered his 'Neglected Argument for the Reality of God': his view of God was somewhat pantheist, and he shared his father's view of scientific research as an attempt to read God's 'great poem', holding that scientific observation was a kind of religious experience.

2. Inquiry and the fixation of belief

In his writings from the 1860s and 1870s, Peirce explicitly questioned Cartesian assumptions about cognition. The papers in the *Journal of Speculative Philosophy* challenged the claim that we have introspective knowledge of our own mental states and disputed the foundationalist view that we have 'intuitive' knowledge – knowledge which is not logically dependent on prior opinions. The influence of the common-sense tradition emerges when Peirce criticizes Descartes' use of the method of doubt. Cartesian doubt is impossible: it will be 'mere self-deception and not real doubt'. Peirce enjoins us not to pretend to doubt in philosophy what we do not doubt in our hearts. Cartesians find the ultimate test of certainty in the individual consciousness, while Peirce urges us to follow the successful sciences in trusting to the critical conversation of a community of inquirers. And philosophy should follow the sciences in trusting the 'multitude and variety of its arguments rather to the conclusiveness of any one'. Our experience of the growth of knowledge suggests that although we are fallible, we can make progress as members of a community of investigators. Descartes and his followers have provided no reason for us not to emulate this in philosophy. Peirce's work on logic and epistemology attempted to vindicate this fallibilist but optimistic view of scientific inquiry. In the 1860s, he tried to do this by arguing that all thoughts are signs and all mental action is inference, and then explaining the grounds of our trust in the forms of reasoning that are used in science. We shall focus here on the arguments he employed in the following decade.

In 'The Fixation of Belief' (1877), Peirce is concerned with 'guiding principles of reasoning'. These are propositions which formulate rules of inference: an inference is good if its guiding principle is true. Habits of reasoning express such guiding principles and almost any proposition could express one: to the proposition that all humans are mortal corresponds the rule that on hearing of the humanity of someone, their mortality may be inferred. However, Peirce is concerned with the special class of logical rules, of propositions that are 'absolutely essential as guiding principles' and he tells us that these are 'necessarily taken for granted in asking whether a certain conclusion follows from certain premises'. The papers in the *Illustrations of the Logic of Science* attempt to draw out facts and principles which 'are deduced from the assumptions which are involved in the logical question', and which we must 'already know before we can have any

clear conception of reasoning at all'. He is hunting for the presuppositions of inquiry and with the fundamental norms which govern our participation in it.

The paper begins by characterizing inquiry which, we are told, starts with the posing of a question, with a real doubt, and concludes with the settled acceptance of an answer to the question, with belief. Both belief and doubt are characterized in a functionalist manner: beliefs are settled states which 'guide our desires and shape our actions'; doubt is an unsettled state whose only effect on action is to provoke inquiry directed at its elimination. A genuine doubt is required to motivate inquiry (contrary to Cartesian doctrine) and once the doubt has been eliminated, inquiry comes to an end: 'the sole object of inquiry is the settlement of opinion'. Since to believe something is always to believe it to be true, it is empty to say that our aim in inquiry is to arrive at the truth.

What methods should we use in order to settle opinions or fix beliefs? Peirce considers four: three prove unsatisfactory and the method of science is endorsed. It is the only method which is consistent with the presuppositions of inquiry, so the norms it provides are 'absolutely essential'. Were we to adopt the method of tenacity, we would seize on any answer to our question, doing all that was required to ignore or resist anything that might persuade us to abandon it. The 'social impulse' prevents us from making this our method: our certainty will inevitably be disturbed when we encounter people who hold other opinions and it is inevitable that we will do so. Proponents of the method of authority would allow a monarch or religious leader to choose an answer for an entire community and would control sources of available information to prevent our certainties being shaken. But this too will fail: no one could control opinions on every question, and we would eventually face problems through encountering people who are not subject to our chosen authority. The failure of these methods shows that we cannot live with a method which ignores the social dimension of inquiry or one that allows the correctness of an answer to be determined by the will of some individual. The a priori method meets these conditions: we are to accept the answer to our question which is 'agreeable to reason', the answer which seems most plausible. But this fails because the correctness of an answer remains a subjective matter: the method would be likely to make truth a matter of fashion.

The method of science introduces objectivity. It requires us to carry out inquiries in accordance with norms which reflect the following fundamental hypothesis:

There are real things, whose characters are entirely independent of our opinions about them; those realities affect our sense according to regular laws, and, though our sensations are as different as our relations to the objects, yet, by taking advantage of the laws of perception, we can ascertain by reasoning how things really are; and any man, if he have sufficient experience and reason enough about it, will be led to the one true conclusion.

(1992-4: 120)

Peirce's arguments in favour of this method are rather unclear, but he strongly suggests that it alone is in harmony with 'the logical question'. It is the only method 'which presents any distinction of a right and wrong way'.

The feeling which gives rise to any method of fixing belief is a dissatisfaction at two repugnant propositions. But here already is a vague concession that there is some one thing to which a proposition should conform. Nobody, therefore, can really doubt that there are realities...

(1992–4: 120)

But Peirce also insists that everyone uses this method about ‘a great many things’, abandoning it only when unsure how to do so, and points to the triumphs of the scientific tradition as further recommendation. However the method of science has so far been formulated sketchily, and we should now examine Peirce’s attempts to fill in some of the details.

3. Pragmatism

Although Peirce did not use the word in print until more than twenty years later, ‘How to Make Our Ideas Clear’ (1878a) introduces the rule for achieving complete clarity about the contents of concepts, propositions and hypotheses which was later called ‘pragmatism’. The rule helps us to carry out scientific investigations in a responsible, self-controlled manner, but Peirce’s principle also has important applications within logic and philosophy. First, it is used to clarify concepts like reality and probability, which are fundamental to his understanding of the method of science. Second, its account of the meaning of propositions helps to explain how the method of science can indeed show anyone ‘the one true conclusion’ to an investigation. And third, it is needed to demonstrate that there are no important propositions – and none on which science depends – whose truth values cannot be established using the method of science. Peirce must show, for example, that all ‘ontological metaphysics’ is ‘gibberish’ (see Meaning and verification).

Peirce contrasts three grades of clarity in our apprehension of a concept or proposition. I possess the first when I unthinkingly apply the concept in my experience, and the second involves possession of an abstract definition. For example, we can define reality as ‘that which is not whatever we happen to think it’, but is unaffected by what we may think of it. These notions of clarity, familiar from rationalists’ talk of ‘clear and distinct ideas’, can appear sufficient only in the light of a discredited logic and philosophy. The third ‘pragmatist’ grade, Peirce later stressed, accords with experimentalist approaches to inquiry and laboratory experience. His formulation of his method for achieving this third grade of clarity is:

Consider what effects, which might conceivably have practical bearing, we conceive the object of our conception to have. Then our conception of those effects is the whole of our conception of the object.

(1992–4: 132)

His examples, and his later formulations, clarify this obscure statement. For example:

To say that a body is heavy simply means that, in the absence of opposing force, it will fall. This (neglecting certain specifications of how it will fall, etc., which exist in the mind of the physicist who uses the word) is evidently the whole conception of weight.

(1992–4: 133)

From the proposition that the body is heavy, I can derive conditional propositions predicting the experiential results of different actions: if I reduce the force acting to support the heavy body, it will fall. Pragmatism holds that I can provide a *complete* clarification of a concept by listing such conditional propositions: they tell me what effects my actions will have if the concept applies to a specified object. As Peirce insisted, this is an ‘experimentalist’s’ view of the content of propositions.

‘How to Make Our Ideas Clear’ uses the principle to clarify the concept of reality. Listing different methods for investigating the velocity of light, Peirce notes that, while users of each may initially produce different results, ‘as each perfects his method and his processes, the results will move steadily together towards a destined centre’. It is typical of scientific inquiry that ‘no modification of the point of view taken, no selection of other facts for study, no natural bent of mind even, can enable a man to escape the predestinate opinion’. Peirce’s clarification of the concept of reality is thus: ‘The opinion which is fated to be ultimately agreed to by all who investigate is what we mean by the truth, and the object represented in this opinion is the real’. Truth is defined by reference to long-run convergence of opinion among responsible inquirers: it is not independent of ‘thought in general’ but it is independent of what any individual may think at any particular time.

Another important application of Peirce’s principle is his account of probability, presented in the third paper of the series, ‘The Doctrine of Chances’ (1878b) (see Probability, interpretations of). Urging that we clarify the idea of probability by examining ‘what real and sensible difference there is between one degree of probability and another’, he follows Locke in identifying probability as a property of inferences. Deductively valid arguments are those which belong ‘to a genus of arguments all constructed in the same way, and such that, when their premises are real facts, their conclusions are so also. If the argument is demonstrative, then this is always so; if it is only probable, then it is for the most part so’ (1992–4: 146). The probability of a mode of argument is thus ‘the proportion of cases in which it carries truth with it’. A probability statement formulates a guiding principle for such an inference. If the probability of a tossed coin landing with heads uppermost is 0.48, then a claim is made about inferences from the premise that this coin was fairly tossed to the conclusion that it lands with heads uppermost: in the long run, such inferences will be successful around 48 per cent of the time. Pragmatism supports a frequency account of probability.

As we go on drawing inference after inference of the given kind, during the first ten or hundred cases the ratio of successes may be expected to show considerable fluctuations; but when we come to the thousands and millions, these fluctuations become less and less; and if we continue for long enough, the ratio will approximate towards a fixed limit.

(1992–4: 146)

4. Induction and the method of science

So far, the method of science has been defined in terms of its underlying presupposition: for any question that we investigate, there is a correct answer which we are fated to reach if we carry out our investigations long enough and well enough. A more detailed account is needed of the

scientific method and of how this convergence in opinion is to be secured. What inferences and methods should we employ, and how do they lead us to the truth?

Like other nineteenth-century thinkers, Peirce emphasized the self-correcting character of inductive reasoning: in the long run, error is sure to be eliminated and whatever survives testing will be the truth. Peirce's development of this idea exploited an analysis of statistical sampling ('quantitative induction') which attempted to establish that successive sampling of a population is guaranteed eventually to discover the proportion of the population having a particular character. This was supplemented by the claim that all inductive inference can be modelled on statistical sampling.

Suppose we wish to know the proportion of white beans in large bag of beans. Drawing out a handful, we find that 75 per cent of these beans are white. An inductive argument would then tentatively conclude that 75 per cent of the beans in the whole bag were white. So long as the handful is sufficiently large, and the beans in the bag are evenly distributed, the probability is high that the proportion of white beans in the bag as a whole is fairly close to 75 per cent. Moreover, if it is not, further sampling will arrive at a figure that is more accurate than the original one. The mathematical details of Peirce's approach need not delay us, although we should note that this is in harmony with his pragmatist clarification of the concept of probability: if the probability of a bean drawn from the bag being white is 0.75, then as we draw more and more handfuls, we expect to find that 75 per cent of those that we draw are indeed white.

But quantitative induction forms only a small part of scientific inference. The experimental testing of theories involves an apparently different form of inference which is referred to as 'hypothesis' in Peirce's earlier writings, and later as 'qualitative induction'. But Peirce's pragmatism reveals an analogy between quantitative and qualitative induction. For pragmatism holds that there is nothing to the content of a hypothesis apart from a set of conditional predictions, expectations about the experiential consequences we should expect our actions to have were the theory to be true. We are not in a position to test every one of those conditional predictions, although we can see that, if all were confirmed, the hypothesis would be true. When a hypothesis is tested empirically, then, we sample those predictions, and we infer from the success of the sample to the reliability of the 'population' of predictions forming the content of the hypothesis. The probability calculus is not applicable in these cases, of course, but as long as the pragmatist principle clarifies the full meaning of the hypothesis, the parallel cannot be denied.

There is an important difference between quantitative and qualitative induction. When subsequent sampling conflicts with my estimate that 75 per cent of the beans are white, it does so by introducing a revised estimate of the proportion: eventually, continued sampling will arrive at the correct figure. When evidence conflicts with a hypothesis in the course of qualitative induction, it does not introduce a replacement hypothesis. We depend upon our ability to think of promising hypotheses and to choose the right ones for empirical test. These matters are addressed in Peirce's account of 'abduction'. Much of the logic of abduction investigates methodological rules to be followed in deciding which hypotheses to test: we should prefer those that can be tested economically and whose falsity would be quickly exposed; we should also

favour those that seem simple, cohere with our metaphysical views, or appeal to explanatory mechanisms similar to those that have been successful elsewhere in science. Many of these matters concern the economics of research: we plan our investigations in order to maximize progress and minimize expenditure of time, money and effort.

5. Abduction and critical common-sensism

More fundamental than this ‘economics of research’, however, is the ‘primary abduction’ on which all scientific activity depends, the presupposition or hope that we have a capacity for guessing right. We have a ‘natural instinct for the truth’: ‘the human mind is akin to the truth in the sense that in a finite number of guesses it will light upon the correct hypothesis’ (1931–58: 7, 139). Unless we can be confident that we shall think of a good hypothesis fairly soon, the motivation to carry out scientific research would weaken. Of course, this provides no reason for believing that the primary abduction offers, at best, grounds for hoping that it is correct. The history of science helps by showing that ‘it has seldom been necessary to try more than two or three hypotheses made by clear genius before the right one was found’.

Peirce’s account of the growth of scientific knowledge involves one further complexity. When first introduced, a hypothesis offers a vague picture which is incomplete and incorrect in many of its details: at best, we hope that some precise revision of it can be defended. Inductive testing will guide us in making revisions, in rejecting some adjustments and developing others:

The familiar kinetical theory of gases illustrates this well. It began with a number of spheres almost infinitesimally small occasionally colliding. It was afterward so modified that the forces between the spheres, instead of merely separating them, were mainly attractive, that the molecules were not spheres, but systems, and that the part of space within which their motions are free is appreciably less than the entire volume of the gas. There was no new hypothetical element in these modifications.

(1931–58: 7, 135–6)

This background to abduction will also contain beliefs and inferences drawn from common sense. Such beliefs and inferences are ‘acritical’: they cannot be subjected to critical evaluation and when asked to defend them we can say only ‘everything counts for them and nothing counts against them’. This slowly evolving body of opinions is indubitable and can almost be seen as instinctive. It is certain largely because common-sense beliefs are invariably vague: any proposed precise version of them would be fallible, but its defeat would not demonstrate that another way of making them precise cannot be found. General ideas drawn from analytical mechanics provide a common-sense framework against which research in physics develops, and the assumptions about beliefs, desires and meanings reflected in decision theory and microeconomics articulate the common-sense background to the social and human sciences. Peirce’s ‘critical common-sensism’ emphasizes the role of such instinctive certainties in grounding our policy of reflective critical inquiry. We should try to doubt such inferences and propositions in order to satisfy ourselves that they are indeed part of common sense, but, of course, we should not deceive ourselves into thinking that they are indeed dubitable on disreputable Cartesian grounds.

Although common-sense beliefs and vague theoretical pictures are hard to criticize, Peirce described himself as a ‘contrite fallibilist’: we are aware that most of our theories require revision and we anticipate that any of them might have to be abandoned (see Fallibilism). We look on them as currently accepted opinions, acknowledging that accepting them now is the best means to eventual progress towards the truth. In Peirce’s later writings, he expresses this fallibilism by denying that we should ever *believe* our current scientific results, and arguing that pure scientific research should be divorced from any concern with the useful applications which its results may have. Ironically, the method of science does not provide a means to the short-term fixation of belief.

Belief, according to Peirce, must result from instinct or sentiment, from the action of common sense, and he was scathing about those who trust theoretical reflection in connection with ‘vital’ matters. When facing important moral decisions or agonizing over the existence of God, we should spurn reflective deliberation, trusting instead our moral and religious sentiments, the instinctive manifestations of common-sense wisdom.

6. Architectonic and self-control

From around 1900, Peirce insisted that his work in logic and epistemology should be embedded in a systematic framework: a proof of pragmatism and a defence of induction were required, and his search for these led to the attempt to ground logic in aesthetics and ethics and to his development of phenomenology as a fundamental branch of philosophy. Why was he dissatisfied with his earlier defence of his views?

First (a minor point), he came to deny that we could establish that something is true by showing that it is a presupposition of inquiry: at best, that warrants our *hoping* that it is true. Hence his views risk refutation through a demonstration that what scientists hope to be true is not in fact so. Second, his pragmatism claimed that all scientific propositions can be fully elucidated using the pragmatic principle: there is nothing to their content apart from conditional predictions. Scientific work is shaped by explanatory ideals which guide us in establishing a *system* of knowledge. If concepts, such as continuity, which have a role in setting these ideals cannot be elucidated using the pragmatist principle, then Peirce’s pragmatism would be on shaky ground. He needed to show that such concepts were consistent with pragmatism – a conclusion his hero Kant would have denied. Moreover, he aspired to an argument for pragmatism which would convince even those who antecedently believed that they understood concepts that it would rule out of court. A particular threat concerned Peirce’s realism. He wished to take natural necessity seriously, and to claim that pragmatism was committed to the objectivity of ‘would-bes’ – to statements about what *would* occur in various possible situations (see §9 below). However, it is commonly assumed that the kind of verificationism that his position represents cannot make sense of the objectivity of ‘would-bes’. Many were convinced by Hume and others that verificationism required nominalism.

Finally, his argument for the superiority of the method of science claimed that the ‘social impulse’ acted against methods such as tenacity and authority. If this is a *psychological* claim about human inquirers, it is hard to see how it establishes the *normative* claim that only the

method of science ought to be employed. Moreover, we have noted that since the method of science only promises to settle belief stably in the long run, requiring us to identify our interests with those of the wider community, we are required to use a different method (trusting to instinct) when we try to settle vital questions. So, it seems, we do use an alternative method much of the time. Or if we use the method of science, confident that we can trust its results in connection with everyday matters, there is a question about the right with which we do so. And why is it rational for us to devote our lives to the cooperative pursuit of long-run stable settlement of beliefs? How can the search for the truth about reality be a good goal for us to adopt? It seems that Peirce must embed his views in a general theory of rationality, in a general theory of how we can order our lives in a self-controlled manner. Otherwise, his defence of the method of science begs too many questions.

By the late 1890s, Peirce was emphasizing that philosophy should have an architectonic character. It should be systematic and guided by a plan of the structure of knowledge as a whole. Thus he relied upon an explicit classification of the sciences, especially the philosophical sciences which can be schematized thus:

1. Mathematics
2. Phenomenology (or 'Phaneroscropy')
3. Normative science:
 - a. Aesthetics
 - b. Ethics
 - c. Logic:
 - i. Speculative grammar
 - ii. Critic
 - iii. Methodeutic
4. Metaphysics

Mathematics, our 'practice of necessary reasoning', needs no foundations, but provides techniques used by phenomenology to obtain a theory of categories from reflection upon all that appears to us in any way. Using these categories, the first two normative sciences provide an account of the rationality of ends: they identify what it is possible to admire unconditionally, and what it is possible to adopt as an unconditional end for conduct. Logic then investigates the norms governing inquiries: the first branch provides a systematic account of sign interpretation and reference; the second classifies arguments and explains their validity; and the third states and defends the methodological principles that guide inquiries. Peirce's theory of truth is defended within his logic. Metaphysics develops a general scientific account of 'the most general features of reality and real objects'. Together, these philosophical sciences explain the possibility of rational, self-controlled inquiry.

7. Categories, phenomenology and normative science

Throughout his career, Peirce's philosophical ideas depended upon a system of categories, a set of universal conceptions which could be used to classify anything that could be experienced, thought about or imagined (see Categories). Growing out of his criticisms of Kant's theory of categories during the 1860s, the system was subject to considerable development and refinement until the final decade of his life and had a fundamental role in grounding his other philosophical views. Although his terminology varied, he most commonly referred to these categories as 'Firstness', 'Secondness' and 'Thirdness'. It is easiest to understand them by following Peirce himself in seeing how they are reflected in the logical forms of a 'perfectly exact, systematic and analytic language in which all reasoning could be expressed and be reduced to formal rules'. Such a language might contain expressions like '... is red' which express properties of a single subject as well as relational expressions such as the two place '...is taller than...' and the three place '...gives...to...'. Peirce insisted that an adequate language would contain expressions of all these three kinds, and also that it need contain no expressions for relations between four or more objects. Concepts or phenomena are classified as forms of Firstness, Secondness and Thirdness according to whether they are expressed by general expressions which take one, two or three subjects. Firstness is what it is independently of anything else, Secondness involves what is in relation to something else, and Thirdness is manifested when something mediates between two others.

Peirce's important 1867 paper 'On a New List of Categories' contained the first published version of the theory. It appeared before Peirce had worked much on the logic of relations and made no use of the terminology of Firstness, Secondness and Thirdness. However it was self-consciously Kantian in defending a system of categories by discussing what was required to reduce the manifold of sense to the unity of a proposition: Peirce spoke of reducing the manifold of Substance to the unity of Being. We do so, he urged, by ascribing a quality to the substance, by classifying it or describing it. But how can we do that? Since 'we know a quality only by means of its contrast or similarity with another', we can ascribe qualities to things only because we can make relational judgments of similarity and difference. And we can make judgments of similarity only because we can carry out 'comparisons': we can interpret one object as a representation of another. So making sense of things by ascribing qualities to them depends upon our ability to make relational judgments and to work with the three-place relation of representation. All three categories are required for even the simplest kind of judgment. Peirce soon came to reject the assumption that quality (monadic characteristics) had a special role in unifying the manifold: the logic of relations led to the overthrow of Aristotelian logic and taught that relational judgments were just as fundamental as these simple monadic ones. Although this led to a reformulation of his theory of categories, he continued to use the argument of this early paper. He claimed that it embodied his 'one contribution to philosophy'.

With the development of the logic of relations, Peirce exploited his 'remarkable theorem' that it was impossible to define triadic relations in terms of simpler ones, whereas it was always possible to provide such definitions for relations with four or more relata. Within standard systems of the logic of relations, this does not hold: it is possible to reduce triadic relations to

dyadic ones. However, recent scholarship suggests that Peirce's claim holds for his own systems of logic and that, for the purposes of constructing a system of categories, the Peircean systems are more perspicuous than those encountered in standard logic texts. Since this argument uses mathematics to defend the categories and mathematics was the foundational discipline without Peirce's architectonic structure, Peirce's continued reliance upon this argument is not surprising.

However, from the late 1880s new quasi-empirical arguments were introduced, culminating after 1900 in a phenomenological defence of them. 'A Guess at the Riddle' (1887–8) traced the 'triad' through logic and semiotics, in metaphysics, psychology, physiology and biology, and in physics and theology, thereby producing a 'long list' of categories. This investigation culminated in the development of Peirce's evolutionary metaphysics (see §10 below). Although not intended as a proof of the theory of categories, it was relevant to establishing a doctrine fundamental to Peirce's realism: Thirdness is found in the physical and biological realms as well as among mental and linguistic phenomena.

From 1903, Peirce undertook to defend his categories by looking 'directly upon the universal phenomenon, that is upon all that in any way appears, whether as fact or as fiction'. With the aid of special analytical techniques, his search again discovered the three fundamental categories, Firstness, Secondness and Thirdness. Since he remained convinced by the early 'logical' arguments, there is a question of why this further defence was required. The answer lies in Peirce's architectonic, his account of how the philosophical sciences all hang together. If the categories are to be used in logic and the other normative sciences, they must be defended in a more fundamental discipline. Since formal logic is a branch of mathematics, this may not seem problematic, but the logical argument for the categories required Peirce to show that a particular mathematical formalism could indeed be used as a system of formal logic: formal logic is, after all, a branch of *applied* mathematics. By showing that a formalism which incorporates the categories is adequate to describe 'all that in any way appears, whether as fact or as fiction', Peirce can be confident in relying upon his categories when he turns to the study of our attempts to discover the facts in logic.

Peirce's work in normative science seeks a theoretical account of what we can admire unconditionally (aesthetics), adopt as an ultimate end (ethics), or adopt as a fundamental goal for inquiry (logic). Thought experiments are employed: we consider different possible objects of experiments or imagine living with a particular aim in various counterfactual circumstances. In each case, the good consists in a manifold of phenomena each with their own qualitative character of Firstness, but standing in dyadic relations, reacting against each other. But this Secondness is mediated: the whole exhibits a coherence or unity which we can apprehend. Beauty, goodness and truth involve a kind of organic unity which excites our admiration, motivates our conduct and satisfies our inquiries. The method of science ensures progress towards a coherent body of opinions which brings our actions and experiences into harmony.

8. Signs and interpretations

Peirce's semiotic provides a wholly general theory of meaning and representation. An important move in his critique of the Cartesian conception of mind during the 1860s was that all thoughts

and experiences are signs. In later years, he used these semiotic conceptions to develop a sophisticated account of language – particularly of the language used by a ‘scientific intelligence’. His philosophical account of science and mathematics focused upon the role of science interpretation in both, and important problems in the ontology of mathematics were answered by reference to the special character of the signs or representations used within that discipline. And the grounds of logic or deductive validity were traced to features of meaning and the sign relation. It is not surprising that Peirce described logic as ‘only another name for *semiotic*, the quasi-necessary or formal doctrine of signs’. There are few of Peirce’s writings that are not concerned with questions of meaning and signification.

His work exploits the fundamental insight that signification is a form of Thirdness. The sign relation is irreducibly triadic, and the third element in this relation is interpretation. A name denotes an object or a sentence stands for a state of affairs by virtue of being interpreted in subsequent thought, speech or action as doing so. The interpretant, which is itself a sign with the same object, thus mediates between the original sign and its object. Thus my understanding of a report that an animal before me is a cat can be variously manifested in my explicitly thinking or saying that this is what the utterance means, in my inferring that the animal probably likes milk, in my offering it cat food, or in my showing surprise when it suddenly barks. Unless the sign has the capacity to produce such interpretant thoughts (the meaning of which in turn depends upon how they are interpreted) it would have no significance. Since a thought too is a sign, the content of a thought (or any other mental event) is determined by how it is interpreted and developed in subsequent thought. In general, the content of a thought or utterance depends upon its effects.

Much of Peirce’s writings about signs was directed at constructing a classification of types of signs: he sought an exhaustive classification of signs, objects and interpretants. One motivation for this was Peirce’s desire to defend the pragmatist principle by showing that it would enable us to be reflectively aware of all those features of how a sign should be interpreted that were relevant to our scientific purposes. He argued that the ‘ultimate logical interpretant’ of a sign was a habit of expectation which could be fully described by application of the pragmatist principle. Some of the classifications are of more general interest, offering important insights into thought, language and other forms of representation. And his writings on signs contain valuable contributions to the understanding of mental phenomena such as emotions, sensory experiences and religious experience as well as interesting discussions of proper names, vagueness, conditionals, modality, quantification, force and content and other live issues in the philosophy of language.

The question of how we are guided in arriving at interpretations of signs introduces the best known of Peirce’s classifications, that between icon, index and symbol. Roughly, interpretation of an iconic sign is grounded in a resemblance between the sign and its object, interpretation of an index exploits a ‘real existential relation’ between the two, and we can defend our interpretation of a symbol by reference to an established practice of so interpreting it. Photographs and maps are icons, signposts and pointing fingers are indices, and it is easy to see that natural language has a strong symbolic component. The utterance of a symbolic sign is always a *replica* of the symbol (a token of the type), and its interpretation appeals to the

interpretations offered of other replicas or tokens. Peirce denied that there were 'pure' icons or indices. Maps and signposts are 'hypo-icons' and 'hypo-indices', having a strong conventional component. The rules governing the use of maps do not fix the interpretation of particular features of the map unaided: they rather guide us in how to use it as an icon. Similarly, although we are able to understand pointing fingers only because we are masters of the practice of doing so, the rules of this practice do not explicitly lay down what a particular finger is pointing at. Rather, they guide us in how to interpret the finger as a conventional index.

This classification exploits Peirce's system of categories. Interpretation of an index depends upon a dyadic existential relation between sign and object: it exploits properties the sign would lack if its object did not exist. When we understand a symbol, we appeal to triadic features of the sign, such as how its replicas have been interpreted in the past. And an understanding of icons exploits common features of sign and object which each could have, even if the other had not existed. In his 1885 paper, 'On the Algebra of Logic: a Contribution to the Philosophy of Notation', Peirce announced that an adequate language for descriptive or scientific purposes must contain signs of all three kinds. Indeed, any proposition must have symbolic, iconic and indexical components. Indices such as names, demonstrative expressions, pronouns and quantifier expressions are required if the proposition is to speak of any external things at all: the universe of discourse must be specified indexically. Symbols are the only general signs, and generality is essential to reasoning: we must be able to recognize that premises and conclusions contain tokens of the same word or phrase type, replicas of the same symbol.

The value of iconic signs is that we can exploit their similarity with their objects, learning more about the latter by noting features of the icon. We can make discoveries about the terrain by making measurements on a map, or learn more about a building by examining a photograph. A proposition provides a sort of diagram of a state of affairs, mirroring its logical structure. Inference exploits this abstract resemblance: we learn more about the world by making substitutions in propositions in the light of other information that is to hand and observing the result of our 'experiment'. This is clearest when we think of formal logic, which, like all of mathematics, constructs iconic representations of the structure of propositions and arguments which enable us to investigate the validity of arguments. Unless descriptive propositions were icons and shared abstract structural properties with their objects, Peirce argued, we could make no sense of how reasoning can provide us with new knowledge. The formal character of reasoning shows that we interpret propositions as icons. So any language is a device for constructing conventional, logical diagrams which are tied down to concrete, existing things through the use of indices.

After 1900, Peirce sought a proof for his pragmatism. He needed to show that no aspect of the meaning of a proposition, nothing relevant to its cognitive functioning, was omitted when we clarify it using the pragmatist principle. One strategy was to develop his theory of signs and show that interpreting a proposition in the light of pragmatism produced its most explicit ('ultimate') logical interpretant. Another strategy was to construct a complete classification of argument forms and to show that we needed no information missed by a pragmatist elucidation in order to employ a proposition in reflective, controlled argument. An important tool here was

the system of existential graphs (see Logic machines and diagrams). A system of formal logic analogous to later natural deduction systems, the graphs promised 'moving pictures of thought' which would exhibit the structure of all possible forms of argument. As well as a complete system of propositional and predicate calculus, the graphs promised an account of sophisticated reasonings involving modality, continuity and abstraction. If all reasoning is reflected in the system of existential graphs, and if the pragmatic principle is true for all concepts whose conceptual role is modelled within them, then the pragmatist is vindicated. Unfortunately there is little evidence that Peirce completed the graphs to his satisfaction.

9. Realism

Peirce described himself as a realist, rejecting nominalism and epistemic idealism as the source of most philosophical ills (see Nominalism; Realism and antirealism). This can be surprising because pragmatism is often understood as an antirealist, verificationist doctrine.

It is useful to distinguish three different themes in his realism. The first is a response to the problem of universals. Peirce argues that it is a mistake to understand realism about 'generals' or universals as a claim about the existence of a particular realm of curious abstract objects. Realists are committed to the objectivity of propositions concerning whether this or that object is a horse; they are not committed to the existence of horseness as a special particular. This view was most clearly expressed in an 1870 review of a new edition of Berkeley's works where Peirce distinguishes two conceptions of reality, nominalist and realist. They differ in how they develop the uncontroversial claim that the real is 'that which is not whatever we happen to think it, but is unaffected by what we may think of it'. Nominalists note that our thoughts are caused by sensations which are, in turn, caused by something outside the mind, and identify the real with these efficient causes of our sensations and thoughts. This picture of reality, which is closely allied to the representative theory of perception and the correspondence theory of truth, makes problematic the question of whether anything in reality corresponds to general conceptions such as 'horse' or 'man' and encourages the sort of mistrust of our conceptual interpretation of sensory input that makes Cartesian strategies attractive. Peirce favours the realist conception which notes that 'to every question there is a true answer, a final conclusion, to which the opinion of every man is constantly gravitating'. Reality is the 'final cause' of inquiry, the answer to a question that we are 'fated' to reach if we inquire long enough and well enough.

This view of reality is reminiscent of Kant's 'empirical realism', and encourages realism about generals because it is objective whether (for example) Pegasus was a horse. The account of reality obtained from the pragmatist principle supports this form of 'realism'. However, since truth is explained in terms of the convergence of opinion, there is no conceptual gap between truth and what efficient, responsible inquirers would agree upon. The position thus appears to be in tension with the realist view that truth is not determined by what we take it to be. Moreover, a realist will presumably hold that there are many truths which inquiry will never uncover, all trace of them having been lost. In the 1870s, Peirce suggested that this was a verbal matter of whether a diamond which was created and destroyed without being exposed to any sort of test was hard, but he later insisted that this was a mistake which his realism enabled him to avoid.

A second theme in Peirce's realism responded to this difficulty. Peirce's realism became more extreme in the 1880s when he defended objective modalities. Natural laws manifest real, natural necessity and there are facts concerning 'would-bes' – subjunctive conditionals concern what *would* occur in various counterfactual (but real) possibilities (see Laws, natural; Counterfactuals). The conditionals employed when we clarify a concept using the pragmatist principle are expressed in the subjunctive mood: they concern what would happen (or what would have happened) had certain actions been carried out. So in later work, Peirce's frequency theory of probability is transformed into a propensity view: the probability of an argument is the proportion of cases in which it *would* transmit truth from premises to conclusion.

Returning in 1906 to the example of the diamond which is destroyed before being tested for hardness, Peirce noted that science teaches that diamonds have in common a molecular structure which accounts for their hardness. We know that if it had been tested, it would have proved hard. The hardness of individual diamonds is not ontologically prior to the fact that diamonds (in general) are hard. This form of realism is connected to the reality of Thirdness. Since we directly experience Thirdness, we are directly aware of necessity or mediation. Peirce's synechism turns the question of realism into the question whether there is real continuity, real mediation.

The third theme reflects Peirce's answer to problems about reference which he faced during the 1870s: we directly perceive external things, referring to them demonstratively in perceptual judgments (see Reference). This allows for the possibility of reference to external objects (including theoretical entities) while being aware that some questions about their character have answers which will never be discovered by us. The irreducibility of Secondness is relevant here: we are aware of external things as reacting against us, as 'other'; and this is reflected in the fact that reference to external things is fundamentally indexical, involving demonstrative expressions in perceptual judgments. Theoretical entities are known to exist because they too possess Secondness – they react with other existing things.

10. Scientific metaphysics and evolutionary cosmology

In *The Monist* (1891–3), Peirce published a series of five papers which fit poorly with the anti-metaphysical flavour of his pragmatist writings. Developing themes that he had been exploring since 1883–4, they contained an evolutionary cosmology, which, he suggested, involved a form of objective idealism, and they argued, against Darwin, that this process of evolution should be seen as, in a sense, purposive: 'agapastic' evolution was driven by evolutionary love, and the universe is a vast mind perfecting itself through time (see Idealism). Some commentators, like Thomas Goudge (1950), attributed this work to a philosophical split personality: the naturalistic, tough-minded, anti-metaphysical pragmatist betrayed a taste for transcendental speculation which could not be reconciled with the rest of his work. Peirce himself was clearly sensitive to the need to show that the different elements of his philosophical vision formed a unity. His cosmology attempted to understand the most general features of our view of the world using the method of science. Metaphysics was empirical, differing from the special sciences only in its generality and in its avoidance of sophisticated experiment: its data was drawn from everyday facts whose very familiarity is likely to hide them from our notice.

He also insisted that his metaphysics was required by his work on logic and the method of science: self-controlled reasoning, employing the scientific method, was possible only if a Peircean metaphysics is possible too. In 'The Fixation of Belief', Peirce sought presuppositions of inquiry. He soon saw that showing that something was a presupposition of inquiry (or of a particular inquiry) did not establish its truth: at best, we are warranted in *hoping* that it is true. We must hope that there is a reality, independent of us, of which we can obtain knowledge, that the questions we investigate have answers, that we possess the freedom needed for logical self-control, that we can tell the difference between a good argument and a bad one, that we have the instincts posited in the 'primary abduction' and so on. We must look to metaphysics for the account of mind and reality that explains the truth of these hopes or regulative ideas. If no such account is possible, rational self-control is an illusion.

According to Peirce, the fundamental rule of logic is: 'Don't block the road of inquiry.' We should never assume that any question lacks an answer or that any regularity lacks an explanation: we should always hope that an explanation is to be found. This led him, in 1883 and later, to set himself the task of explaining the fact that there are general laws. Nominalists take there to be brute regularities which have no explanation, and physical atomism appears to require this nominalistic picture. If all law and regularity can be explained, nominalism must be rejected and Peirce is committed to the rejection of metaphysical or physical atomism. Peirce's answer is to construct an evolutionary metaphysics which traces the evolution of law out of pure possibility (of Thirdness out of Firstness). And this evolutionary story enjoins that the universe contains pure chance (Peirce's 'tychism'): a generalizing tendency reinforces chance regularities and the universe becomes steadily more regular and ordered. Just as we acquire more and more habits as our hypotheses are confirmed and habits of expectation are reinforced, so the universe itself becomes more and more 'hidebound with habits' (see Determinism and indeterminism).

The analogy just offered is important for understanding Peirce's evolutionary story: our ideas of inference, purpose and the growth of knowledge – ideas linked to the practice of sign interpretation – provide the model we must use in making sense of the physical world. Problems of interaction show that we require a monistic system of metaphysics, and physicalism can make no sense of consciousness and other mental phenomena. Hence Peirce's view that the entire universe is a vast mind: laws are analogous to habits, and the ways in which laws determine events have to be understood by appeal to teleology and final causation. Physical events differ from ordinary mental events in being less flexible, being more 'hidebound with habits'. We arrive at a form of idealism which, although it does not make reality depend upon the contents of human minds or on its being known, still holds that our fundamental explanatory categories are those most familiar from ordinary psychological explanation. The evolution of law is not the mechanical and meaningless process described by Darwin. Peirce's evolution is 'agapastic': evolutionary love is manifested in the ways in which the universe becomes steadily more perfect. Against this background, it is no surprise that in 1908 Peirce published a 'Neglected Argument for the Reality of God'. He believed that the Universe was a vast mind, and that even those who explicitly defend atheism are likely to have a natural belief in this pantheistic god. It is manifested in a confidence that the Universe is steadily becoming more perfect, and in our sense

that through contributing to science we contribute to ‘the process of creation’, to the growing rationality of the Universe.

List of works

Although Peirce published extensively, he did not publish any major philosophical treatises summarizing his position. The following list samples some of the more important pieces, but inevitably it omits much that is significant: any list of ‘major works’, particularly after 1890, will be controversial and arbitrary. This material is all readily available in the first two collections, listed below.

Peirce, C.S. (1931–58) *Collected Papers of Charles Sanders Peirce*, ed. C. Hartshorne and P. Weiss (vols 1–6) and A. Burks (vols 7–8), Cambridge, MA: Harvard University Press, 8 vols.

(A selection of papers and excerpts from manuscripts which was responsible for introducing Peirce’s work to a wide audience. Since the material is organized thematically rather than chronologically and the texts are not all reliable, this edition is being superseded by *The Writings of Charles S. Peirce*.)

Peirce, C.S. (1982–) *The Writings of Charles S. Peirce: A Chronological Edition*, ed. M. Fisch, C. Kloesel, E. Moore, N. Houser et al., Bloomington, IN: Indiana University Press.

(A reliable and extensive selection of Peirce’s published and unpublished writings, organized chronologically, and expected to run to thirty volumes. An indispensable tool for research, it is probably less useful for the new reader. The introductions to the different volumes provide an invaluable intellectual biography of Peirce.)

Peirce, C.S. (1992–4) *The Essential Peirce*, ed. N. Houser, and C. Kloesel, Bloomington, IN: Indiana University Press.

(An excellent two-volume selection which contains reliable texts of all of Peirce’s most important published and unpublished works.)

Peirce, C.S. (1867) ‘On a New List of Categories’, *Proceedings of the American Academy of Arts and Sciences* 7: 287–298.

(A classic but difficult paper, containing the first published statement of Peirce’s theory of categories. Reprinted as chap. 1, vol. 1 of Houser and Kloesel (eds) *The Essential Peirce*.)

The first three of the following papers contain an attack on Cartesian approaches to philosophy, introduce Peirce’s claim that all thought is in signs, and develop an account of truth and cognition on this basis. They are reprinted as chapters 2 to 4 of Houser and Kloesel (eds) *The Essential Peirce*.

Peirce, C.S. (1868a) ‘Questions Concerning Certain Faculties Claimed for Man’, *Journal of Speculative Philosophy* 2: 103–114;

(Challenges the Cartesian assumption that we can trust introspection as a source of information about the mind and denies that there are any 'intuitions', first premises for reasoning which are not shaped by earlier thoughts.)

Peirce, C.S. (1868b) 'Some Consequences of Four Incapacities', *Journal of Speculative Philosophy* 2: 140–157;

(The first published statement of Peirce's semiotic – his claim that all thought is in signs – and his ideas about reality.)

Peirce, C.S. (1868c) 'On a New List of Categories', in Houser and Kloesel (eds) *The Essential Peirce*, Bloomington, IN: Indiana University Press, 1–10.

(The first statement of Peirce's post-Kantian categorial scheme.)

Peirce, C.S. (1869) 'Grounds of Validity of the Laws of Logic: Further Consequences of Four Incapacities', *Journal of Speculative Philosophy* 2: 193–208.

(Draws out the implications of the two previous papers for the explanation of the validity of inductive and deductive reasoning.)

Peirce, C.S. (1870) 'Fraser's The Works of George Berkeley', *North American Review* 113: 449–472.

(A lengthy review which contains important discussions of realism versus nominalism (Houser and Kloesel 1992–4) and Peirce's conception of truth. Chapter 5 of this series of six papers is based on Peirce's attempt to write a logic text during the early 1870s. Although they are readable and extremely influential, the role of Peirce's theories of signs and categories is not made explicit. Available in chapters 7 to 12 of Houser and Kloesel.)

Peirce, C.S. (1877) 'The Fixation of Belief', *Popular Science Monthly* 12: 1–15.

(Classic statement of Peirce's theory of inquiry, defending the method of science as a method for replacing doubt by settled belief.)

Peirce, C.S. (1878a) 'How to Make Our Ideas Clear', *Popular Science Monthly* 12: 286–302.

(Introduces the pragmatist principle for clarifying concepts and ideas and uses it to explain the meaning of Reality.)

Peirce, C.S. (1878b) 'The Doctrine of Chances', *Popular Science Monthly* 12: 604–615

(Uses the pragmatist principle to clarify our understanding of statements of probability.)

Peirce, C.S. (1878c) 'The Probability of Induction', *Popular Science Monthly* 12: 705–718.

(Develops his view of probability and links it to an account of the success of inductive reasoning.)

Peirce, C.S. (1878d) 'The Order of Nature', *Popular Science Monthly* 13: 203–217.

(Attacks Mill's defence of inductive reasoning and argues that the success of science requires that human beings possess 'innate ideas': due to natural selection, they are predisposed to arrive at the correct theories of the world.)

Peirce, C.S. (1878e) 'Deduction, Induction and Hypothesis', *Popular Science Monthly* 13: 470–482.

(A formal and historical classification of the kinds of reasoning used in science.)

Peirce, C.S. (1887–8) 'A Guess at the Riddle', manuscript, 1887–8.

(This manuscript elaborates Peirce's system of categories through showing how they are manifested in different fields of knowledge. Chapter 19 of Houser and Kloesel (1992–4).)

Although occasionally hard and obscure, the first of the following five papers present the metaphysical system which Peirce had been developing throughout the 1880s. Reprinted as chapters 21 to 25 of Houser and Kloesel (1992–4).

Peirce, C.S. (1891) 'The Architecture of Theories', *The Monist* 1: 161–176.

(Discusses the proper approach to developing a system of metaphysics and describes the fundamental concepts to be used. His evolutionary cosmology is sketched and the importance of chance and continuity for an adequate philosophical system is emphasized.)

Peirce, C.S. (1892a) 'The Doctrine of Necessity Examined', *The Monist* 2: 321–337.

(Criticizes the most common arguments for determinism and defends his 'tychism', the doctrine that the universe must contain absolute chance.)

Peirce, C.S. (1892b) 'The Law of Mind', *The Monist* 2: 533–559.

(Introduces Peirce's 'synechism', the use of the idea of continuity in philosophy. The paper discusses the mathematical analysis of continuity as well as emphasizing its importance for understanding the mind.)

Peirce, C.S. (1892c) 'Man's Glassy Essence', *The Monist* 3: 1–22.

(Applies Peirce's theory of categories and his synechism to the understanding of matter and the relations between mind and body: contains the suggestion that 'matter is effete mind'.)

Peirce, C.S. (1892d) 'Evolutionary Love', *The Monist* 3: 176–200.

(Discusses the mechanisms of evolution, finally defending 'agapism', the doctrine that love is operative in the evolution of the universe.)

Peirce, C.S. (1898) *Reasoning and the Logic of Things*, ed. K.L. Ketner, Cambridge, MA: Harvard University Press.

(An important series of lectures which provides a useful introduction to Peirce's work in logic and philosophy. As well as an important discussion of theory and practice, they contain clear introductions to some of his logical theories and a useful discussion of causation and continuity.)

Hilary Putnam's valuable introduction contains useful information about Peirce's work on the mathematics of continuity.)

Peirce, C.S. (1903) *Pragmatism*, in *Collected Papers of Charles Sanders Peirce*, ed. C. Hartshorne and P. Weiss (vols 1–6), Cambridge, MA: Harvard University Press, 1931–58, vol. 5, 13–131.

(Lectures to Harvard University philosophy department, which attempt to state and defend Peirce's pragmatism. They elaborate his views on phenomenology and the categories; logic, ethics and aesthetics as normative sciences; abduction and perceptual judgments; and realism. An important, though sometimes obscure source.)

The first three of the following papers were part of an uncompleted series intended to 'prove' pragmatism. Manuscript drafts of later papers in the series survive.

Peirce, C.S. (1905a) 'What Pragmatism Is', *The Monist* 15: 161–181.

(Clarifies Peirce's pragmatism, relating it to laboratory practice and christening it 'pragmaticism' to distinguish it from William James' position.)

Peirce, C.S. (1905b) 'Issues of Pragmaticism', *The Monist* 15: 481–499.

(Contains important discussions of Peirce's mature realism and his critical common-sensism.)

Peirce, C.S. (1906) 'Prolegomena to an Apology for Pragmaticism', *The Monist* 16: 492–546.

(An introduction to Peirce's 'existential graphs', a system of formal logic which is to have a fundamental role in the unfinished proof of pragmatism.)

Peirce, C.S. (1908) 'A Neglected Argument for the Reality of God', *Hibbert Journal* 7: 90–112.

(An interesting argument for God's reality which is intended to fit Peirce's account of the method of science.)

Eisele, C. (1976) *The New Elements of Mathematics*, The Hague: Mouton.

(A five-volume anthology of Peirce's contributions to mathematics and mathematical logic.)

Hardwick, C. (1977) *Semiotic and Significs*, Bloomington, IN: Indiana University Press.

(This contains Peirce's correspondence with Lady Welby and is an important source for his work on signs.)

References and further reading

The secondary literature on Peirce is now enormous and the list below omits much that is interesting and important. The most important source of journal articles is the quarterly *Transactions of the Charles S. Peirce Society*.

Brent, J. (1993) *Charles Sanders Peirce: A Life*, Bloomington, IN: Indiana University Press.

(A fascinating study of Peirce's career and of his troubled personal life.)

Burch, R. (1991) *A Peircean Reduction Thesis*, Lubbock, TX: Texas Tech University Press.

(An important study which develops Peirce's formal logic and his use of it to defend his categories.)

Colapietro, V. (1989) *Peirce's Approach to the Self*, Buffalo, NY: State University of New York Press.

(Discusses Peirce's philosophy of mind and subjectivity from a perspective that takes his semiotic very seriously.)

Fisch, M. (1986) *Peirce, Semiotic and Pragmatism*, Bloomington, IN: Indiana University Press.

(A collection of papers dealing with biographical and philosophical matters by a distinguished scholar whose influence on the development of Peirce studies has been unparalleled.)

Goudge, T. (1950) *The Thought of C.S. Peirce*, Toronto: University of Toronto Press.

(Influential early monograph which argued that the tough-minded, naturalistic, empiricist aspect of Peirce's work could not be reconciled with the speculative, 'transcendental' side of his character.)

Hausman, C. (1993) *Charles S. Peirce's Evolutionary Philosophy*, Cambridge: Cambridge University Press.

(This book emphasizes the systematic structure of Peirce's work, studying his pragmatism, his theory of categories and his account of continuity and places special emphasis upon his metaphysical writings.)

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