

## Charles Sanders Peirce

Born in Cambridge, Massachusetts, **Charles Sanders Peirce** (September 10, 1839 - April 19, 1914)

was the son of Benjamin Peirce, a Harvard professor who was the foremost American mathematician of his time. [“Peirce” is pronounced “purse.”] Charles grew up in the company of the leading figures in academic and scientific circles. He was a prodigy in both science and philosophy and perhaps was even more brilliant in mathematics than his illustrious father. After reading Immanuel Kant’s *Critique of Pure Reason* at age 13, the young Peirce announced that Kant’s system was corrupted by its “puerile logic.”



*Charles Sanders Peirce*

Benjamin planned to make his son a “thinking machine.” To do so he supervised every step of his son’s



*Benjamin Peirce*

his efforts were mixed. Charles was a rather ordinary student at Harvard. His independence of mind, which was first greatly admired, impeded his success in getting the recognition his genius deserved. Still, his father’s training made his son, for better or worse, what he became. And what did he become?

According to Max H. Fisch in *The Play of Musement*, Charles was “the most original and most versatile intellect the Americas have ever produced. He was mathematician, astronomer, chemist, geodesist, surveyor, cartographer, metrologist, spectroscopist, engineer, inventor, psychologist, lexicographer, historian of science, mathematical economist, lifelong student of medicine, book reviewer, dramatist, actor, short story writer, phenomenologist, semiotician, logician, rhetorician and metaphysician.”

Peirce joined the U.S. Coast Guard and Geodetic Survey in 1861, where he remained for thirty years.

His primary field of scientific research was geodesy, and he was instrumental in integrating the geodetic work of the United States with that of the rest of the world. His efforts raised the stature of the U.S. Coast Survey to a position of respectability in international scientific circles. Although he never held a permanent academic position, during the 1860s he gave lectures on the philosophy of science and logic at Harvard, and between 1879 and 1884 he lectured on logic at Johns Hopkins University. Although his connection was with the philosophy department, Peirce became a member of the mathematical community that included James Joseph Sylvester and for a time Arthur Cayley. During this period Peirce became regarded as one of the world's great logicians.

Unfortunately, in 1884, it was reported to the board of trustees of Johns Hopkins that Peirce openly was having an affair with a Frenchwoman while still married to his estranged wife. As a result of the scandal, his contract was not renewed and he was forced to leave academia forever. From that point on he dedicated himself to private study. The result was an enormous number of papers, which when collected and published after his death, filled eight volumes. His mathematical researches were in mathematical logic, set theory, transfinite arithmetic, the Four Color Problem, knots and linkages, probability, and in extending his father's work with associative algebras. His interest in conformal map projections led him to invent a quincuncial map projection using elliptic functions.

Peirce is best known as the founder of *pragmatism*, which had its origin in the discussions of a fortnightly "Metaphysical Club," located in Cambridge. Besides Peirce, its members included Oliver Wendell Holmes Jr., John Fiske, William James, Josiah Royce and Francis E. Abbott. Peirce first gave systematic expression to Pragmatism as a philosophical movement in an article "How to Make Our Ideas Clear," in *Popular Science Monthly*, January 1878. He claimed that to develop a thought's meaning, it is only necessary to determine what conduct it is fitted to produce, and that conduct is its sole significance. Peirce proposed a theory of meaning in which a belief or an idea is to be understood

by the actions, uses, and habits to which it gives rise. Pragmatism was extended by, among others, William James and later revised by John Dewey. Pragmatism agrees with empiricism in emphasizing the priority of experience over *a priori* reasoning. Pragmatists interpret ideas as instruments and plans of action. They object to the view that concepts, judgments, and reasoning processes are representative of reality and the processes of reality. They claim that statements only have meaning to the extent that they can affect our actions, and truth is what works for a scientifically sophisticated community.

Two important tenets of Peirce's pragmatism are *critical common-sensism* and *contrite fallibilism*. By common-sensism, he meant that humans often have no alternative other than adopting vague but indubitable beliefs that "rest on the everyday experience of multitudinous populations." An example of common-sensism is the belief that there is order in the universe, something that has never been proved, despite being readily accepted by most. Contrite fallibilism asserts that all human beliefs and conclusions, even those put forward by scientists, are subject to error. Peirce asserted, "that we can never be absolutely sure of anything, nor can we with probability ascertain the exact value of any measure or general ratio." Peirce's lifelong friend and benefactor James was quite persuasive in publicizing the pragmatic view but gave it his own characteristic twist, splitting it away from Peirce's doctrines, which caused the latter to rename his philosophy *pragmaticism* to distinguish it from the work of James.

Peirce applied the concepts of Boolean algebra to relations. He considered the union, intersection, relative product, relative sum, complement and converse of relative terms such as "father of" and "son of," (symbolically  $f$  and  $s$ ). He used the expression  $f + s$  to represent "father of or son of",  $f \cdot s$  to represent "father of and son of",  $f ; e$  to represent "father of a son of",  $f \dagger s$  to represent "father of every son of";  $\sim f$  to represent "is not a father of" and  $\sim f$  to represent "is one to whom the other is father." Peirce presented numerous theorems involving his operations on relative terms. Peirce's calculus of

relations remains an alternative, algebraic approach to the logic of relations.

Peirce strenuously disagreed with Augustus De Morgan's contention that probability was a measure of confidence or degree of belief, which is now known as the subjectivist theory of probability. Peirce also ridiculed the Bayesian analysis of the problem of induction by the Belgian statistician and sociologist Adolphe Quételet. Peirce adopted the objectivist notion of probability as an idea with clear empirical content and empirical procedures. For Peirce that which is assigned a probability is not a proposition nor an event but rather an argument with premisses (his preferred spelling) and a conclusion. To determine the probability of a particular argument it is required to determine all the times in which all of the premisses are true, case-by-case. A changing ratio is calculated whose numerator is the number of occasions to that point in which both the conclusion and the premisses are true and the denominator is the number of occasions to that point when the premisses are true, irrespective of whether the conclusion is true.

Benjamin Peirce was not the first father to set out to make his child an intellectual giant. An earlier example is of Leopold Mozart and his son Wolfgang Amadeus Mozart. In more recent times, the father of Tiger Woods and the father of the tennis sisters, Venus and Serena Williams made conscious efforts when their children were very young to train them to become champions. The unanswered question is whether the fathers created their children's particular talents or merely revealed and nurtured them. Although not everyone will wish to program their children's lives, much can be done to help them discover their gifts and develop themselves as fully as possible.

**Quotation of the Day:** "Among the minor, yet striking characteristics of mathematics, may be mentioned the fleshless and skeletal build of its propositions; the peculiar difficulty, complication, and stress of its reasonings; the perfect exactitude of its results; their broad universality; their practical infallibility." – Charles Sanders Peirce