Charles Sanders Peirce

en.wikipedia.org

March 21, 2022

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1 Charles Sanders Peirce

American thinker who founded pragmatism (1839–1914)

Charles Sanders Peirce

Born	September 10, 1839 Cambridge, Massachusetts, U.S.
Died	April 19, 1914 (aged 74) Milford, Pennsylvania, U.S.
Alma mater	Harvard University
Parent(s)	• Benjamin Peirce (father)

Scientific career

Fields

- Logic
- mathematics
- statistics[1][2]
- philosophy
- metrology[3]
- chemistry
- experimental psychology[4]
- economics[5]
- linguistics[6]
- history of science

Institutions	Johns Hopkins University

Philosophy career

Era	Late modern philosophy
Region	Western philosophy
School	Pragmatism Pragmaticism
Notable students	

Charles Sanders Peirce

Main interests

- Philosophical logic
- metaphysics
- epistemology

Signature

Part of a series[1] on
Charles Sanders Peirce

- Bibliography[2]

Philosophical

- Categories (Peirce)[3]
- Existential graph[4]
- Peirce's law[5]
- Peirce's semiotic theory[6]
- Pragmatic maxim[7]
- Pragmaticism[8]
- Fallibilism[9]
- Synechism[10]
- Tychism[11]
- Phaneron[12]
- Classification of the sciences[13]

Biographical

1 https://en.wikipedia.org/wiki/Category:Charles_Sanders_Peirce
2 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography
3 https://en.wikipedia.org/wiki/Categories_(Peirce)
4 https://en.wikipedia.org/wiki/Existential_graph
5 https://en.wikipedia.org/wiki/Peirce%27s_law
6 https://en.wikipedia.org/wiki/Semiotic_theory_of_Charles_Sanders_Peirce
7 https://en.wikipedia.org/wiki/Pragmatic_maxim
8 https://en.wikipedia.org/wiki/Pragmaticism
9 https://en.wikipedia.org/wiki/Fallibilism
10 https://en.wikipedia.org/wiki/Synechism
11 https://en.wikipedia.org/wiki/Tychism
12 https://en.wikipedia.org/wiki/Phaneron
13 https://en.wikipedia.org/wiki/Classification_of_the_sciences_(Peirce)

- Juliette Peirce[14]
- Charles Santiago Sanders Peirce[15]

- v[16]
- t[17]
- e[18]

Charles Sanders Peirce (/pɜːrs/[19][8][9] *PURSS*[20]; September 10, 1839 – April 19, 1914) was an American philosopher, logician[21], mathematician and scientist who is sometimes known as "the father of pragmatism[22]".[10][11] He was known as a somewhat unusual character.[12][*vague*[23]]

Educated as a chemist and employed as a scientist for thirty years, Peirce made major contributions to logic[24], a subject that, for him, encompassed much of what is now called epistemology[25] and the philosophy of science[26]. He saw logic as the formal branch of semiotics[27], of which he is a founder, which foreshadowed the debate among logical positivists[28] and proponents of philosophy of language[29] that dominated 20th-century Western philosophy. Additionally, he defined the concept of abductive reasoning[30], as well as rigorously formulated mathematical induction[31] and deductive reasoning[32]. As early as 1886, he saw that logical operations could be carried out by electrical switching circuits[33]. The same idea was used decades later to produce digital computers.[13]

In 1934, the philosopher Paul Weiss[34] called Peirce "the most original and versatile of American philosophers and America's greatest logician".[14]

14 https://en.wikipedia.org/wiki/Juliette_Peirce
15 https://en.wikipedia.org/wiki/Charles_Santiago_Sanders_Peirce
16 https://en.wikipedia.org/wiki/Template:C._S._Peirce_articles
17 https://en.wikipedia.org/wiki/Template_talk:C._S._Peirce_articles
18 https://en.wikipedia.org/w/index.php?title=Template:C._S._Peirce_articles&action=edit
19 https://en.wikipedia.org/wiki/Help:IPA/English
20 https://en.wikipedia.org/wiki/Help:Pronunciation_respelling_key
21 https://en.wikipedia.org/wiki/Logic
22 https://en.wikipedia.org/wiki/Pragmatism
24 https://en.wikipedia.org/wiki/Logic
25 https://en.wikipedia.org/wiki/Epistemology
26 https://en.wikipedia.org/wiki/Philosophy_of_science
27 https://en.wikipedia.org/wiki/Semiotics
28 https://en.wikipedia.org/wiki/Logical_positivists
29 https://en.wikipedia.org/wiki/Philosophy_of_language
30 https://en.wikipedia.org/wiki/Abductive_reasoning
31 https://en.wikipedia.org/wiki/Mathematical_induction
32 https://en.wikipedia.org/wiki/Deductive_reasoning
33 https://en.wikipedia.org/wiki/Logic_gate
34 https://en.wikipedia.org/wiki/Paul_Weiss_(philosopher)

1.1 Life

Figure 1 Peirce's birthplace. Now part of Lesley University's Graduate School of Arts and Social Sciences.

Peirce was born at 3 Phillips Place in Cambridge, Massachusetts[35]. He was the son of Sarah Hunt Mills and Benjamin Peirce[36], himself a professor of astronomy[37] and mathematics at Harvard University[38]. At age 12, Charles read his older brother's copy of Richard Whately[39]'s *Elements of Logic*, then the leading English-language text on the subject. So began his lifelong fascination with logic and reasoning.[15] He went on to earn a Bachelor of Arts degree and a Master of Arts degree (1862) from Harvard. In 1863 the Lawrence Scientific School[40] awarded him a Bachelor of Science degree, Harvard's first *summa cum laude* chemistry[41] degree.[16] His academic record was otherwise undistinguished.[17] At Harvard, he began lifelong friendships with Francis Ellingwood Abbot[42], Chauncey Wright[43],

35 https://en.wikipedia.org/wiki/Cambridge,_Massachusetts
36 https://en.wikipedia.org/wiki/Benjamin_Peirce
37 https://en.wikipedia.org/wiki/Astronomy
38 https://en.wikipedia.org/wiki/Harvard_University
39 https://en.wikipedia.org/wiki/Richard_Whately
40 https://en.wikipedia.org/wiki/Lawrence_Scientific_School
41 https://en.wikipedia.org/wiki/Chemistry
42 https://en.wikipedia.org/wiki/Francis_Ellingwood_Abbot
43 https://en.wikipedia.org/wiki/Chauncey_Wright

and William James[44].[18] One of his Harvard instructors, Charles William Eliot[45], formed an unfavorable opinion of Peirce. This proved fateful, because Eliot, while President of Harvard (1869–1909—a period encompassing nearly all of Peirce's working life), repeatedly vetoed Peirce's employment at the university.[19]

Peirce suffered from his late teens onward from a nervous condition then known as "facial neuralgia", which would today be diagnosed as trigeminal neuralgia[46]. His biographer, Joseph Brent, says that when in the throes of its pain "he was, at first, almost stupefied, and then aloof, cold, depressed, extremely suspicious, impatient of the slightest crossing, and subject to violent outbursts of temper".[20] Its consequences may have led to the social isolation of his later life.

1.1.1 Early employment

Between 1859 and 1891, Peirce was intermittently employed in various scientific capacities by the United States Coast Survey[47] and its successor, the United States Coast and Geodetic Survey[48],[21] where he enjoyed his highly influential father's protection until the latter's death in 1880.[22] That employment exempted Peirce from having to take part in the American Civil War[49]; it would have been very awkward for him to do so, as the Boston Brahmin[50] Peirces sympathized with the Confederacy[51].[23] At the Survey, he worked mainly in geodesy[52] and gravimetry[53], refining the use of pendulums[54] to determine small local variations in the Earth's gravity[55].[21] He was elected a resident fellow of the American Academy of Arts and Sciences[56] in January 1867.[24] The Survey sent him to Europe five times,[25] first in 1871 as part of a group sent to observe a solar eclipse[57]. There, he sought out Augustus De Morgan[58], William Stanley Jevons[59], and William Kingdon Clifford[60],[26] British mathematicians and logicians whose turn of mind resembled his own. From 1869 to 1872, he was employed as an assistant in Harvard's astronomical observatory, doing important work on determining the brightness of stars[61] and the shape of the Milky Way[62].[27] On April 20, 1877, he was elected a member of the National Academy of Sciences[63].[28] Also

44 https://en.wikipedia.org/wiki/William_James
45 https://en.wikipedia.org/wiki/Charles_William_Eliot
46 https://en.wikipedia.org/wiki/Trigeminal_neuralgia
47 https://en.wikipedia.org/wiki/U.S._National_Geodetic_Survey
48 https://en.wikipedia.org/wiki/United_States_Coast_and_Geodetic_Survey
49 https://en.wikipedia.org/wiki/American_Civil_War
50 https://en.wikipedia.org/wiki/Boston_Brahmin
51 https://en.wikipedia.org/wiki/Confederate_States_of_America
52 https://en.wikipedia.org/wiki/Geodesy
53 https://en.wikipedia.org/wiki/Gravimetry
54 https://en.wikipedia.org/wiki/Pendulum
55 https://en.wikipedia.org/wiki/Gravity
56 https://en.wikipedia.org/wiki/American_Academy_of_Arts_and_Sciences
57 https://en.wikipedia.org/wiki/Solar_eclipse
58 https://en.wikipedia.org/wiki/Augustus_De_Morgan
59 https://en.wikipedia.org/wiki/William_Stanley_Jevons
60 https://en.wikipedia.org/wiki/William_Kingdon_Clifford
61 https://en.wikipedia.org/wiki/Star
62 https://en.wikipedia.org/wiki/Milky_Way
63 https://en.wikipedia.org/wiki/National_Academy_of_Sciences

in 1877, he proposed measuring the meter as so many wavelengths[64] of light of a certain frequency[65],[29] the kind of definition employed from 1960 to 1983[66].

During the 1880s, Peirce's indifference to bureaucratic detail waxed while his Survey work's quality and timeliness waned. Peirce took years to write reports that he should have completed in months.[*according to whom?*[67]] Meanwhile, he wrote entries, ultimately thousands, during 1883–1909 on philosophy, logic, science, and other subjects for the encyclopedic *Century Dictionary*[68].[30] In 1885, an investigation by the Allison[69] Commission exonerated Peirce, but led to the dismissal of Superintendent Julius Hilgard[70] and several other Coast Survey employees for misuse of public funds.[31] In 1891, Peirce resigned from the Coast Survey at Superintendent Thomas Corwin Mendenhall[71]'s request.[32]

1.1.2 Johns Hopkins University

In 1879, Peirce was appointed lecturer in logic at Johns Hopkins University[72], which had strong departments in areas that interested him, such as philosophy (Royce[73] and Dewey[74] completed their Ph.D.s at Hopkins), psychology (taught by G. Stanley Hall[75] and studied by Joseph Jastrow[76], who coauthored a landmark empirical study with Peirce), and mathematics (taught by J. J. Sylvester[77], who came to admire Peirce's work on mathematics and logic). His *Studies in Logic by Members of the Johns Hopkins University*[78] (1883) contained works by himself and Allan Marquand[79], Christine Ladd[80], Benjamin Ives Gilman[81], and Oscar Howard Mitchell[82], several of whom were his graduate students.[7] Peirce's nontenured position at Hopkins was the only academic appointment he ever held.

Brent documents something Peirce never suspected, namely that his efforts to obtain academic employment, grants, and scientific respectability were repeatedly frustrated by the covert opposition of a major Canadian-American scientist of the day, Simon Newcomb[83].[33] Peirce's efforts may also have been hampered by what Brent characterizes as "his difficult personality".[34] In contrast, Keith Devlin[84] believes that Peirce's work was too far ahead of

64 https://en.wikipedia.org/wiki/Wavelength
65 https://en.wikipedia.org/wiki/Frequency
66 https://en.wikipedia.org/wiki/Metre#Wavelength_definition
68 https://en.wikipedia.org/wiki/Century_Dictionary
69 https://en.wikipedia.org/wiki/William_B._Allison
70 https://en.wikipedia.org/wiki/Julius_Hilgard
71 https://en.wikipedia.org/wiki/Thomas_Corwin_Mendenhall
72 https://en.wikipedia.org/wiki/Johns_Hopkins_University
73 https://en.wikipedia.org/wiki/Josiah_Royce
74 https://en.wikipedia.org/wiki/John_Dewey
75 https://en.wikipedia.org/wiki/G._Stanley_Hall
76 https://en.wikipedia.org/wiki/Joseph_Jastrow
77 https://en.wikipedia.org/wiki/J._J._Sylvester
78 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#SIL
79 https://en.wikipedia.org/wiki/Allan_Marquand
80 https://en.wikipedia.org/wiki/Christine_Ladd-Franklin
81 https://en.wikipedia.org/wiki/Benjamin_Ives_Gilman
82 https://en.wikipedia.org/w/index.php?title=Oscar_Howard_Mitchell&action=edit&redlink=1
83 https://en.wikipedia.org/wiki/Simon_Newcomb
84 https://en.wikipedia.org/wiki/Keith_Devlin

his time to be appreciated by the academic establishment of the day and that this played a large role in his inability to obtain a tenured position.[35]

Peirce's personal life undoubtedly worked against his professional success. After his first wife, Harriet Melusina Fay[85] ("Zina"), left him in 1875,[36] Peirce, while still legally married, became involved with Juliette[86], whose last name, given variously as Froissy and Pourtalai, [37] and nationality (she spoke French)[38] remains uncertain.[39] When his divorce from Zina became final in 1883, he married Juliette.[40] That year, Newcomb pointed out to a Johns Hopkins trustee that Peirce, while a Hopkins employee, had lived and traveled with a woman to whom he was not married; the ensuing scandal led to his dismissal in January 1884.[41] Over the years Peirce sought academic employment at various universities without success. [42] He had no children by either marriage.[43]

1.1.3 Poverty

Figure 2 Arisbe in 2011

85 https://en.wikipedia.org/wiki/Melusina_Fay_Peirce
86 https://en.wikipedia.org/wiki/Juliette_Peirce

Figure 3 Cambridge, where Peirce was born and raised, New York City, where he often visited and sometimes lived, and Milford, where he spent the later years of his life with his second wife Juliette

Figure 4 Juliette and Charles by a well at their home Arisbe in 1907

Figure 5 Charles and Juliette Peirce's grave

In 1887, Peirce spent part of his inheritance from his parents to buy 2,000 acres (8 km^2) of rural land near Milford, Pennsylvania[87], which never yielded an economic return.[44] There he had an 1854 farmhouse remodeled to his design.[45] The Peirces named the property "Arisbe[88]". There they lived with few interruptions for the rest of their lives,[46] Charles writing prolifically, much of it unpublished to this day (see Works[89]). Living beyond their means soon led to grave financial and legal difficulties.[47] He spent much of his last two

87 https://en.wikipedia.org/wiki/Milford,_Pennsylvania
88 https://en.wikipedia.org/wiki/Juliette_Peirce#Arisbe
89 #Works

decades unable to afford heat in winter and subsisting on old bread donated by the local baker. Unable to afford new stationery, he wrote on the verso[90] side of old manuscripts. An outstanding warrant for assault and unpaid debts led to his being a fugitive in New York City for a while.[48] Several people, including his brother James Mills Peirce[91][49] and his neighbors, relatives of Gifford Pinchot[92], settled his debts and paid his property taxes and mortgage.[50]

Peirce did some scientific and engineering consulting and wrote much for meager pay, mainly encyclopedic dictionary entries, and reviews for *The Nation*[93] (with whose editor, Wendell Phillips Garrison[94], he became friendly). He did translations for the Smithsonian Institution[95], at its director Samuel Langley[96]'s instigation. Peirce also did substantial mathematical calculations for Langley's research on powered flight. Hoping to make money, Peirce tried inventing.[51] He began but did not complete several books.[52] In 1888, President Grover Cleveland[97] appointed him to the Assay Commission[98].[53]

From 1890 on, he had a friend and admirer in Judge Francis C. Russell[99] of Chicago,[54] who introduced Peirce to editor Paul Carus[100] and owner Edward C. Hegeler[101] of the pioneering American philosophy journal *The Monist*[102], which eventually published at least 14 articles by Peirce.[55] He wrote many texts in James Mark Baldwin[103]'s *Dictionary of Philosophy and Psychology*[104] (1901–1905); half of those credited to him appear to have been written actually by Christine Ladd-Franklin[105] under his supervision.[56] He applied in 1902 to the newly formed Carnegie Institution[106] for a grant to write a systematic book describing his life's work. The application was doomed; his nemesis, Newcomb, served on the Carnegie Institution executive committee, and its president had been president of Johns Hopkins at the time of Peirce's dismissal.[57]

The one who did the most to help Peirce in these desperate times was his old friend William James[107], dedicating his *Will to Believe* (1897) to Peirce, and arranging for Peirce to be paid to give two series of lectures at or near Harvard (1898 and 1903).[58] Most important, each year from 1907 until James's death in 1910, James wrote to his friends in the Boston intelligentsia to request financial aid for Peirce; the fund continued even after James died. Peirce reciprocated by designating James's eldest son as his heir should Juliette predecease him.[59] It has been believed that this was also why Peirce used "Santiago" ("St. James" in

90 https://en.wikipedia.org/wiki/Verso
91 https://en.wikipedia.org/wiki/James_Mills_Peirce
92 https://en.wikipedia.org/wiki/Gifford_Pinchot
93 https://en.wikipedia.org/wiki/The_Nation_(U.S._periodical)
94 https://en.wikipedia.org/wiki/Wendell_Phillips_Garrison
95 https://en.wikipedia.org/wiki/Smithsonian_Institution
96 https://en.wikipedia.org/wiki/Samuel_Langley
97 https://en.wikipedia.org/wiki/Grover_Cleveland
98 https://en.wikipedia.org/wiki/Assay_Commission
99 https://en.wikipedia.org/w/index.php?title=Francis_C._Russell&action=edit&redlink=1
100 https://en.wikipedia.org/wiki/Paul_Carus
101 https://en.wikipedia.org/wiki/Edward_C._Hegeler
102 https://en.wikipedia.org/wiki/The_Monist
103 https://en.wikipedia.org/wiki/James_Mark_Baldwin
104 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#Peirce's_definitions_in_the_Baldwin
105 https://en.wikipedia.org/wiki/Christine_Ladd-Franklin
106 https://en.wikipedia.org/wiki/Carnegie_Institution
107 https://en.wikipedia.org/wiki/William_James

English) as a middle name, but he appeared in print as early as 1890 as Charles Santiago Peirce. (See Charles Santiago Sanders Peirce[108] for discussion and references).

Peirce died destitute in Milford, Pennsylvania[109], twenty years before his widow. Juliette Peirce kept the urn with Peirce's ashes at Arisbe. In 1934, Pennsylvania Governor Gifford Pinchot[110] arranged for Juliette's burial on Milford Cemetery. The urn with Peirce's ashes was interred with Juliette.[60]

1.1.4 Slavery, the American Civil War, and racism

Peirce grew up in a home where white supremacy was taken for granted, and Southern slavery was considered natural.[61]

Until the outbreak of the Civil War his father described himself as a secessionist[111], but after the outbreak of the war, this stopped and he became a Union[112] partisan, providing donations to the Sanitary Commission[113], the leading Northern war charity. No members of the Peirce family volunteered or enlisted. Peirce shared his father's views and liked to use the following syllogism[114] to illustrate the unreliability of traditional forms of logic:[62]

> All Men are equal in their political rights.
>
> Negroes are Men.
>
> Therefore, negroes are equal in political rights to whites.

1.2 Reception

Bertrand Russell[115] (1959) wrote "Beyond doubt [...] he was one of the most original minds of the later nineteenth century and certainly the greatest American thinker ever".[63] Russell and Whitehead[116]'s *Principia Mathematica*[117], published from 1910 to 1913, does not mention Peirce (Peirce's work was not widely known until later).[64] A. N. Whitehead[118], while reading some of Peirce's unpublished manuscripts soon after arriving at Harvard in 1924, was struck by how Peirce had anticipated his own "process" thinking. (On Peirce and process metaphysics[119], see Lowe 1964.[27]) Karl Popper[120] viewed Peirce as "one of the greatest philosophers of all times".[65] Yet Peirce's achievements were not immediately

108 https://en.wikipedia.org/wiki/Charles_Santiago_Sanders_Peirce
109 https://en.wikipedia.org/wiki/Milford,_Pennsylvania
110 https://en.wikipedia.org/wiki/Gifford_Pinchot
111 https://en.wikipedia.org/wiki/Secession_in_the_United_States
112 https://en.wikipedia.org/wiki/Union_(American_Civil_War)
113 https://en.wikipedia.org/wiki/United_States_Sanitary_Commission
114 https://en.wikipedia.org/wiki/Syllogism
115 https://en.wikipedia.org/wiki/Bertrand_Russell
116 https://en.wikipedia.org/wiki/Alfred_North_Whitehead
117 https://en.wikipedia.org/wiki/Principia_Mathematica
118 https://en.wikipedia.org/wiki/A._N._Whitehead
119 https://en.wikipedia.org/wiki/Process_metaphysics
120 https://en.wikipedia.org/wiki/Karl_Popper

recognized. His imposing contemporaries William James[121] and Josiah Royce[122][66] admired him and Cassius Jackson Keyser[123], at Columbia and C. K. Ogden[124], wrote about Peirce with respect but to no immediate effect.

The first scholar to give Peirce his considered professional attention was Royce's student Morris Raphael Cohen[125], the editor of an anthology of Peirce's writings entitled *Chance, Love, and Logic*[126] (1923), and the author of the first bibliography of Peirce's scattered writings.[67] John Dewey[127] studied under Peirce at Johns Hopkins.[7] From 1916 onward, Dewey's writings repeatedly mention Peirce with deference. His 1938 *Logic: The Theory of Inquiry* is much influenced by Peirce.[68] The publication of the first six volumes of *Collected Papers* (1931–1935), the most important event to date in Peirce studies and one that Cohen made possible by raising the needed funds,[69] did not prompt an outpouring of secondary studies. The editors of those volumes, Charles Hartshorne[128] and Paul Weiss[129], did not become Peirce specialists. Early landmarks of the secondary literature include the monographs by Buchler (1939), Feibleman (1946), and Goudge[130] (1950), the 1941 PhD thesis by Arthur W. Burks[131] (who went on to edit volumes 7 and 8), and the studies edited by Wiener and Young (1952). The Charles S. Peirce Society[132] was founded in 1946. Its *Transactions*, an academic quarterly specializing in Peirce's pragmatism and American philosophy has appeared since 1965.[70] (See Phillips 2014, 62 for discussion of Peirce and Dewey relative to transactionalism[133].)

By 1943 such was Peirce's reputation, in the US at least, that *Webster's Biographical Dictionary* said that Peirce was "now regarded as the most original thinker and greatest logician of his time".[71]

In 1949, while doing unrelated archival work, the historian of mathematics Carolyn Eisele[134] (1902–2000) chanced on an autograph letter by Peirce. So began her forty years of research on Peirce, "the mathematician and scientist," culminating in Eisele (1976, 1979, 1985). Beginning around 1960, the philosopher and historian of ideas[135] Max Fisch[136] (1900–1995) emerged as an authority on Peirce (Fisch, 1986).[72] He includes many of his relevant articles in a survey (Fisch 1986: 422–48) of the impact of Peirce's thought through 1983.

121 https://en.wikipedia.org/wiki/William_James
122 https://en.wikipedia.org/wiki/Josiah_Royce
123 https://en.wikipedia.org/wiki/Cassius_Jackson_Keyser
124 https://en.wikipedia.org/wiki/C._K._Ogden
125 https://en.wikipedia.org/wiki/Morris_Raphael_Cohen
126 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#CLL
127 https://en.wikipedia.org/wiki/John_Dewey
128 https://en.wikipedia.org/wiki/Charles_Hartshorne
129 https://en.wikipedia.org/wiki/Paul_Weiss_(philosopher)
130 https://en.wikipedia.org/wiki/T._A._Goudge
131 https://en.wikipedia.org/wiki/Arthur_W._Burks
132 https://en.wikipedia.org/wiki/Charles_S._Peirce_Society
133 https://en.wikipedia.org/wiki/Transactionalism
134 https://en.wikipedia.org/wiki/Carolyn_Eisele
135 https://en.wikipedia.org/wiki/History_of_ideas
136 https://en.wikipedia.org/w/index.php?title=Max_Fisch&action=edit&redlink=1

Peirce has gained an international following, marked by university research centers devoted to Peirce studies and pragmatism[137] in Brazil (CeneP/CIEP[138]), Finland (HPRC[139] and Commens[140]), Germany (Wirth's group[141], Hoffman's and Otte's group[142], and Deuser's and Härle's group[73]), France (L'I.R.S.C.E.[143]), Spain (GEP[144]), and Italy (CSP[145]). His writings have been translated into several languages, including German, French, Finnish, Spanish, and Swedish. Since 1950, there have been French, Italian, Spanish, British, and Brazilian Peirce scholars of note. For many years, the North American philosophy department most devoted to Peirce was the University of Toronto[146], thanks in part to the leadership of Thomas Goudge[147] and David Savan. In recent years, U.S. Peirce scholars have clustered at Indiana University – Purdue University Indianapolis[148], home of the Peirce Edition Project[149] (PEP) –, and Pennsylvania State University[150].

> Currently, considerable interest is being taken in Peirce's ideas by researchers wholly outside the arena of academic philosophy. The interest comes from industry, business, technology, intelligence organizations, and the military; and it has resulted in the existence of a substantial number of agencies, institutes, businesses, and laboratories in which ongoing research into and development of Peircean concepts are being vigorously undertaken.
>
> —
>
> Robert Burch, 2001, updated 2010[21]

In recent years, Peirce's trichotomy[151] of signs is exploited by a growing number of practitioners for marketing and design tasks.

John Deely[152] writes that Peirce was the last of the "moderns" and "first of the postmoderns". He lauds Peirce's doctrine of signs as a contribution to the dawn of the Postmodern[153] epoch. Deely additionally comments that "Peirce stands...in a position analogous to the position occupied by Augustine[154] as last of the Western Fathers[155] and first of the medievals".[74]

137 https://en.wikipedia.org/wiki/Pragmatism
138 #CIEP
139 #HPRC
140 #CDPT
141 #IRGAI
142 #RGSEME
143 #LIRSCE
144 #GEP
145 #CSPI
146 https://en.wikipedia.org/wiki/University_of_Toronto
147 https://en.wikipedia.org/wiki/T._A._Goudge
148 https://en.wikipedia.org/wiki/IUPUI
149 #PEP
150 https://en.wikipedia.org/wiki/Pennsylvania_State_University
151 https://en.wiktionary.org/wiki/trichotomy
152 https://en.wikipedia.org/wiki/John_Deely
153 https://en.wikipedia.org/wiki/Postmodern
154 https://en.wikipedia.org/wiki/Augustine_of_Hippo
155 https://en.wikipedia.org/wiki/Church_Fathers

1.3 Works

See also: Charles Sanders Peirce bibliography[156] Peirce's reputation rests largely on academic papers published in American scientific and scholarly journals such as *Proceedings of the American Academy of Arts and Sciences*[157], the *Journal of Speculative Philosophy*, *The Monist*[158], *Popular Science*[159] *Monthly*, the *American Journal of Mathematics*[160], *Memoirs of the National Academy of Sciences*[161], *The Nation*[162], and others. See Articles by Peirce, published in his lifetime[163] for an extensive list with links to them online. The only full-length book (neither extract nor pamphlet) that Peirce authored and saw published in his lifetime[75] was *Photometric Researches*[164] (1878), a 181-page monograph on the applications of spectrographic methods to astronomy. While at Johns Hopkins, he edited *Studies in Logic*[165] (1883), containing chapters by himself and his graduate students[166]. Besides lectures during his years (1879–1884) as lecturer in Logic at Johns Hopkins, he gave at least nine series of lectures, many now published; see Lectures by Peirce[167].

After Peirce's death, Harvard University[168] obtained from Peirce's widow the papers found in his study, but did not microfilm them until 1964. Only after Richard Robin (1967)[76] catalogued this *Nachlass*[169] did it become clear that Peirce had left approximately 1,650 unpublished manuscripts, totaling over 100,000 pages,[77] mostly still unpublished except on microfilm[170]. On the vicissitudes of Peirce's papers, see Houser (1989).[78] Reportedly the papers remain in unsatisfactory condition.[79]

The first published anthology of Peirce's articles was the one-volume *Chance, Love and Logic: Philosophical Essays*[171], edited by Morris Raphael Cohen[172], 1923, still in print. Other one-volume anthologies[173] were published in 1940, 1957, 1958, 1972, 1994, and 2009, most still in print. The main posthumous editions[80] of Peirce's works in their long trek to light, often multi-volume, and some still in print, have included:

1931–1958: *Collected Papers of Charles Sanders Peirce*[174] (CP), 8 volumes, includes many published works, along with a selection of previously unpublished work and a smattering of his correspondence. This long-time standard edition drawn from Peirce's work from the 1860s to 1913 remains the most comprehensive survey of his prolific output from 1893 to

156 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography
157 https://en.wikipedia.org/wiki/American_Academy_of_Arts_and_Sciences
158 https://en.wikipedia.org/wiki/The_Monist
159 https://en.wikipedia.org/wiki/Popular_Science
160 https://en.wikipedia.org/wiki/American_Journal_of_Mathematics
161 https://en.wikipedia.org/wiki/United_States_National_Academy_of_Sciences
162 https://en.wikipedia.org/wiki/The_Nation_(U.S._periodical)
163 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#Articles_by_Peirce,_published_in_his_lifetime
164 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#PR
165 #SIL
166 #GS
167 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#Lectures_by_Peirce
168 https://en.wikipedia.org/wiki/Harvard_University
169 https://en.wikipedia.org/wiki/Nachlass
170 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#mf
171 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#CLL
172 https://en.wikipedia.org/wiki/Morris_Raphael_Cohen
173 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#Other_collections
174 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#CP

1913. It is organized thematically, but texts (including lecture series) are often split up across volumes, while texts from various stages in Peirce's development are often combined, requiring frequent visits to editors' notes.[81] Edited (1–6) by Charles Hartshorne[175] and Paul Weiss[176] and (7–8) by Arthur Burks[177], in print and online.

1975–1987: *Charles Sanders Peirce: Contributions to* The Nation[178], 4 volumes, includes Peirce's more than 300 reviews and articles published 1869–1908 in *The Nation*[179]. Edited by Kenneth Laine Ketner and James Edward Cook, online.

1976: *The New Elements of Mathematics by Charles S. Peirce*[180], 4 volumes in 5, included many previously unpublished Peirce manuscripts on mathematical subjects, along with Peirce's important published mathematical articles. Edited by Carolyn Eisele, back in print.

1977: *Semiotic and Significs: The Correspondence between C. S. Peirce and Victoria Lady Welby*[181] (2nd edition 2001), included Peirce's entire correspondence (1903–1912) with Victoria, Lady Welby[182]. Peirce's other published correspondence is largely limited to the 14 letters included in volume 8 of the *Collected Papers*, and the 20-odd pre-1890 items included so far in the *Writings*. Edited by Charles S. Hardwick with James Cook, out of print.

1982–now: *Writings of Charles S. Peirce, A Chronological Edition*[183] (W), Volumes 1–6 & 8, of a projected 30. The limited coverage, and defective editing and organization, of the *Collected Papers* led Max Fisch and others in the 1970s to found the Peirce Edition Project[184] (PEP), whose mission is to prepare a more complete critical chronological edition. Only seven volumes have appeared to date, but they cover the period from 1859 to 1892, when Peirce carried out much of his best-known work. *Writings of Charles S. Peirce*, 8 was published in November 2010; and work continues on *Writings of Charles S. Peirce*, 7, 9, and 11. In print and online.

1985: *Historical Perspectives on Peirce's Logic of Science: A History of Science*[185], 2 volumes. Auspitz has said,[82] "The extent of Peirce's immersion in the science of his day is evident in his reviews in the *Nation* [...] and in his papers, grant applications, and publishers' prospectuses in the history and practice of science", referring latterly to *Historical Perspectives*. Edited by Carolyn Eisele, back in print.

1992: *Reasoning and the Logic of Things*[186] collects in one place Peirce's 1898 series of lectures invited by William James. Edited by Kenneth Laine Ketner, with commentary by Hilary Putnam[187], in print.

175 https://en.wikipedia.org/wiki/Charles_Hartshorne
176 https://en.wikipedia.org/wiki/Paul_Weiss_(philosopher)
177 https://en.wikipedia.org/wiki/Arthur_Burks
178 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#CN
179 https://en.wikipedia.org/wiki/The_Nation
180 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#NEM
181 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#SS
182 https://en.wikipedia.org/wiki/Victoria,_Lady_Welby
183 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#W
184 http://peirce.iupui.edu/
185 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#HP
186 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#RLT
187 https://en.wikipedia.org/wiki/Hilary_Putnam

1992–1998: *The Essential Peirce*[188] (EP), 2 volumes, is an important recent sampler of Peirce's philosophical writings. Edited (1) by Nathan Hauser and Christian Kloesel and (2) by *Peirce Edition Project* editors, in print.

1997: *Pragmatism as a Principle and Method of Right Thinking*[189] collects Peirce's 1903 Harvard "Lectures on Pragmatism" in a study edition, including drafts, of Peirce's lecture manuscripts, which had been previously published in abridged form; the lectures now also appear in *The Essential Peirce*, 2. Edited by Patricia Ann Turisi, in print.

2010: *Philosophy of Mathematics: Selected Writings*[190] collects important writings by Peirce on the subject, many not previously in print. Edited by Matthew E. Moore, in print.

188 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#EP
189 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#PPM
190 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#PMSW

1.4 Mathematics

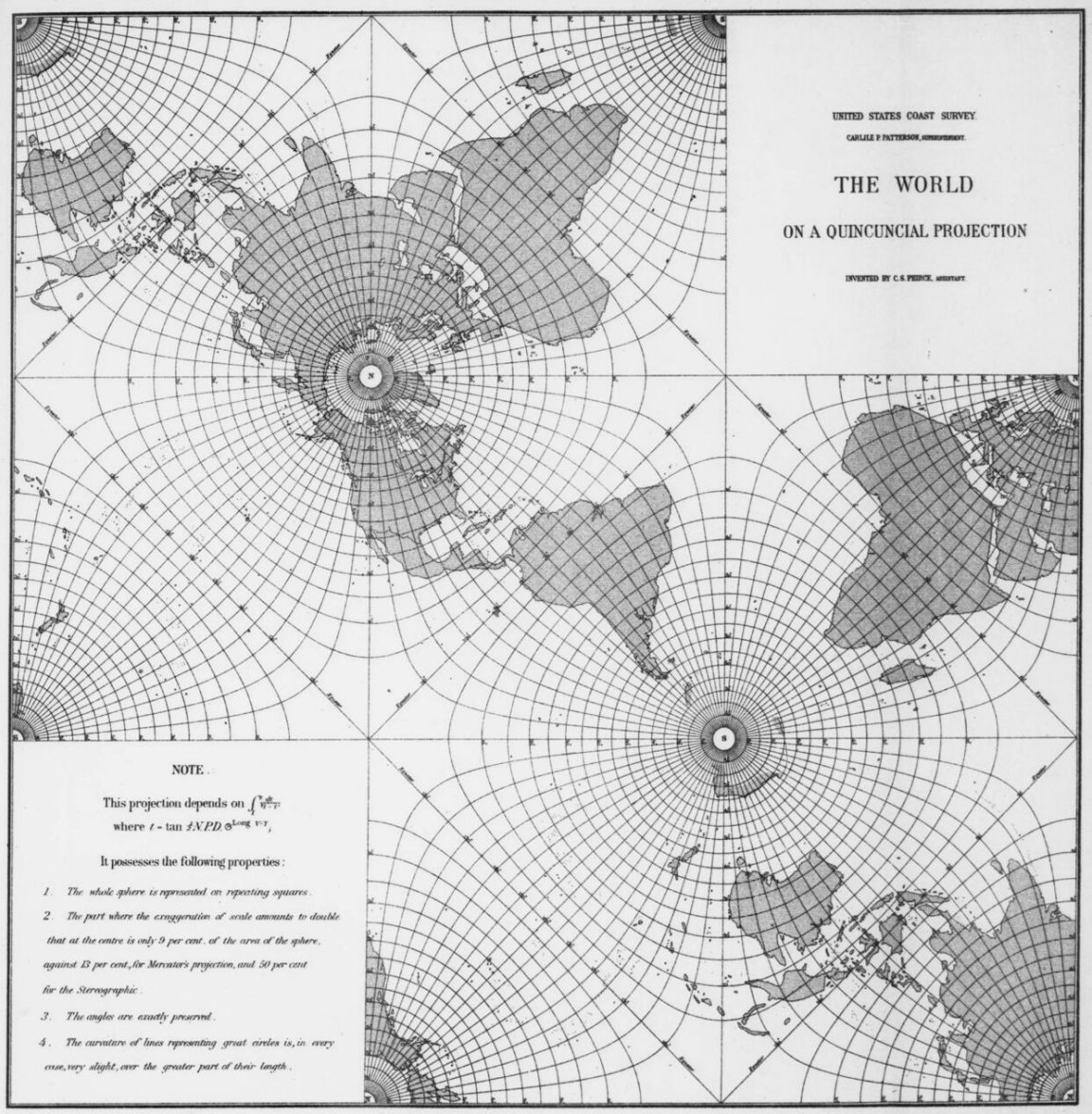

Figure 6 "The World on a Quincuncial Projection", 1879.[83] Peirce's projection of a sphere onto a square keeps angles true except at four isolated points on the equator, and has less scale variation than the Mercator projection. It can be tessellated; that is, multiple copies can be joined together continuously edge-to-edge.

Peirce's most important work in pure mathematics was in logical and foundational areas. He also worked on linear algebra[191], matrices[192], various geometries, topology[193] and List-

191 https://en.wikipedia.org/wiki/Linear_algebra
192 https://en.wikipedia.org/wiki/Matrix_(mathematics)
193 https://en.wikipedia.org/wiki/Topology

ing numbers[194], Bell numbers[195], graphs[196], the four-color problem[197], and the nature of continuity.

He worked on applied mathematics in economics, engineering, and map projections (such as the Peirce quincuncial projection[198]), and was especially active in probability[199] and statistics.[84]

DiscoveriesPeirce made a number of striking discoveries in formal logic and foundational mathematics, nearly all of which came to be appreciated only long after he died:

In 1860[85] he suggested a cardinal arithmetic for infinite numbers, years before any work by Georg Cantor[200] (who completed his dissertation in 1867[201]) and without access to Bernard Bolzano[202]'s 1851 (posthumous) *Paradoxien des Unendlichen*.

↓

The Peirce arrow[203],
symbol for "(neither) ... **nor** ...", also called the *Quine dagger*In 1880–1881[86] he showed how Boolean algebra[204] could be done via a repeated sufficient single binary operation[205] (logical NOR[206]), anticipating Henry M. Sheffer[207] by 33 years. (See also De Morgan's Laws[208].)

In 1881[87] he set out the axiomatization of natural number arithmetic[209], a few years before Richard Dedekind[210] and Giuseppe Peano[211]. In the same paper Peirce gave, years before Dedekind, the first purely cardinal definition of a finite set in the sense now known as "Dedekind-finite[212]", and implied by the same stroke an important formal definition of an infinite set[213] (Dedekind-infinite), as a set[214] that can be put into a one-to-one correspondence[215] with one of its proper subsets[216].

194 https://en.wikipedia.org/wiki/Listing_number
195 https://en.wikipedia.org/wiki/Bell_number
196 https://en.wikipedia.org/wiki/Graph_theory
197 https://en.wikipedia.org/wiki/Four-color_problem
198 https://en.wikipedia.org/wiki/Peirce_quincuncial_projection
199 https://en.wikipedia.org/wiki/Probability
200 https://en.wikipedia.org/wiki/Georg_Cantor
201 https://en.wikipedia.org/wiki/Georg_Cantor#Teacher_and_researcher
202 https://en.wikipedia.org/wiki/Bernard_Bolzano
203 https://en.wikipedia.org/wiki/Logical_NOR
204 https://en.wikipedia.org/wiki/Boolean_algebra_(logic)
205 https://en.wikipedia.org/wiki/Functional_completeness
206 https://en.wikipedia.org/wiki/Logical_NOR
207 https://en.wikipedia.org/wiki/Henry_M._Sheffer
208 https://en.wikipedia.org/wiki/De_Morgan%27s_Laws
209 https://en.wikipedia.org/wiki/Peano_axioms
210 https://en.wikipedia.org/wiki/Richard_Dedekind
211 https://en.wikipedia.org/wiki/Giuseppe_Peano
212 https://en.wikipedia.org/wiki/Dedekind-finite
213 https://en.wikipedia.org/wiki/Infinite_set
214 https://en.wikipedia.org/wiki/Set_(mathematics)
215 https://en.wikipedia.org/wiki/One-to-one_correspondence
216 https://en.wikipedia.org/wiki/Subsets

In 1885[88] he distinguished between first-order and second-order quantification.[89][90] In the same paper he set out what can be read as the first (primitive) axiomatic set theory[217], anticipating Zermelo[218] by about two decades (Brady 2000,[91] pp. 132–33).

In 1886, he saw that Boolean calculations could be carried out via electrical switches,[13] anticipating Claude Shannon[219] by more than 50 years.

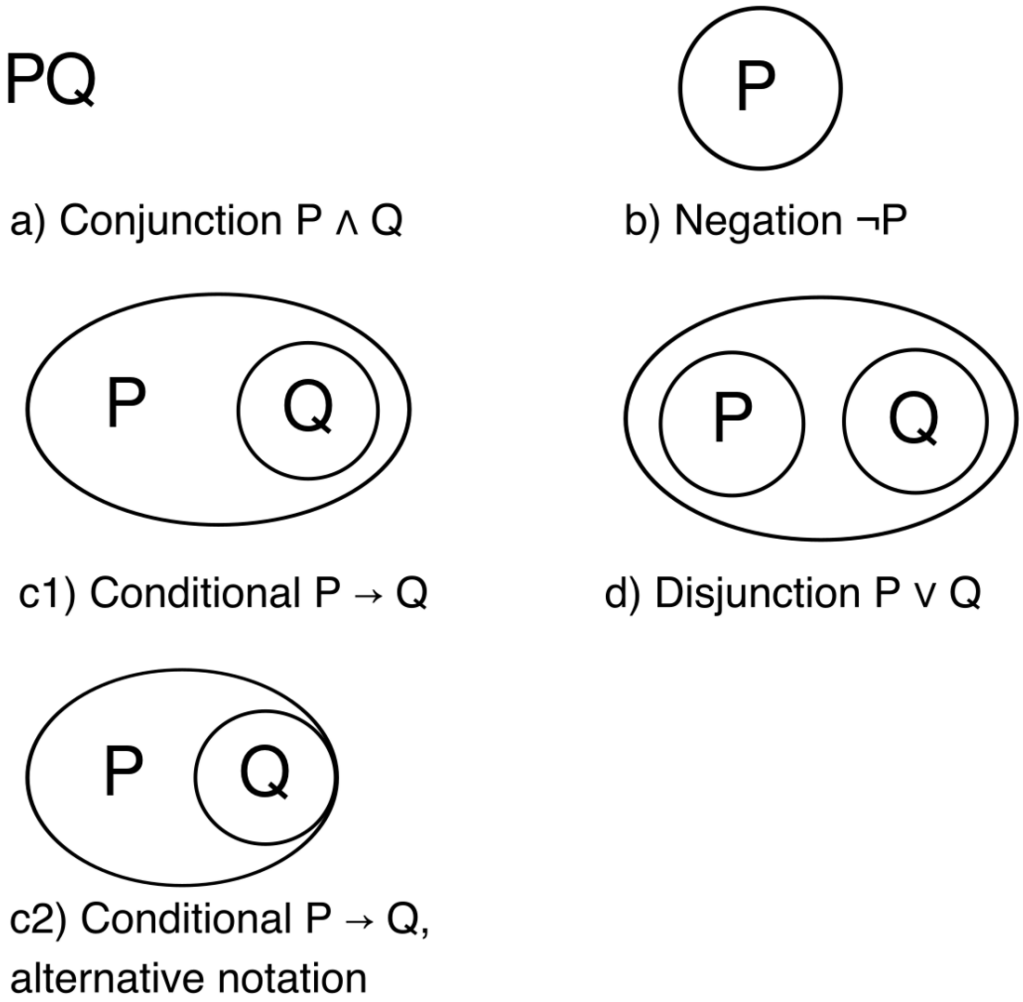

Figure 7 Existential graphs: Alpha graphs

217 https://en.wikipedia.org/wiki/Axiomatic_set_theory
218 https://en.wikipedia.org/wiki/Zermelo
219 https://en.wikipedia.org/wiki/Claude_Shannon

By the later 1890s[92] he was devising existential graphs[220], a diagrammatic notation for the predicate calculus[221]. Based on them are John F. Sowa[222]'s conceptual graphs[223] and Sun-Joo Shin's diagrammatic reasoning[224].

The New Elements of MathematicsPeirce wrote drafts for an introductory textbook, with the working title *The New Elements of Mathematics*, that presented mathematics from an original standpoint. Those drafts and many other of his previously unpublished mathematical manuscripts finally appeared[84] in *The New Elements of Mathematics by Charles S. Peirce* (1976), edited by mathematician Carolyn Eisele[225].

Nature of mathematics Peirce agreed with Auguste Comte[226] in regarding mathematics as more basic than philosophy and the special sciences (of nature and mind). Peirce classified[227] mathematics into three subareas: (1) mathematics of logic, (2) discrete series, and (3) pseudo-continua (as he called them, including the real numbers[228]) and continua. Influenced by his father Benjamin[229], Peirce argued that mathematics studies purely hypothetical objects and is not just the science of quantity but is more broadly the science which draws necessary conclusions; that mathematics aids logic, not vice versa; and that logic itself is part of philosophy and is the science *about* drawing conclusions necessary and otherwise.[93]

1.4.1 Mathematics of logic

Mathematical logic and foundations, some noted articles

- ”On an Improvement in Boole's Calculus of Logic” (1867)
- ”Description of a Notation for the Logic of Relatives” (1870)
- ”On the Algebra of Logic” (1880)
- ”A Boolean Algebra with One Constant” (1880 MS)
- ”On the Logic of Number” (1881)
- ”Note B: The Logic of Relatives” (1883)
- ”On the Algebra of Logic: A Contribution to the Philosophy of Notation” (1884/1885)
- ”The Logic of Relatives” (1897)
- ”The Simplest Mathematics” (1902 MS)
- ”Prolegomena to an Apology for Pragmaticism” (1906, on existential graphs)

Beginning with his first paper on the ”Logic of Relatives” (1870)[230], Peirce extended the theory of relations[231] that Augustus De Morgan[232] had just recently awakened from its Cinderella slumbers. Much of the mathematics of relations now taken for granted was ”borrowed” from Peirce, not always with all due credit; on that and on how the young

220 https://en.wikipedia.org/wiki/Existential_graph
221 https://en.wikipedia.org/wiki/Predicate_calculus
222 https://en.wikipedia.org/wiki/John_F._Sowa
223 https://en.wikipedia.org/wiki/Conceptual_graph
224 https://en.wikipedia.org/wiki/Diagrammatic_reasoning
225 https://en.wikipedia.org/wiki/Carolyn_Eisele
226 https://en.wikipedia.org/wiki/Auguste_Comte
227 https://en.wikipedia.org/wiki/Classification_of_the_sciences_(Peirce)
228 https://en.wikipedia.org/wiki/Real_numbers
229 https://en.wikipedia.org/wiki/Benjamin_Peirce
230 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#LOR1870
231 https://en.wikipedia.org/wiki/Theory_of_relations
232 https://en.wikipedia.org/wiki/Augustus_De_Morgan

Bertrand Russell[233], especially his *Principles of Mathematics* and *Principia Mathematica*[234], did not do Peirce justice, see Anellis (1995).[64] In 1918 the logician C. I. Lewis[235] wrote, "The contributions of C.S. Peirce to symbolic logic are more numerous and varied than those of any other writer—at least in the nineteenth century."[94] Beginning in 1940, Alfred Tarski[236] and his students rediscovered aspects of Peirce's larger vision of relational logic, developing the perspective of relation algebra[237].

Relational logic gained applications. In mathematics, it influenced the abstract analysis of E. H. Moore[238] and the lattice theory[239] of Garrett Birkhoff[240]. In computer science, the relational model[241] for databases[242] was developed with Peircean ideas in work of Edgar F. Codd[243], who was a doctoral student[95] of Arthur W. Burks[244], a Peirce scholar. In economics, relational logic was used by Frank P. Ramsey[245], John von Neumann[246], and Paul Samuelson[247] to study preferences and utility and by Kenneth J. Arrow[248] in *Social Choice and Individual Values*[249], following Arrow's association with Tarski at City College of New York[250].

On Peirce and his contemporaries Ernst Schröder[251] and Gottlob Frege[252], Hilary Putnam[253] (1982)[89] documented that Frege's work on the logic of quantifiers had little influence on his contemporaries, although it was published four years before the work of Peirce and his student Oscar Howard Mitchell[254]. Putnam found that mathematicians and logicians learned about the logic of quantifiers through the independent work of Peirce and Mitchell, particularly through Peirce's "On the Algebra of Logic: A Contribution to the Philosophy of Notation"[88] (1885), published in the premier American mathematical journal of the day, and cited by Peano[255] and Schröder, among others, who ignored Frege. They also adopted and modified Peirce's notations, typographical variants of those now used. Peirce apparently was ignorant of Frege's work, despite their overlapping achievements in logic, philosophy of language[256], and the foundations of mathematics[257].

233 https://en.wikipedia.org/wiki/Bertrand_Russell
234 https://en.wikipedia.org/wiki/Principia_Mathematica
235 https://en.wikipedia.org/wiki/Clarence_Irving_Lewis
236 https://en.wikipedia.org/wiki/Alfred_Tarski
237 https://en.wikipedia.org/wiki/Relation_algebra
238 https://en.wikipedia.org/wiki/E._H._Moore
239 https://en.wikipedia.org/wiki/Lattice_(order)
240 https://en.wikipedia.org/wiki/Garrett_Birkhoff
241 https://en.wikipedia.org/wiki/Relational_model
242 https://en.wikipedia.org/wiki/Database
243 https://en.wikipedia.org/wiki/Edgar_F._Codd
244 https://en.wikipedia.org/wiki/Arthur_W._Burks
245 https://en.wikipedia.org/wiki/Frank_P._Ramsey
246 https://en.wikipedia.org/wiki/John_von_Neumann
247 https://en.wikipedia.org/wiki/Paul_Samuelson
248 https://en.wikipedia.org/wiki/Kenneth_J._Arrow
249 https://en.wikipedia.org/wiki/Social_Choice_and_Individual_Values
250 https://en.wikipedia.org/wiki/City_College_of_New_York
251 https://en.wikipedia.org/wiki/Ernst_Schr%C3%B6der_(mathematician)
252 https://en.wikipedia.org/wiki/Gottlob_Frege
253 https://en.wikipedia.org/wiki/Hilary_Putnam
254 https://en.wikipedia.org/w/index.php?title=Oscar_Howard_Mitchell&action=edit&redlink=1
255 https://en.wikipedia.org/wiki/Peano
256 https://en.wikipedia.org/wiki/Philosophy_of_language
257 https://en.wikipedia.org/wiki/Foundations_of_mathematics

Peirce's work on formal logic had admirers besides Ernst Schröder[258]:

- Philosophical algebraist William Kingdon Clifford[259][96] and logician William Ernest Johnson[260], both British;
- The Polish school of logic and foundational mathematics, including Alfred Tarski[261];
- Arthur Prior[262], who praised and studied Peirce's logical work in a 1964 paper[27] and in *Formal Logic* (saying on page 4 that Peirce "perhaps had a keener eye for essentials than any other logician before or since").

A philosophy of logic, grounded in his categories and semiotic, can be extracted from Peirce's writings and, along with Peirce's logical work more generally, is exposited and defended in Hilary Putnam (1982);[89] the Introduction in Nathan Houser *et al.* (1997);[97] and Randall Dipert[263]'s chapter in Cheryl Misak[264] (2004).[98]

1.4.2 Continua

Continuity and synechism[265] are central in Peirce's philosophy: "I did not at first suppose that it was, as I gradually came to find it, the master-Key of philosophy".[99]

From a mathematical point of view, he embraced infinitesimals[266] and worked long on the mathematics of continua. He long held that the real numbers constitute a pseudo-continuum;[100] that a true continuum is the real subject matter of *analysis situs* (topology[267]); and that a true continuum of instants exceeds—and within any lapse of time has room for—any Aleph number[268] (any infinite *multitude* as he called it) of instants.[101]

In 1908 Peirce wrote that he found that a true continuum might have or lack such room. Jérôme Havenel (2008): "It is on 26 May 1908, that Peirce finally gave up his idea that in every continuum there is room for whatever collection of any multitude. From now on, there are different kinds of continua, which have different properties."[102]

1.4.3 Probability and statistics

Peirce held that science achieves statistical probabilities, not certainties, and that spontaneity (absolute chance) is real (see Tychism[269] on his view). Most of his statistical writings promote the frequency interpretation[270] of probability (objective ratios of cases), and many of his writings express skepticism about (and criticize the use of) probability[271] when such

258 https://en.wikipedia.org/wiki/Ernst_Schr%C3%B6der_(mathematician)
259 https://en.wikipedia.org/wiki/William_Kingdon_Clifford
260 https://en.wikipedia.org/wiki/William_Ernest_Johnson
261 https://en.wikipedia.org/wiki/Alfred_Tarski
262 https://en.wikipedia.org/wiki/Arthur_Prior
263 https://en.wikipedia.org/wiki/Randall_Dipert
264 https://en.wikipedia.org/wiki/Cheryl_Misak
265 https://en.wikipedia.org/wiki/Synechism
266 https://en.wikipedia.org/wiki/Infinitesimal
267 https://en.wikipedia.org/wiki/Topology
268 https://en.wikipedia.org/wiki/Aleph_number
269 https://en.wikipedia.org/wiki/Tychism
270 https://en.wikipedia.org/wiki/Frequency_probability
271 https://en.wikipedia.org/wiki/Statistical_model

models are not based on objective randomization[272].[103] Though Peirce was largely a frequentist, his possible world semantics[273] introduced the "propensity" theory of probability[274] before Karl Popper[275].[104][105] Peirce (sometimes with Joseph Jastrow[276]) investigated the probability judgments[277] of experimental subjects, "perhaps the very first" elicitation and estimation of subjective probabilities[278] in experimental psychology[279] and (what came to be called) Bayesian statistics[280].[2]

Peirce was one of the founders of statistics[281]. He formulated modern statistics in "Illustrations of the Logic of Science[282]" (1877–1878) and "A Theory of Probable Inference[283]" (1883). With a repeated measures design[284], Charles Sanders Peirce and Joseph Jastrow introduced blinded[285], controlled randomized experiments[286] in 1884[106] (Hacking 1990:205) [1] (before Ronald A. Fisher[287]).[2] He invented optimal design[288] for experiments on gravity, in which he "corrected the means[289]". He used correlation[290] and smoothing[291]. Peirce extended the work on outliers[292] by Benjamin Peirce[293], his father.[2] He introduced terms "confidence[294]" and "likelihood[295]" (before Jerzy Neyman[296] and Fisher[297]). (See Stephen Stigler[298]'s historical books and Ian Hacking[299] 1990.[1])

1.5 Philosophy

> It is not sufficiently recognized that Peirce's career was that of a scientist, not a philosopher; and that during his lifetime he was known and valued chiefly as a scientist, only secondarily as a logician, and scarcely at all as a philosopher. Even his work in phi-

272 https://en.wikipedia.org/wiki/Randomization
273 https://en.wikipedia.org/wiki/Possible_world_semantics
274 https://en.wikipedia.org/wiki/Propensity_probability
275 https://en.wikipedia.org/wiki/Karl_Popper
276 https://en.wikipedia.org/wiki/Joseph_Jastrow
277 https://en.wikipedia.org/wiki/Bayesian_probability
278 https://en.wikipedia.org/wiki/Subjective_probability
279 https://en.wikipedia.org/wiki/Experimental_psychology
280 https://en.wikipedia.org/wiki/Bayesian_statistics
281 https://en.wikipedia.org/wiki/Founders_of_statistics
282 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#illus
283 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce_bibliography#SIL
284 https://en.wikipedia.org/wiki/Repeated_measures_design
285 https://en.wikipedia.org/wiki/Blind_experiment
286 https://en.wikipedia.org/wiki/Randomized_controlled_trial
287 https://en.wikipedia.org/wiki/Ronald_A._Fisher
288 https://en.wikipedia.org/wiki/Optimal_design
289 https://en.wikipedia.org/wiki/Analysis_of_variance
290 https://en.wikipedia.org/wiki/Correlation
291 https://en.wikipedia.org/wiki/Smoothing
292 https://en.wikipedia.org/wiki/Peirce%27s_criterion
293 https://en.wikipedia.org/wiki/Benjamin_Peirce
294 https://en.wikipedia.org/wiki/Confidence_interval
295 https://en.wikipedia.org/wiki/Likelihood_function
296 https://en.wikipedia.org/wiki/Jerzy_Neyman
297 https://en.wikipedia.org/wiki/Ronald_A._Fisher
298 https://en.wikipedia.org/wiki/Stephen_Stigler
299 https://en.wikipedia.org/wiki/Ian_Hacking

losophy and logic will not be understood until this fact becomes a standing premise of Peircean studies.

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Max Fisch 1964, p. 486.[27]

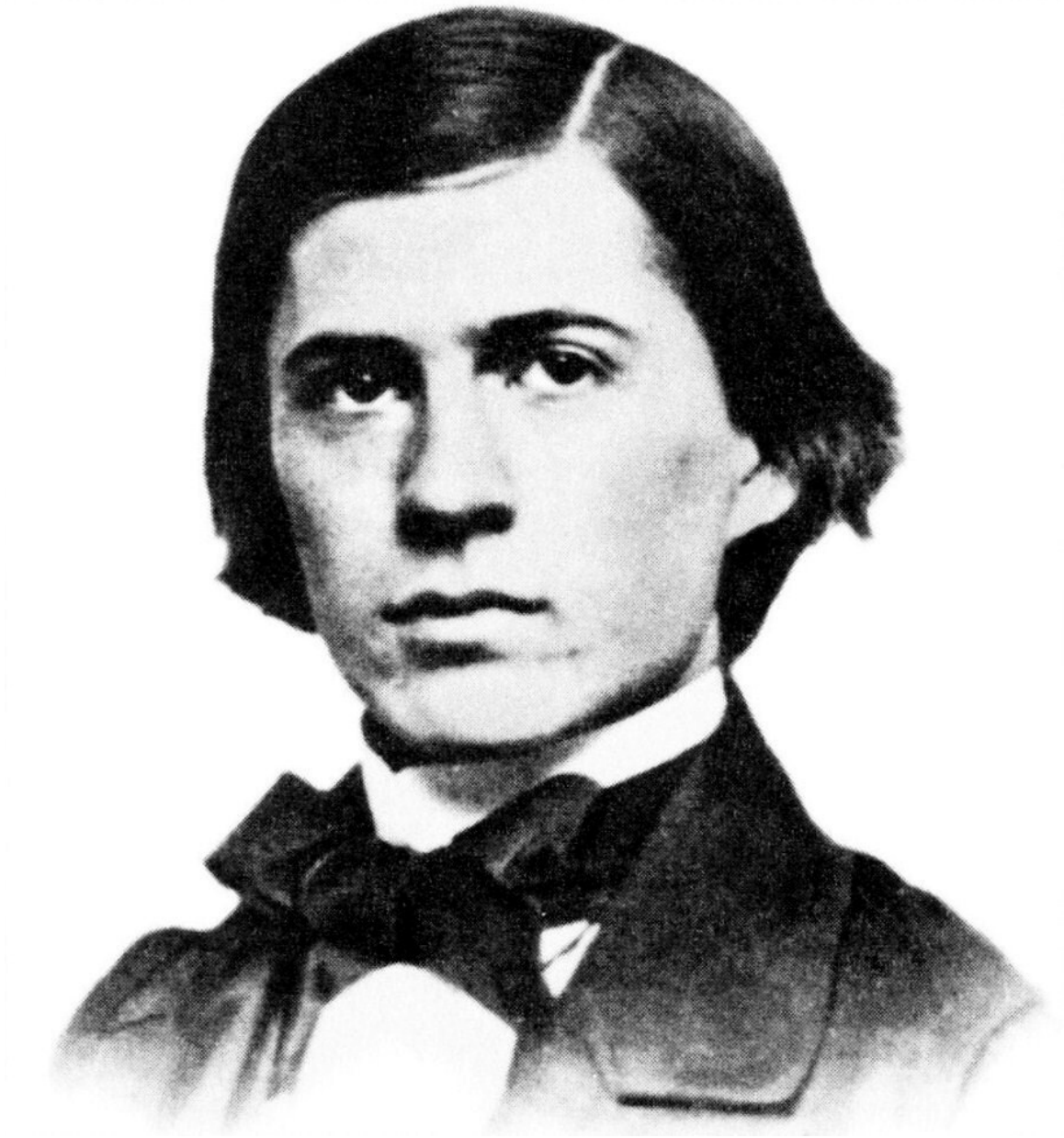


Figure 8 Charles Sanders Peirce in 1859

Peirce was a working scientist for 30 years, and arguably was a professional philosopher only during the five years he lectured at Johns Hopkins. He learned philosophy mainly by

reading, each day, a few pages of Immanuel Kant[300]'s *Critique of Pure Reason*[301], in the original German, while a Harvard undergraduate. His writings bear on a wide array of disciplines, including mathematics, logic[302], philosophy, statistics, astronomy[303],[27] metrology[304],[3] geodesy[305], experimental psychology[306],[4] economics,[5] linguistics[307],[6] and the history and philosophy of science[308]. This work has enjoyed renewed interest and approval, a revival inspired not only by his anticipations of recent scientific developments but also by his demonstration of how philosophy can be applied effectively to human problems.

Peirce's philosophy includes (see below in related sections) a pervasive three-category system: belief that truth is immutable and is both independent from actual opinion (fallibilism[309]) and discoverable (no radical skepticism), logic as formal semiotic on signs, on arguments, and on inquiry's ways—including philosophical pragmatism[310] (which he founded), critical common-sensism[311], and scientific method[312]—and, in metaphysics: Scholastic realism[313], e.g. John Duns Scotus[314], belief in God, freedom, and at least an attenuated immortality, objective idealism[315], and belief in the reality of continuity and of absolute chance, mechanical necessity, and creative love. In his work, fallibilism and pragmatism may seem to work somewhat like skepticism[316] and positivism[317], respectively, in others' work. However, for Peirce, fallibilism is balanced by an anti-skepticism[318] and is a basis for belief in the reality of absolute chance and of continuity,[107] and pragmatism commits one to anti-nominalist[319] belief in the reality of the general (CP 5.453–57).

For Peirce, First Philosophy, which he also called cenoscopy, is less basic than mathematics and more basic than the special sciences (of nature and mind). It studies positive phenomena in general, phenomena available to any person at any waking moment, and does not settle questions by resorting to special experiences.[108] He divided[320] such philosophy into (1) phenomenology (which he also called phaneroscopy or categorics), (2) normative sciences (esthetics, ethics, and logic), and (3) metaphysics; his views on them are discussed in order below.

300 https://en.wikipedia.org/wiki/Immanuel_Kant
301 https://en.wikipedia.org/wiki/Critique_of_Pure_Reason
302 https://en.wikipedia.org/wiki/Logic
303 https://en.wikipedia.org/wiki/Astronomy
304 https://en.wikipedia.org/wiki/Metrology
305 https://en.wikipedia.org/wiki/Geodesy
306 https://en.wikipedia.org/wiki/Experimental_psychology
307 https://en.wikipedia.org/wiki/Linguistics
308 https://en.wikipedia.org/wiki/History_and_philosophy_of_science
309 https://en.wikipedia.org/wiki/Fallibilism
310 https://en.wikipedia.org/wiki/Pragmatism
311 #Critical_common-sensism
312 https://en.wikipedia.org/wiki/Scientific_method
313 https://en.wikipedia.org/wiki/Philosophical_realism
314 https://en.wikipedia.org/wiki/John_Duns_Scotus
315 https://en.wikipedia.org/wiki/Objective_idealism
316 https://en.wikipedia.org/wiki/Skepticism
317 https://en.wikipedia.org/wiki/Positivism
318 https://en.wikipedia.org/wiki/Pragmatism#antiskep
319 https://en.wikipedia.org/wiki/Nominalist
320 https://en.wikipedia.org/wiki/Classification_of_the_sciences_(Peirce)

1.5.1 Theory of categories

Main article: Categories (Peirce)[321] On May 14, 1867, the 27-year-old Peirce presented a paper entitled "On a New List of Categories" to the American Academy of Arts and Sciences[322], which published it the following year. The paper outlined a theory of predication, involving three universal categories that Peirce developed in response to reading Aristotle[323], Immanuel Kant[324], and G. W. F. Hegel[325], categories that Peirce applied throughout his work for the rest of his life.[21] Peirce scholars generally regard the "New List" as foundational or breaking the ground for Peirce's "architectonic", his blueprint for a pragmatic philosophy. In the categories one will discern, concentrated, the pattern that one finds formed by the three grades of clearness in "How To Make Our Ideas Clear[326]" (1878 paper foundational to pragmatism), and in numerous other trichotomies in his work.

"On a New List of Categories" is cast as a Kantian deduction; it is short but dense and difficult to summarize. The following table is compiled from that and later works.[109] In 1893, Peirce restated most of it for a less advanced audience.[110]

Peirce's categories (technical name: the cenopythagorean categories)[111]					
Name	**Typical characterizaton**	**As universe of experience**	**As quantity**	**Technical definition**	**Valence, "adicity"**
Firstness[112]	Quality of feeling	Ideas, chance, possibility	Vagueness, "some"	Reference to a ground (a ground is a pure abstraction of a quality)[113]	Essentially monadic (the quale, in the sense of the *such*,[114] which has the quality)
Secondness[115]	Reaction, resistance, (dyadic) relation	Brute facts, actuality	Singularity, discreteness, "this[327]"	Reference to a correlate (by its relate)	Essentially dyadic (the relate and the correlate)
Thirdness[116]	Representation, mediation	Habits, laws, necessity	Generality, continuity, "all"	Reference to an interpretant*	Essentially triadic (sign, object, interpretant*)

**Note:* An interpretant is an interpretation (human or otherwise) in the sense of the product of an interpretive process.

1.5.2 Aesthetics and ethics

Peirce did not write extensively in aesthetics and ethics,[117] but came by 1902 to hold that aesthetics, ethics, and logic, in that order, comprise the normative sciences.[118] He characterized aesthetics as the study of the good (grasped as the admirable), and thus of the ends governing all conduct and thought.[119]

1.6 Philosophy: logic, or semiotic

Semiotics[328]

General concepts

321 https://en.wikipedia.org/wiki/Categories_(Peirce)
322 https://en.wikipedia.org/wiki/American_Academy_of_Arts_and_Sciences
323 https://en.wikipedia.org/wiki/Aristotle
324 https://en.wikipedia.org/wiki/Immanuel_Kant
325 https://en.wikipedia.org/wiki/G._W._F._Hegel
326 https://en.wikisource.org/wiki/How_to_Make_Our_Ideas_Clear
327 https://en.wikipedia.org/wiki/Haecceity

Semiotics[328]

- Sign[329]
  - (relation[330]
  - relational complex[331])
- Code[332]
- Confabulation[333]
- Connotation[334] / Denotation[335]
- Encoding[336] / Decoding[337]
- Lexical[338]
- Modality[339]
- Representation[340]
- Salience[341]
- Semiosis[342]
- Semiosphere[343]
- Semiotic theory of Peirce[344]
- *Umwelt*[345]
- Value[346]

Fields

329 https://en.wikipedia.org/wiki/Sign_(semiotics)
330 https://en.wikipedia.org/wiki/Sign_relation
331 https://en.wikipedia.org/wiki/Sign_relational_complex
332 https://en.wikipedia.org/wiki/Code_(semiotics)
333 https://en.wikipedia.org/wiki/Confabulation
334 https://en.wikipedia.org/wiki/Connotation_(semiotics)
335 https://en.wikipedia.org/wiki/Denotation_(semiotics)
336 https://en.wikipedia.org/wiki/Encoding_(semiotics)
337 https://en.wikipedia.org/wiki/Decoding_(semiotics)
338 https://en.wikipedia.org/wiki/Lexical_(semiotics)
339 https://en.wikipedia.org/wiki/Modality_(semiotics)
340 https://en.wikipedia.org/wiki/Representation_(arts)
341 https://en.wikipedia.org/wiki/Salience_(semiotics)
342 https://en.wikipedia.org/wiki/Semiosis
343 https://en.wikipedia.org/wiki/Semiosphere
344 https://en.wikipedia.org/wiki/Semiotic_theory_of_Charles_Sanders_Peirce
345 https://en.wikipedia.org/wiki/Umwelt
346 https://en.wikipedia.org/wiki/Value_(semiotics)

Semiotics[328]

- Biosemiotics[347]
- Cognitive semiotics[348]
- Computational semiotics[349]
- Literary semiotics[350]
- Semiotics of culture[351]
- Social semiotics[352]

Methods

- Commutation test[353]
- Paradigmatic analysis[354]
- Syntagmatic analysis[355]

Semioticians

347 https://en.wikipedia.org/wiki/Biosemiotics
348 https://en.wikipedia.org/wiki/Cognitive_semiotics
349 https://en.wikipedia.org/wiki/Computational_semiotics
350 https://en.wikipedia.org/wiki/Semiotic_literary_criticism
351 https://en.wikipedia.org/wiki/Semiotics_of_culture
352 https://en.wikipedia.org/wiki/Social_semiotics
353 https://en.wikipedia.org/wiki/Commutation_test_(semiotics)
354 https://en.wikipedia.org/wiki/Paradigmatic_analysis
355 https://en.wikipedia.org/wiki/Syntagmatic_analysis

Semiotics[328]

- Mikhail Bakhtin[356]
- Roland Barthes[357]
- Marcel Danesi[358]
- John Deely[359]
- Umberto Eco[360]
- Gottlob Frege[361]
- Algirdas Julien Greimas[362]
- Félix Guattari[363]
- Stuart Hall[364]
- Louis Hjelmslev[365]
- Vyacheslav Ivanov[366]
- Roman Jakobson[367]
- Roberta Kevelson[368]
- Kalevi Kull[369]
- Juri Lotman[370]
- Charles W. Morris[371]
- Charles S. Peirce
- Susan Petrilli[372]
- John Poinsot[373]
- Augusto Ponzio[374]
- Ferdinand de Saussure[375]
- Thomas Sebeok[376]
- Michael Silverstein[377]
- Eero Tarasti[378]
- Vladimir Toporov[379]
- Jakob von Uexküll[380]
- Victoria Lady Welby[381]

356 https://en.wikipedia.org/wiki/Mikhail_Bakhtin
357 https://en.wikipedia.org/wiki/Roland_Barthes
358 https://en.wikipedia.org/wiki/Marcel_Danesi
359 https://en.wikipedia.org/wiki/John_Deely
360 https://en.wikipedia.org/wiki/Umberto_Eco
361 https://en.wikipedia.org/wiki/Gottlob_Frege
362 https://en.wikipedia.org/wiki/Algirdas_Julien_Greimas
363 https://en.wikipedia.org/wiki/F%C3%A9lix_Guattari
364 https://en.wikipedia.org/wiki/Stuart_Hall_(cultural_theorist)
365 https://en.wikipedia.org/wiki/Louis_Hjelmslev
366 https://en.wikipedia.org/wiki/Vyacheslav_Ivanov_(philologist)
367 https://en.wikipedia.org/wiki/Roman_Jakobson
368 https://en.wikipedia.org/wiki/Roberta_Kevelson
369 https://en.wikipedia.org/wiki/Kalevi_Kull
370 https://en.wikipedia.org/wiki/Juri_Lotman
371 https://en.wikipedia.org/wiki/Charles_W._Morris
372 https://en.wikipedia.org/wiki/Susan_Petrilli
373 https://en.wikipedia.org/wiki/John_of_St._Thomas
374 https://en.wikipedia.org/wiki/Augusto_Ponzio
375 https://en.wikipedia.org/wiki/Ferdinand_de_Saussure
376 https://en.wikipedia.org/wiki/Thomas_Sebeok

Semiotics[328]
Related topics

- Copenhagen–Tartu school[382]
- Tartu–Moscow Semiotic School[383]
- Structuralism[384]
- Post-structuralism[385]
- Deconstruction[386]
- Postmodernism[387]

- v[388]
- t[389]
- e[390]

1.6.1 Logic as philosophical

Peirce regarded logic *per se* as a division of philosophy, as a normative science based on esthetics and ethics, as more basic than metaphysics,[120] and as "the art of devising methods of research".[121] More generally, as inference, "logic is rooted in the social principle", since inference depends on a standpoint that, in a sense, is unlimited.[122] Peirce called (with no sense of deprecation) "mathematics of logic" much of the kind of thing which, in current research and applications, is called simply "logic". He was productive in both (philosophical) logic and logic's mathematics, which were connected deeply in his work and thought.

Peirce argued that logic is formal semiotic: the formal study of signs in the broadest sense, not only signs that are artificial, linguistic, or symbolic, but also signs that are semblances or are indexical such as reactions. Peirce held that "all this universe is perfused with signs, if it is not composed exclusively of signs",[123] along with their representational and inferential relations. He argued that, since all thought takes time, all thought is in signs[124] and sign processes ("semiosis") such as the inquiry process. He divided[391] logic into: (1) speculative grammar, or stechiology, on how signs can be meaningful and, in relation to that, what kinds of signs there are, how they combine, and how some embody or incorporate others;

377 https://en.wikipedia.org/wiki/Michael_Silverstein
378 https://en.wikipedia.org/wiki/Eero_Tarasti
379 https://en.wikipedia.org/wiki/Vladimir_Toporov
380 https://en.wikipedia.org/wiki/Jakob_von_Uexk%C3%BCll
381 https://en.wikipedia.org/wiki/Victoria_Lady_Welby
382 https://en.wikipedia.org/wiki/Copenhagen%E2%80%93Tartu_school
383 https://en.wikipedia.org/wiki/Tartu%E2%80%93Moscow_Semiotic_School
384 https://en.wikipedia.org/wiki/Structuralism
385 https://en.wikipedia.org/wiki/Post-structuralism
386 https://en.wikipedia.org/wiki/Deconstruction
387 https://en.wikipedia.org/wiki/Postmodernism
388 https://en.wikipedia.org/wiki/Template:Semiotics
389 https://en.wikipedia.org/wiki/Template_talk:Semiotics
390 https://en.wikipedia.org/w/index.php?title=Template:Semiotics&action=edit
391 https://en.wikipedia.org/wiki/Classification_of_the_sciences_(Peirce)

(2) logical critic, or logic proper, on the modes of inference; and (3) speculative or universal rhetoric[392], or methodeutic,[125] the philosophical theory of inquiry, including pragmatism.

Presuppositions of logic

In his "F.R.L." [First Rule of Logic] (1899), Peirce states that the first, and "in one sense, the sole", rule of reason is that, *to learn, one needs to desire to learn* and desire it without resting satisfied with that which one is inclined to think.[120] So, the first rule is, *to wonder* . Peirce proceeds to a critical theme in research practices and the shaping of theories:

> ...there follows one corollary[393] which itself deserves to be inscribed upon every wall of the city of philosophy:
>
> Do not block the way of inquiry.

Peirce adds, that method and economy are best in research but no outright sin inheres in trying any theory in the sense that the investigation via its trial adoption can proceed unimpeded and undiscouraged, and that "the one unpardonable offence" is a philosophical barricade against truth's advance, an offense to which "metaphysicians in all ages have shown themselves the most addicted". Peirce in many writings holds that logic precedes metaphysics[394] (ontological, religious, and physical).

Peirce goes on to list four common barriers to inquiry: (1) Assertion of absolute certainty; (2) maintaining that something is absolutely unknowable; (3) maintaining that something is absolutely inexplicable because absolutely basic or ultimate; (4) holding that perfect exactitude is possible, especially such as to quite preclude unusual and anomalous phenomena. To refuse absolute theoretical certainty is the heart of *fallibilism*, which Peirce unfolds into refusals to set up any of the listed barriers. Peirce elsewhere argues (1897) that logic's presupposition of fallibilism leads at length to the view that chance and continuity are very real (tychism[395] and synechism[396]).[107]

The First Rule of Logic pertains to the mind's presuppositions in undertaking reason and logic; presuppositions, for instance, that truth and the real do not depend on yours or my opinion of them but do depend on representational relation and consist in the destined end in investigation taken far enough (see below[397]). He describes such ideas as, collectively, hopes which, in particular cases, one is unable seriously to doubt.[126]

Four incapacities

The *Journal of Speculative Philosophy* series (1868–1869), including

- Questions concerning certain Faculties claimed for Man (1868)
- Some Consequences of Four Incapacities (1868)

392 https://en.wikipedia.org/wiki/Universal_rhetoric
393 https://en.wikipedia.org/wiki/Corollary
394 https://en.wikipedia.org/wiki/Classification_of_the_sciences_(Peirce)
395 https://en.wikipedia.org/wiki/Tychism
396 https://en.wikipedia.org/wiki/Synechism
397 #defs

- Grounds of Validity of the Laws of Logic:
  Further Consequences of Four Incapacities (1869)

In three articles in 1868–1869,[124][127][128] Peirce rejected mere verbal or hyperbolic doubt[398] and first or ultimate principles, and argued that we have (as he numbered them[127]):

1. No power of Introspection. All knowledge of the internal world comes by hypothetical reasoning from known external facts.
2. No power of Intuition (cognition without logical determination by previous cognitions). No cognitive stage is absolutely first in a process. All mental action has the form of inference.
3. No power of thinking without signs. A cognition must be interpreted in a subsequent cognition in order to be a cognition at all.
4. No conception of the absolutely incognizable.

(The above sense of the term "intuition" is almost Kant's, said Peirce. It differs from the current looser sense that encompasses instinctive or anyway half-conscious inference.)

Peirce argued that those incapacities imply the reality of the general and of the continuous, the validity of the modes of reasoning,[128] and the falsity of philosophical Cartesianism[399] (see below[400]).

Peirce rejected the conception (usually ascribed to Kant) of the unknowable thing-in-itself [127] and later said that to "dismiss make-believes" is a prerequisite for pragmatism.[129]

Logic as formal semiotic

Peirce sought, through his wide-ranging studies through the decades, formal philosophical ways to articulate thought's processes, and also to explain the workings of science. These inextricably entangled questions of a dynamics of inquiry rooted in nature and nurture led him to develop his semiotic with very broadened conceptions of signs and inference, and, as its culmination, a theory of inquiry for the task of saying 'how science works' and devising research methods. This would be logic by the medieval definition taught for centuries: art of arts, science of sciences, having the way to the principles of all methods.[121] Influences radiate from points on parallel lines of inquiry in Aristotle[401]'s work, in such *loci* as: the basic terminology of psychology[402] in *On the Soul*[403]; the founding description of sign relations[404] in *On Interpretation*[405]; and the differentiation of inference[406] into three modes that are commonly translated into English as *abduction*[407], *deduction*[408], and *induction*[409], in the

398 https://en.wikipedia.org/wiki/Hyperbolic_doubt
399 https://en.wikipedia.org/wiki/Ren%C3%A9_Descartes
400 #Against_Cartesianism
401 https://en.wikipedia.org/wiki/Aristotle
402 https://en.wikipedia.org/wiki/Psychology
403 https://en.wikipedia.org/wiki/On_the_Soul
404 https://en.wikipedia.org/wiki/Sign_relation
405 https://en.wikipedia.org/wiki/On_Interpretation
406 https://en.wikipedia.org/wiki/Inference
407 https://en.wikipedia.org/wiki/Abductive_reasoning
408 https://en.wikipedia.org/wiki/Deductive_reasoning
409 https://en.wikipedia.org/wiki/Inductive_reasoning

Prior Analytics[410], as well as inference by analogy[411] (called *paradeigma* by Aristotle), which Peirce regarded as involving the other three modes.

Peirce began writing on semiotic in the 1860s, around the time when he devised his system of three categories. He called it both *semiotic*[412] and *semeiotic*. Both are current in singular and plural. He based it on the conception of a triadic sign relation[413], and defined *semiosis*[414] as "action, or influence, which is, or involves, a cooperation of *three* subjects, such as a sign, its object, and its interpretant, this tri-relative influence not being in any way resolvable into actions between pairs".[130] As to signs in thought, Peirce emphasized the reverse: "To say, therefore, that thought cannot happen in an instant, but requires a time, is but another way of saying that every thought must be interpreted in another, or that all thought is in signs."[124]

Peirce held that all thought is in signs, issuing in and from interpretation, where *sign* is the word for the broadest variety of conceivable semblances, diagrams, metaphors, symptoms, signals, designations, symbols, texts, even mental concepts and ideas, all as determinations of a mind or *quasi-mind*, that which at least functions like a mind, as in the work of crystals or bees[131]—the focus is on sign action in general rather than on psychology, linguistics, or social studies (fields which he also pursued).

Inquiry is a kind of inference process, a manner of thinking and semiosis. Global divisions of ways for phenomena to stand as signs, and the subsumption of inquiry and thinking within inference as a sign process, enable the study of inquiry on semiotics' three levels:

1. Conditions for meaningfulness. Study of significatory elements and combinations, their grammar.
2. Validity, conditions for true representation. Critique of arguments in their various separate modes.
3. Conditions for determining interpretations. Methodology of inquiry in its mutually interacting modes.

Peirce uses examples often from common experience, but defines and discusses such things as assertion and interpretation in terms of philosophical logic. In a formal vein, Peirce said:

> *On the Definition of Logic.* Logic is *formal semiotic.* A sign is something, *A*, which brings something, *B*, its *interpretant* sign, determined or created by it, into the same sort of correspondence (or a lower implied sort) with something, *C*, its *object*, as that in which itself stands to *C*. This definition no more involves any reference to human thought than does the definition of a line as the place within which a particle lies during a lapse of time. It is from this definition that I deduce the principles of logic by mathematical reasoning, and by mathematical reasoning that, I aver, will support criticism of Weierstrassian[415] severity, and that is perfectly evident. The word "formal" in the definition is also defined.[132]

410 https://en.wikipedia.org/wiki/Prior_Analytics
411 https://en.wikipedia.org/wiki/Analogy
412 https://en.wikipedia.org/wiki/Semiotic
413 https://en.wikipedia.org/wiki/Sign_relation
414 https://en.wikipedia.org/wiki/Semiosis
415 https://en.wikipedia.org/wiki/Weierstrass

1.6.2 Signs

Main article: Semiotic theory of Charles Sanders Peirce[416] See also: Representation (arts) § Peirce and representation[417], and Sign (semiotics) § Triadic signs[418]

A list of noted writings by Peirce on signs and sign relations is at Semiotic theory of Charles Sanders Peirce § References and further reading[419].

Sign relation

Peirce's theory of signs is known to be one of the most complex semiotic theories due to its generalistic claim. Anything is a sign—not absolutely as itself, but instead in some relation or other. The *sign relation*[420] is the key. It defines three roles encompassing (1) the sign, (2) the sign's subject matter, called its *object*, and (3) the sign's meaning or ramification as formed into a kind of effect called its *interpretant* (a further sign, for example a translation). It is an irreducible *triadic relation*[421], according to Peirce. The roles are distinct even when the things that fill those roles are not. The roles are but three; a sign of an object leads to one or more interpretants, and, as signs, they lead to further interpretants.

Extension × intension = information. Two traditional approaches to sign relation, necessary though insufficient, are the way of *extension*[422] (a sign's objects, also called breadth, denotation, or application) and the way of *intension*[423] (the objects' characteristics, qualities, attributes referenced by the sign, also called depth, comprehension[424], significance, or connotation). Peirce adds a third, the way of *information*[425], including change of information, to integrate the other two approaches into a unified whole.[133] For example, because of the equation above, if a term's total amount of information stays the same, then the more that the term 'intends' or signifies about objects, the fewer are the objects to which the term 'extends' or applies.

Determination. A sign depends on its object in such a way as to represent its object—the object enables and, in a sense, determines the sign. A physically causal sense of this stands out when a sign consists in an indicative reaction. The interpretant depends likewise on both the sign and the object—an object determines a sign to determine an interpretant. But this determination is not a succession of dyadic events, like a row of toppling dominoes; sign determination is triadic. For example, an interpretant does not merely represent something which represented an object; instead an interpretant represents something *as* a sign representing the object. The object (be it a quality or fact or law or even fictional) determines the sign to an interpretant through one's collateral experience[134] with the object, in which the object is found or from which it is recalled, as when a sign consists in a

416 https://en.wikipedia.org/wiki/Semiotic_theory_of_Charles_Sanders_Peirce
417 https://en.wikipedia.org/wiki/Representation_(arts)#Peirce_and_representation
418 https://en.wikipedia.org/wiki/Sign_(semiotics)#Triadic_signs
419 https://en.wikipedia.org/wiki/Semiotic_theory_of_Charles_Sanders_Peirce#References_and_further_reading
420 https://en.wikipedia.org/wiki/Sign_relation
421 https://en.wikipedia.org/wiki/Triadic_relation
422 https://en.wikipedia.org/wiki/Extension_(semantics)
423 https://en.wikipedia.org/wiki/Intension
424 https://en.wikipedia.org/wiki/Comprehension_(logic)
425 https://en.wikipedia.org/wiki/Logic_of_information

chance semblance of an absent object. Peirce used the word "determine" not in a strictly deterministic sense, but in a sense of "specializes", *bestimmt*,[135] involving variable amount, like an influence.[136] Peirce came to define representation and interpretation in terms of (triadic) determination.[137] The object determines the sign to determine another sign—the interpretant—to be related to the object *as the sign is related to the object*, hence the interpretant, fulfilling its function as sign of the object, determines a further interpretant sign. The process is logically structured to perpetuate itself, and is definitive of sign, object, and interpretant in general.[136]

Semiotic elements

Peirce held there are exactly three basic elements in semiosis (sign action):

1. A *sign* (or *representamen*)[138] represents, in the broadest possible sense of "represents". It is something interpretable as saying something about something. It is not necessarily symbolic, linguistic, or artificial—a cloud might be a sign of rain for instance, or ruins the sign of ancient civilization.[139] As Peirce sometimes put it (he defined *sign* at least 76 times[136]), the sign stands *for* the object *to* the interpretant. A sign represents its object in some respect, which respect is the sign's *ground*.[113]
2. An *object* (or *semiotic object*) is a subject matter of a sign and an interpretant. It can be anything thinkable, a quality, an occurrence, a rule, etc., even fictional, such as Prince Hamlet[426].[140] All of those are special or partial objects. The object most accurately is the universe of discourse[427] to which the partial or special object belongs.[140] For instance, a perturbation of Pluto's orbit is a sign about Pluto but ultimately not only about Pluto. An object either (i) is *immediate* to a sign and is the object as represented in the sign or (ii) is a *dynamic* object, the object as it really is, on which the immediate object is founded "as on bedrock".[141]
3. An *interpretant*[428] (or *interpretant sign*) is a sign's meaning or ramification as formed into a kind of idea or effect, an interpretation, human or otherwise. An interpretant is a sign (a) of the object and (b) of the interpretant's "predecessor" (the interpreted sign) as a sign of the same object. An interpretant either (i) is *immediate* to a sign and is a kind of quality or possibility such as a word's usual meaning, or (ii) is a *dynamic* interpretant, such as a state of agitation, or (iii) is a *final* or *normal* interpretant, a sum of the lessons which a sufficiently considered sign *would* have as effects on practice, and with which an actual interpretant may at most coincide.

Some of the understanding needed by the mind depends on familiarity with the object. To know what a given sign denotes, the mind needs some experience of that sign's object, experience outside of, and collateral to, that sign or sign system. In that context Peirce speaks of collateral experience, collateral observation, collateral acquaintance, all in much the same terms.[134]

426 https://en.wikipedia.org/wiki/Prince_Hamlet
427 https://en.wikipedia.org/wiki/Universe_of_discourse
428 https://en.wikipedia.org/wiki/Interpretant

Classes of signs

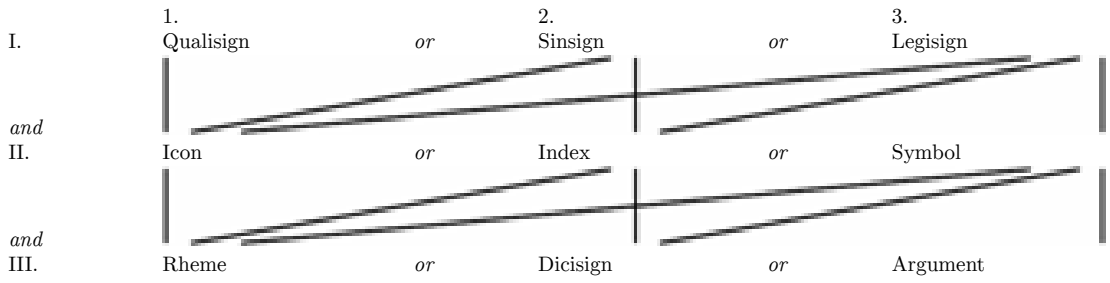
Among Peirce's many sign typologies, three stand out, interlocked. The first typology depends on the sign itself, the second on how the sign stands for its denoted object, and the third on how the sign stands for its object to its interpretant. Also, each of the three typologies is a three-way division, a trichotomy[429], via Peirce's three phenomenological categories[430]: (1) quality of feeling, (2) reaction, resistance, and (3) representation, mediation. [142]

I. *Qualisign, sinsign, legisign* (also called *tone, token, type,*and also called *potisign, actisign, famisign*):[143] This typology classifies every sign according to the sign's own phenomenological category—the qualisign is a quality, a possibility, a "First"; the sinsign is a reaction or resistance, a singular object, an actual event or fact, a "Second"; and the legisign is a habit, a rule, a representational relation, a "Third".

II. *Icon, index, symbol*: This typology, the best known one, classifies every sign according to the category of the sign's way of denoting its object—the icon (also called semblance or likeness) by a quality of its own, the index by factual connection to its object, and the symbol by a habit or rule for its interpretant.

III. *Rheme, dicisign, argument* (also called *sumisign, dicisign, suadisign,* also *seme, pheme, delome,*[143] and regarded as very broadened versions of the traditional *term, proposition, argument*): This typology classifies every sign according to the category which the interpretant attributes to the sign's way of denoting its object—the rheme, for example a term, is a sign interpreted to represent its object in respect of quality; the dicisign, for example a proposition, is a sign interpreted to represent its object in respect of fact; and the argument is a sign interpreted to represent its object in respect of habit or law. This is the culminating typology of the three, where the sign is understood as a structural element of inference.

Lines of joint classification of signs.
Every sign is:[142]



Every sign belongs to one class or another within (I) *and* within (II) *and* within (III). Thus each of the three typologies is a three-valued parameter for every sign. The three parameters are not independent of each other; many co-classifications are absent, for reasons pertaining to the lack of either habit-taking or singular reaction in a quality, and the lack of habit-taking in a singular reaction. The result is not 27 but instead ten classes of signs fully specified at this level of analysis.

429 https://en.wikipedia.org/wiki/Trichotomy_(philosophy)
430 #Theory_of_categories

1.6.3 Modes of inference

Main article: Inquiry[431] Borrowing a brace of concepts from Aristotle[432], Peirce examined three basic modes of inference[433]—*abduction*[434], *deduction*[435], and *induction*[436]—in his "critique of arguments" or "logic proper". Peirce also called abduction "retroduction", "presumption", and, earliest of all, "hypothesis". He characterized it as guessing and as inference to an explanatory hypothesis. He sometimes expounded the modes of inference by transformations of the categorical syllogism Barbara (AAA)[437], for example in "Deduction, Induction, and Hypothesis" (1878).[144] He does this by rearranging the *rule* (Barbara's major premise), the *case* (Barbara's minor premise), and the *result* (Barbara's conclusion):

Deduction.	Induction.	Hypothesis (Abduction).
Rule: All the beans from this bag are white.	*Case:* These beans are [randomly selected] from this bag.	*Rule:* All the beans from this bag are white.
Case: These beans are beans from this bag.	*Result:* These beans are white.	*Result:* These beans [oddly] are white.
∴ *Result:* These beans are white.	∴ *Rule:* All the beans from this bag are white.	∴ *Case:* These beans are from this bag.

Peirce 1883 in "A Theory of Probable Inference" (*Studies in Logic*[438]) equated hypothetical inference with the induction of characters of objects (as he had done in effect before[127]). Eventually dissatisfied, by 1900 he distinguished them once and for all and also wrote that he now took the syllogistic forms and the doctrine of logical extension and comprehension as being less basic than he had thought. In 1903 he presented the following logical form for abductive inference:[145]

> The surprising fact, C, is observed;
>
> But if A were true, C would be a matter of course,
>
> Hence, there is reason to suspect that A is true.

The logical form does not also cover induction, since induction neither depends on surprise nor proposes a new idea for its conclusion. Induction seeks facts to test a hypothesis; abduction seeks a hypothesis to account for facts. "Deduction proves that something *must* be; Induction shows that something *actually is* operative; Abduction merely suggests that something *may be*."[146] Peirce did not remain quite convinced that one logical form covers all abduction.[147] In his methodeutic[439] or theory of inquiry (see below), he portrayed abduction as an economic initiative to further inference and study, and portrayed all three modes as clarified by their coordination in essential roles in inquiry: hypothetical explanation, deductive prediction, inductive testing.

431 https://en.wikipedia.org/wiki/Inquiry
432 https://en.wikipedia.org/wiki/Aristotle
433 https://en.wikipedia.org/wiki/Inference
434 https://en.wikipedia.org/wiki/Abductive_reasoning
435 https://en.wikipedia.org/wiki/Deductive_reasoning
436 https://en.wikipedia.org/wiki/Inductive_reasoning
437 https://en.wikipedia.org/wiki/Syllogism#Barbara_(AAA-1)
438 #SIL
439 https://en.wikipedia.org/wiki/Methodeutic

1.6.4 Pragmatism

Main articles: Pragmaticism[440], Pragmatic maxim[441], and Pragmatic theory of truth § Peirce[442] Some noted articles and lectures

- Illustrations of the Logic of Science[443] (1877–1878):
  inquiry, pragmatism, statistics, inference

  1. The Fixation of Belief (1877)
  2. How to Make Our Ideas Clear (1878)
  3. The Doctrine of Chances (1878)
  4. The Probability of Induction (1878)
  5. The Order of Nature (1878)
  6. Deduction, Induction, and Hypothesis (1878)

- The Harvard lectures on pragmatism (1903)
- What Pragmatism Is (1905)
- Issues of Pragmaticism (1905)
- Pragmatism (1907 MS in *The Essential Peirce*, 2)

Peirce's recipe for pragmatic thinking, which he called *pragmatism*[444] and, later, *pragmaticism*[445], is recapitulated in several versions of the so-called *pragmatic maxim*[446]. Here is one of his more emphatic reiterations[447] of it:

> Consider what effects that might *conceivably* have practical bearings you *conceive* the objects of your *conception* to have. Then, your *conception* of those effects is the whole of your *conception* of the object.

As a movement, pragmatism began in the early 1870s in discussions among Peirce, William James[448], and others in the Metaphysical Club[449]. James among others regarded some articles by Peirce such as "The Fixation of Belief[450]" (1877) and especially "How to Make Our Ideas Clear[451]" (1878) as foundational to pragmatism[452].[148] Peirce (CP 5.11–12), like James (*Pragmatism: A New Name for Some Old Ways of Thinking*[453], 1907), saw pragmatism as embodying familiar attitudes, in philosophy and elsewhere, elaborated into a new deliberate method for fruitful thinking about problems. Peirce differed from James and the early John Dewey[454], in some of their tangential enthusiasms, in being decidedly more rationalistic

440 https://en.wikipedia.org/wiki/Pragmaticism
441 https://en.wikipedia.org/wiki/Pragmatic_maxim
442 https://en.wikipedia.org/wiki/Pragmatic_theory_of_truth#Peirce
443 https://en.wikisource.org/wiki/Author:Charles_Sanders_Peirce#Articles_in_The_Popular_Science_Monthly_Project
444 https://en.wikipedia.org/wiki/Pragmatism
445 https://en.wikipedia.org/wiki/Pragmaticism
446 https://en.wikipedia.org/wiki/Pragmatic_maxim
447 https://en.wikipedia.org/wiki/Pragmatic_maxim#2
448 https://en.wikipedia.org/wiki/William_James
449 https://en.wikipedia.org/wiki/The_Metaphysical_Club
450 https://en.wikisource.org/wiki/The_Fixation_of_Belief
451 https://en.wikisource.org/wiki/How_to_Make_Our_Ideas_Clear
452 https://en.wikipedia.org/wiki/Pragmatism
453 https://en.wikisource.org/wiki/Pragmatism:_A_New_Name_for_Some_Old_Ways_of_Thinking
454 https://en.wikipedia.org/wiki/John_Dewey

and realistic, in several senses of those terms, throughout the preponderance of his own philosophical moods.

In 1905 Peirce coined the new name pragmaticism[455] "for the precise purpose of expressing the original definition", saying that "all went happily" with James's and F.C.S. Schiller[456]'s variant uses of the old name "pragmatism" and that he coined the new name because of the old name's growing use in "literary journals, where it gets abused". Yet he cited as causes, in a 1906 manuscript, his differences with James and Schiller and, in a 1908 publication, his differences with James as well as literary author Giovanni Papini[457]'s declaration of pragmatism's indefinability. Peirce in any case regarded his views that truth is immutable and infinity is real, as being opposed by the other pragmatists, but he remained allied with them on other issues.[149]

Pragmatism begins with the idea that belief is that on which one is prepared to act. Peirce's pragmatism is a method of clarification of conceptions of objects. It equates any conception of an object to a conception of that object's effects to a general extent of the effects' conceivable implications for informed practice. It is a method of sorting out conceptual confusions occasioned, for example, by distinctions that make (sometimes needed) formal yet not practical differences. He formulated both pragmatism and statistical principles as aspects of scientific logic, in his "Illustrations of the Logic of Science" series of articles. In the second one, "How to Make Our Ideas Clear[458]", Peirce discussed three grades of clearness of conception:

1. Clearness of a conception familiar and readily used, even if unanalyzed and undeveloped.
2. Clearness of a conception in virtue of clearness of its parts, in virtue of which logicians called an idea "distinct", that is, clarified by analysis of just what makes it applicable. Elsewhere, echoing Kant, Peirce called a likewise distinct definition "nominal" (CP 5.553).
3. Clearness in virtue of clearness of conceivable practical implications of the object's conceived effects, such that fosters fruitful reasoning, especially on difficult problems. Here he introduced that which he later called the pragmatic maxim[459].

By way of example of how to clarify conceptions, he addressed conceptions about truth and the real as questions of the presuppositions of reasoning[460] in general. In clearness's second grade (the "nominal" grade), he defined truth as a sign's correspondence to its object, and the real as the object of such correspondence, such that truth and the real are independent of that which you or I or any actual, definite community of inquirers[461] think. After that needful but confined step, next in clearness's third grade (the pragmatic, practice-oriented grade) he defined truth as that opinion which *would* be reached, sooner or later but still inevitably, by research taken far enough, such that the real does depend on that ideal final opinion—a dependence to which he appeals in theoretical arguments elsewhere, for instance for the long-run validity of the rule of induction.[150] Peirce argued that even to

455 https://en.wikipedia.org/wiki/Pragmaticism
456 https://en.wikipedia.org/wiki/F.C.S._Schiller
457 https://en.wikipedia.org/wiki/Giovanni_Papini
458 https://en.wikisource.org/wiki/How_to_Make_Our_Ideas_Clear
459 https://en.wikipedia.org/wiki/Pragmatic_maxim
460 #Presuppositions_of_logic
461 https://en.wikipedia.org/wiki/Community_of_inquiry

argue against the independence and discoverability of truth and the real is to presuppose that there is, about that very question under argument, a truth with just such independence and discoverability.

Peirce said that a conception's meaning consists in "all general modes of rational conduct[462]" implied by "acceptance" of the conception—that is, if one were to accept, first of all, the conception as true, then what could one conceive to be consequent general modes of rational conduct by all who accept the conception as true?—the whole of such consequent general modes is the whole meaning. His pragmatism does not equate a conception's meaning, its intellectual purport, with the conceived benefit or cost of the conception itself, like a meme (or, say, propaganda), outside the perspective of its being true, nor, since a conception is general, is its meaning equated with any definite set of actual consequences or upshots corroborating or undermining the conception or its worth. His pragmatism also bears no resemblance to "vulgar" pragmatism, which misleadingly connotes a ruthless and Machiavellian[463] search for mercenary or political advantage. Instead the pragmatic maxim is the heart of his pragmatism as a method of experimentational mental reflection[464][151] arriving at conceptions in terms of conceivable confirmatory and disconfirmatory circumstances—a method hospitable to the formation of explanatory hypotheses, and conducive to the use and improvement of verification.[152]

Peirce's pragmatism, as method and theory of definitions and conceptual clearness, is part of his theory of inquiry,[153] which he variously called speculative, general, formal or universal rhetoric[465] or simply methodeutic.[125] He applied his pragmatism as a method throughout his work.

Theory of inquiry

See also: Inquiry[466]

Critical common-sensism

Critical common-sensism,[154] treated by Peirce as a consequence of his pragmatism, is his combination of Thomas Reid's common-sense philosophy[467] with a fallibilism[468] that recognizes that propositions of our more or less vague common sense now indubitable may later come into question, for example because of transformations of our world through science. It includes efforts to work up in tests genuine doubts for a core group of common indubitables that vary slowly if at all.

Rival methods of inquiry

In "The Fixation of Belief[469]" (1877), Peirce described inquiry in general not as the pursuit

462 https://en.wikipedia.org/wiki/Pragmatic_maxim#2
463 https://en.wikipedia.org/wiki/Machiavelli
464 https://en.wikipedia.org/wiki/Pragmatic_maxim#6
465 https://en.wikipedia.org/wiki/Universal_rhetoric
466 https://en.wikipedia.org/wiki/Inquiry
467 https://en.wikipedia.org/wiki/Scottish_School_of_Common_Sense
468 https://en.wikipedia.org/wiki/Fallibilism
469 https://en.wikisource.org/wiki/The_Fixation_of_Belief

of truth *per se* but as the struggle to move from irritating, inhibitory doubt born of surprise, disagreement, and the like, and to reach a secure belief, belief being that on which one is prepared to act. That let Peirce frame scientific inquiry as part of a broader spectrum and as spurred, like inquiry generally, by actual doubt, not mere verbal, quarrelsome, or hyperbolic doubt[470], which he held to be fruitless. Peirce sketched four methods of settling opinion, ordered from least to most successful:

1. The method of *tenacity* (policy of sticking to initial belief) – which brings comforts and decisiveness but leads to trying to ignore contrary information and others' views as if truth were intrinsically private, not public. The method goes against the social impulse and easily falters since one may well notice when another's opinion seems as good as one's own initial opinion. Its successes can be brilliant but tend to be transitory.
2. The method of *authority* – which overcomes disagreements but sometimes brutally. Its successes can be majestic and long-lasting, but it cannot regulate people thoroughly enough to withstand doubts indefinitely, especially when people learn about other societies present and past.
3. The method of the *a priori* – which promotes conformity less brutally but fosters opinions as something like tastes, arising in conversation and comparisons of perspectives in terms of "what is agreeable to reason". Thereby it depends on fashion in paradigms[471] and goes in circles over time. It is more intellectual and respectable but, like the first two methods, sustains accidental and capricious beliefs, destining some minds to doubt it.
4. The method of *science* – wherein inquiry supposes that the real is discoverable but independent of particular opinion, such that, unlike in the other methods, inquiry can, by its own account, go wrong (fallibilism[472]), not only right, and thus purposely tests itself and criticizes, corrects, and improves itself.

Peirce held that, in practical affairs, slow and stumbling ratiocination is often dangerously inferior to instinct and traditional sentiment, and that the scientific method is best suited to theoretical research,[155] which in turn should not be trammeled by the other methods and practical ends; reason's "first rule"[120] is that, in order to learn, one must desire to learn and, as a corollary, must not block the way of inquiry. Scientific method[473] excels over the others finally by being deliberately designed to arrive—eventually—at the most secure beliefs, upon which the most successful practices can be based. Starting from the idea that people seek not truth *per se* but instead to subdue irritating, inhibitory doubt, Peirce showed how, through the struggle, some can come to submit to truth for the sake of belief's integrity, seek as truth the guidance of potential conduct correctly to its given goal, and wed themselves to the scientific method.

Scientific method

Insofar as clarification by pragmatic reflection suits explanatory hypotheses and fosters predictions and testing, pragmatism points beyond the usual duo of foundational alternatives:

470 https://en.wikipedia.org/wiki/Hyperbolic_doubt
471 https://en.wikipedia.org/wiki/Paradigm
472 https://en.wikipedia.org/wiki/Fallibilism
473 https://en.wikipedia.org/wiki/Scientific_method

deduction[474] from self-evident truths, or *rationalism*[475]; and induction[476] from experiential phenomena, or *empiricism*[477].

Based on his critique of three modes of argument[478] and different from either foundationalism[479] or coherentism[480], Peirce's approach seeks to justify claims by a three-phase dynamic of inquiry:

1. Active, abductive[481] genesis of theory, with no prior assurance of truth;
2. Deductive application of the contingent theory so as to clarify its practical implications;
3. Inductive testing and evaluation of the utility of the provisional theory in anticipation of future experience, in both senses: *prediction*[482] and *control*.

Thereby, Peirce devised an approach to inquiry far more solid than the flatter image of inductive generalization *simpliciter*, which is a mere re-labeling of phenomenological patterns. Peirce's pragmatism was the first time the scientific method[483] was proposed as an epistemology[484] for philosophical questions.

A theory that succeeds better than its rivals in predicting and controlling our world is said to be nearer the truth. This is an operational notion of truth used by scientists.

Peirce extracted the pragmatic model[485] or theory[486] of inquiry from its raw materials in classical logic and refined it in parallel with the early development of symbolic logic to address problems about the nature of scientific reasoning.

Abduction, deduction, and induction make incomplete sense in isolation from one another but comprise a cycle understandable as a whole insofar as they collaborate toward the common end of inquiry. In the pragmatic way of thinking about conceivable practical implications, every thing has a purpose, and, as possible, its purpose should first be denoted. Abduction hypothesizes an explanation for deduction to clarify into implications to be tested so that induction can evaluate the hypothesis, in the struggle to move from troublesome uncertainty to more secure belief. No matter how traditional and needful it is to study the modes of inference in abstraction from one another, the integrity of inquiry strongly limits the effective modularity[487] of its principal components.

Peirce's outline of the scientific method in §III–IV of "A Neglected Argument"[156] is summarized below (except as otherwise noted). There he also reviewed plausibility and inductive precision (issues of critique of arguments[488]).

474 https://en.wikipedia.org/wiki/Deductive_reasoning
475 https://en.wikipedia.org/wiki/Rationalism
476 https://en.wikipedia.org/wiki/Inductive_reasoning
477 https://en.wikipedia.org/wiki/Empiricism
478 #Modes_of_inference
479 https://en.wikipedia.org/wiki/Foundationalism
480 https://en.wikipedia.org/wiki/Coherentism
481 https://en.wikipedia.org/wiki/Abductive_reasoning
482 https://en.wikipedia.org/wiki/Prediction
483 https://en.wikipedia.org/wiki/Scientific_method
484 https://en.wikipedia.org/wiki/Epistemology
485 https://en.wikipedia.org/wiki/Mental_model
486 https://en.wikipedia.org/wiki/Theory
487 https://en.wikipedia.org/wiki/Modularity_(programming)
488 #Modes_of_inference

1. *Abductive* (or retroductive) phase. Guessing, inference to explanatory hypotheses for selection of those best worth trying. From abduction, Peirce distinguishes induction as inferring, on the basis of tests, the proportion of truth in the hypothesis. Every inquiry, whether into ideas, brute facts, or norms and laws, arises from surprising observations in one or more of those realms (and for example at any stage of an inquiry already underway). All explanatory content of theories comes from abduction, which guesses a new or outside idea so as to account in a simple, economical way for a surprising or complicated phenomenon. The modicum of success in our guesses far exceeds that of random luck, and seems born of attunement to nature by developed or inherent instincts, especially insofar as best guesses are optimally plausible and simple in the sense of the "facile and natural", as by Galileo[489]'s natural light of reason and as distinct from "logical simplicity".[157] Abduction is the most fertile but least secure mode of inference. Its general rationale is inductive: it succeeds often enough and it has no substitute in expediting us toward new truths.[158] In 1903, Peirce called pragmatism "the logic of abduction".[159] Coordinative method leads from abducting a plausible hypothesis to judging it for its testability[160] and for how its trial would economize inquiry itself.[161] The hypothesis, being insecure, needs to have practical implications leading at least to mental tests and, in science, lending themselves to scientific tests. A simple but unlikely guess, if not costly to test for falsity, may belong first in line for testing. A guess is intrinsically worth testing if it has plausibility or reasoned objective probability, while subjective likelihood[490], though reasoned, can be misleadingly seductive. Guesses can be selected for trial strategically, for their caution (for which Peirce gave as example the game of Twenty Questions[491]), breadth, or incomplexity.[162] One can discover only that which would be revealed through their sufficient experience anyway, and so the point is to expedite it; economy of research demands the leap, so to speak, of abduction and governs its art.[161]

2. *Deductive* phase. Two stages:

i. Explication. Not clearly premised, but a deductive analysis of the hypothesis so as to render its parts as clear as possible.

ii. Demonstration: Deductive Argumentation, Euclidean[492] in procedure. Explicit deduction of consequences of the hypothesis as predictions about evidence to be found. Corollarial[493] or, if needed, Theorematic.

3. *Inductive* phase. Evaluation of the hypothesis, inferring from observational or experimental tests of its deduced consequences. The long-run validity of the rule of induction is deducible from the principle (presuppositional to reasoning in general) that the real "is only the object of the final opinion to which sufficient investigation would lead";[150] in other words, anything excluding such a process would never be real. Induction involving the ongoing accumulation of evidence follows "a method which, sufficiently persisted in", will "diminish the error below any predesignate degree". Three stages:

i. Classification. Not clearly premised, but an inductive classing of objects of experience under general ideas.

489 https://en.wikipedia.org/wiki/Galileo
490 https://en.wikipedia.org/wiki/Subjective_probability
491 https://en.wikipedia.org/wiki/Twenty_Questions
492 https://en.wikipedia.org/wiki/Euclid
493 https://en.wikipedia.org/wiki/Corollary

ii. Probation: direct Inductive Argumentation. Crude or Gradual in procedure. Crude Induction, founded on experience in one mass (CP 2.759), presumes that future experience on a question will not differ utterly from all past experience (CP 2.756). Gradual Induction makes a new estimate of the proportion of truth in the hypothesis after each test, and is Qualitative or Quantitative. Qualitative Gradual Induction depends on estimating the relative evident weights of the various qualities of the subject class under investigation (CP 2.759; see also *Collected Papers of Charles Sanders Peirce*, 7.114–20). Quantitative Gradual Induction depends on how often, in a fair sample of instances of S, S is found actually accompanied by P that was predicted for S (CP 2.758). It depends on measurements, or statistics, or counting.

iii. Sentential Induction. "...which, by Inductive reasonings, appraises the different Probations singly, then their combinations, then makes self-appraisal of these very appraisals themselves, and passes final judgment on the whole result".

Against Cartesianism

Peirce drew on the methodological implications of the four incapacities[494]—no genuine introspection, no intuition in the sense of non-inferential cognition, no thought but in signs, and no conception of the absolutely incognizable—to attack philosophical Cartesianism[495], of which he said that:[127]

1. "It teaches that philosophy must begin in universal doubt" – when, instead, we start with preconceptions, "prejudices [...] which it does not occur to us *can* be questioned", though we may find reason to question them later. "Let us not pretend to doubt in philosophy what we do not doubt in our hearts."

2. "It teaches that the ultimate test of certainty is...in the individual consciousness" – when, instead, in science a theory stays on probation till agreement is reached, then it has no actual doubters left. No lone individual can reasonably hope to fulfill philosophy's multi-generational dream. When "candid and disciplined minds" continue to disagree on a theoretical issue, even the theory's author should feel doubts about it.

3. It trusts to "a single thread of inference depending often upon inconspicuous premisses" – when, instead, philosophy should, "like the successful sciences", proceed only from tangible, scrutinizable premisses and trust not to any one argument but instead to "the multitude and variety of its arguments" as forming, not a chain at least as weak as its weakest link, but "a cable whose fibers", soever "slender, are sufficiently numerous and intimately connected".

4. It renders many facts "absolutely inexplicable, unless to say that 'God makes them so' is to be regarded as an explanation"[163] – when, instead, philosophy should avoid being "unidealistic",[164] misbelieving that something real can defy or evade all possible ideas, and supposing, inevitably, "some absolutely inexplicable, unanalyzable ultimate", which explanatory surmise explains nothing and so is inadmissible.

494 #Four_incapacities

495 https://en.wikipedia.org/wiki/Ren%C3%A9_Descartes

1.7 Philosophy: metaphysics

Some noted articles

- The *Monist* Metaphysical Series (1891–1893)
  - The Architecture of Theories (1891)
  - The Doctrine of Necessity Examined (1892)
  - The Law of Mind (1892)
  - Man's Glassy Essence (1892)
  - Evolutionary Love (1893)
- Immortality in the Light of Synechism (1893 MS)

Peirce divided[496] metaphysics into (1) ontology or general metaphysics, (2) psychical[497] or religious metaphysics, and (3) physical metaphysics.

1.7.1 Ontology

Peirce was a scholastic[498] realist[499], declaring for the reality of generals[500] as early as 1868. [165] Regarding modalities[501] (possibility, necessity, etc.), he came in later years to regard himself as having wavered earlier as to just how positively real the modalities are. In his 1897 "The Logic of Relatives" he wrote:

> I formerly defined the possible as that which in a given state of information (real or feigned) we do not know not to be true. But this definition today seems to me only a twisted phrase which, by means of two negatives, conceals an anacoluthon. We know in advance of experience that certain things are not true, because we see they are impossible.

Peirce retained, as useful for some purposes, the definitions in terms of information states, but insisted that the pragmaticist is committed to a strong modal realism[502] by conceiving of objects in terms of predictive general conditional propositions about how they *would* behave under certain circumstances.[166]

1.7.2 Psychical or religious metaphysics

Peirce believed in God, and characterized such belief as founded in an instinct explorable in musing over the worlds of ideas, brute facts, and evolving habits—and it is a belief in God not as an *actual* or *existent* being (in Peirce's sense of those words), but all the same as a *real* being.[167] In "A Neglected Argument for the Reality of God[503]" (1908),[156] Peirce sketches, for God's reality, an argument to a hypothesis of God as the Necessary Being, a hypothesis which he describes in terms of how it would tend to develop and become compelling in musement and inquiry by a normal person who is led, by the hypothesis, to

496 https://en.wikipedia.org/wiki/Classification_of_the_sciences_(Peirce)
497 https://en.wiktionary.org/wiki/psychical
498 https://en.wikipedia.org/wiki/Scholasticism
499 https://en.wikipedia.org/wiki/Philosophical_realism
500 https://en.wikipedia.org/wiki/Problem_of_universals
501 https://en.wikipedia.org/wiki/Modal_logic
502 https://en.wikipedia.org/wiki/Modal_realism
503 https://en.wikisource.org/wiki/A_Neglected_Argument_for_the_Reality_of_God

consider as being purposed the features of the worlds of ideas, brute facts, and evolving habits (for example scientific progress), such that the thought of such purposefulness will "stand or fall with the hypothesis"; meanwhile, according to Peirce, the hypothesis, in supposing an "infinitely incomprehensible" being, starts off at odds with its own nature as a purportively true conception, and so, no matter how much the hypothesis grows, it both (A) inevitably regards itself as partly true, partly vague, and as continuing to define itself without limit, and (B) inevitably has God appearing likewise vague but growing, though God as the Necessary Being is not vague or growing; but the hypothesis will hold it to be *more* false to say the opposite, that God is purposeless. Peirce also argued that the will is free[168] and (see Synechism[504]) that there is at least an attenuated kind of immortality.

1.7.3 Physical metaphysics

Peirce held the view, which he called objective idealism[505], that "matter is effete mind, inveterate habits becoming physical laws".[169] Peirce asserted the reality of (1) absolute chance (his tychist[506] view), (2) mechanical necessity (anancist[507] view), and (3) that which he called the law of love (agapist[508] view), echoing his categories[509] Firstness, Secondness, and Thirdness, respectively. He held that fortuitous variation (which he also called "sporting"), mechanical necessity, and creative love are the three modes of evolution (modes called "tychasm", "anancasm", and "agapasm")[170] of the cosmos and its parts. He found his conception of agapasm embodied in Lamarckian evolution[510]; the overall idea in any case is that of evolution tending toward an end or goal, and it could also be the evolution of a mind or a society; it is the kind of evolution which manifests workings of mind in some general sense. He said that overall he was a synechist, holding with reality of continuity, [171] especially of space, time, and law.[172]

1.8 Science of review

Main article: Classification of the sciences (Peirce)[511] Peirce outlined two fields, "Cenoscopy" and "Science of Review", both of which he called philosophy. Both included philosophy about science. In 1903 he arranged them, from more to less theoretically basic, thus:[108]

1. Science of Discovery.
    a) Mathematics.
    b) Cenoscopy (philosophy as discussed earlier in this article – categorial, normative, metaphysical), as First Philosophy, concerns positive phenomena in general, does not rely on findings from special sciences, and includes the *general* study of inquiry and scientific method.
    c) Idioscopy, or the Special Sciences (of nature and mind).

504 https://en.wikipedia.org/wiki/Synechism
505 https://en.wikipedia.org/wiki/Objective_idealism
506 https://en.wikipedia.org/wiki/Tychism
507 https://en.wikipedia.org/wiki/Ananke
508 https://en.wikipedia.org/wiki/Agapism
509 #Theory_of_categories
510 https://en.wikipedia.org/wiki/Lamarckism
511 https://en.wikipedia.org/wiki/Classification_of_the_sciences_(Peirce)

2. Science of Review, as Ultimate Philosophy, arranges "... the results of discovery, beginning with digests, and going on to endeavor to form a philosophy of science". His examples included Humboldt[512]'s *Cosmos*[513], Comte[514]'s *Philosophie positive*[515], and Spencer[516]'s *Synthetic Philosophy*.
3. Practical Science, or the Arts.

Peirce placed, within Science of Review, the work and theory of classifying the sciences[517] (including mathematics and philosophy). His classifications, on which he worked for many years, draw on argument and wide knowledge, and are of interest both as a map for navigating his philosophy and as an accomplished polymath's survey of research in his time.

1.9 See also

- Charles Sanders Peirce's type–token distinction[518]
- Continuous predicate[519]
- Entitative graph[520]
- Howland will forgery trial[521]
- Hypostatic abstraction[522]
- Idea § Charles Sanders Peirce[523]
- *Laws of Form*[524]
- List of American philosophers[525]
- Logic of information[526]
- Logical machine[527]
- Logical matrix[528]
- Mathematical psychology[529]
- Normal distribution § Naming[530]
- Peirce triangle[531]
- Peircean realism[532]

512 https://en.wikipedia.org/wiki/Alexander_von_Humboldt
513 https://en.wikipedia.org/wiki/Alexander_Von_Humboldt#The_"Cosmos"
514 https://en.wikipedia.org/wiki/Auguste_Comte
515 https://en.wikipedia.org/wiki/Course_of_Positive_Philosophy
516 https://en.wikipedia.org/wiki/Herbert_Spencer
517 https://en.wikipedia.org/wiki/Classification_of_the_sciences_(Peirce)
518 https://en.wikipedia.org/wiki/Charles_Sanders_Peirce%27s_type%E2%80%93token_distinction
519 https://en.wikipedia.org/wiki/Continuous_predicate
520 https://en.wikipedia.org/wiki/Entitative_graph
521 https://en.wikipedia.org/wiki/Howland_will_forgery_trial
522 https://en.wikipedia.org/wiki/Hypostatic_abstraction
523 https://en.wikipedia.org/wiki/Idea#Charles_Sanders_Peirce
524 https://en.wikipedia.org/wiki/Laws_of_Form
525 https://en.wikipedia.org/wiki/List_of_American_philosophers
526 https://en.wikipedia.org/wiki/Logic_of_information
527 https://en.wikipedia.org/wiki/Logical_machine
528 https://en.wikipedia.org/wiki/Logical_matrix
529 https://en.wikipedia.org/wiki/Mathematical_psychology
530 https://en.wikipedia.org/wiki/Normal_distribution#Naming
531 https://en.wikipedia.org/wiki/Peirce_triangle
532 https://en.wikipedia.org/wiki/Peircean_realism

- Phaneron[533]
- Pragmatics[534]
- Problem of universals § Peirce[535]
- Quantification (science) § History[536]
- Relation algebra[537]
- Truth table[538]

1.9.1 Contemporaries associated with Peirce

- Oliver Wendell Holmes Jr.[539]
- George Herbert Mead[540]

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534 https://en.wikipedia.org/wiki/Pragmatics
535 https://en.wikipedia.org/wiki/Problem_of_universals#Peirce
536 https://en.wikipedia.org/wiki/Quantification_(science)#History
537 https://en.wikipedia.org/wiki/Relation_algebra
538 https://en.wikipedia.org/wiki/Truth_table
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540 https://en.wikipedia.org/wiki/George_Herbert_Mead
541 https://en.wikipedia.org/wiki/Ian_Hacking
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552 https://archive.today/20130112162124/http://ptonline.aip.org/journals/doc/PHTOAD-ft/vol_62/iss_12/39_1.shtml?bypassSSO
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693 http://www.cspeirce.com/menu/library/aboutcsp/houser/fortunes.htm
694 http://www.helsinki.fi/~pietarin/Memorandum-Peirce%20Society-Pietarinen-2012.pdf
695 http://www.helsinki.fi/science/commens/collections.html
696 https://archive.today/20120708211504/http://bjps.oxfordjournals.org/cgi/pdf_extract/38/1/117
697 http://www.cspeirce.com/menu/library/aboutcsp/auspitz/escape.htm
698 https://archive.org/details/sim_american-journal-of-mathematics_1879_2/page/n403/mode/2up
699 https://en.wikipedia.org/wiki/Doi_(identifier)
700 https://doi.org/10.2307%2F2369491
701 https://en.wikipedia.org/wiki/JSTOR_(identifier)
702 http://www.jstor.org/stable/2369491
703 https://en.wikipedia.org/wiki/Arthur_W._Burks
704 http://projecteuclid.org/DPubS/Repository/1.0/Disseminate?view=body&id=pdf_1&handle=euclid.bams/1183541145

85. Peirce (1860 MS), "Orders of Infinity", *News from the Peirce Edition Project*, September 2010[705] (PDF), p. 6, with the manuscript's text. Also see logic historian Irving Anellis's November 11, 2010 comment[706] Archived[707] April 23, 2017, at the Wayback Machine[708] at peirce-l.
86. Peirce (MS, winter of 1880–81), "A Boolean Algebra with One Constant", *Collected Papers of Charles Sanders Peirce*, 4.12–20, *Writings of Charles S. Peirce*, 4:218–21. Google Preview[709]. See Roberts, Don D. (1973), *The Existential Graphs of Charles S. Peirce*, p. 131.
87. Peirce (1881), "On the Logic of Number", *American Journal of Mathematics* v. 4, pp. 85–95[710]. Reprinted (CP 3.252–88), (*Writings of Charles S. Peirce*, 4:299–309). See See Shields, Paul (1997), "Peirce's Axiomatization of Arithmetic", in Houser *et al.*, eds., *Studies in the Logic of Charles S. Peirce*.
88. Peirce (1885), "On the Algebra of Logic: A Contribution to the Philosophy of Notation", *American Journal of Mathematics* 7, two parts, first part published 1885, pp. 180–202[711] (see Houser in linked paragraph[712] in "Introduction" in *Writings of Charles S. Peirce*, 4). Presented, National Academy of Sciences, Newport, RI, October 14–17, 1884 (see *The Essential Peirce*, 1, Headnote 16[713]). 1885 is the year usually given for this work. Reprinted *Collected Papers of Charles Sanders Peirce*, 3.359–403, *Writings of Charles S. Peirce*, 5:162–90, *The Essential Peirce*, 1:225–28, in part.
89. Putnam, Hilary (1982), "Peirce the Logician", *Historia Mathematica* 9, 290–301. Reprinted, pp. 252–60 in Putnam (1990), *Realism with a Human Face*, Harvard. Excerpt with article's last five pages[714].
90. It was in Peirce's 1885 "On the Algebra of Logic". See Byrnes, John (1998), "Peirce's First-Order Logic of 1885", *Transactions of the Charles S. Peirce Society* v. 34, n. 4, pp. 949–76.
91. Brady, Geraldine (2000), *From Peirce to Skolem: A Neglected Chapter in the History of Logic*, North-Holland/Elsevier Science BV, Amsterdam, Netherlands.
92. See Peirce (1898), Lecture 3, "The Logic of Relatives" (not the 1897 *Monist* article), *Reasoning and the Logic of Things*[715], pp. 146–64 [151]
93. Peirce (1898), "The Logic of Mathematics in Relation to Education" in *Educational Review* v. 15, pp. 209–16[716] (via *Internet Archive*). Reprinted *Collected Papers of Charles Sanders Peirce*, 3.553–62. See also his "The Simplest Mathematics" (1902 MS), *Collected Papers of Charles Sanders Peirce*, 4.227–323.

705 http://www.iupui.edu/~peirce/PEP_news_Sept2010.pdf
706 http://thread.gmane.org/gmane.science.philosophy.peirce/6621/focus=6626
707 https://web.archive.org/web/20170423131106/http://thread.gmane.org/gmane.science.philosophy.peirce/6621/focus=6626
708 https://en.wikipedia.org/wiki/Wayback_Machine
709 https://archive.org/details/writingsofcharle0002peir
710 https://books.google.com/books?id=LQgPAAAAIAAJ&pg=PA85
711 https://books.google.com/books?id=lwYPAAAAIAAJ&&pg=PA180
712 http://www.iupui.edu/~peirce/writings/v4/v4introx.htm#21note
713 http://www.iupui.edu/~peirce/ep/ep1/heads/ep1heads.htm#16
714 http://www.jfsowa.com/peirce/putnam.htm
715 #RLT
716 https://archive.org/stream/educationalrevie15newyuoft#page/209/mode/1up

94. Lewis, Clarence Irving (1918), *A Survey of Symbolic Logic*, see ch. 1, §7 "Peirce", pp. 79–106, see p. 79[717] (*Internet Archive*). Note that Lewis's bibliography lists works by Frege, tagged with asterisks as important.
95. Avery, John (2003) *Information theory and evolution*, p. 167; also Mitchell, Melanie, "My Scientific Ancestry[718] Archived[719] October 8, 2014, at the Wayback Machine[720]".
96. Beil, Ralph G. and Ketner, Kenneth (2003), "Peirce, Clifford, and Quantum Theory", *International Journal of Theoretical Physics* v. 42, n. 9, pp. 1957–72.
97. Houser, Roberts, and Van Evra, eds. (1997), *Studies in the Logic of Charles Sanders Peirce*, Indiana U., Bloomington, IN.
98. Misak, ed. (2004), *The Cambridge Companion to Peirce*, Cambridge U., UK.
99. Peirce (1893–1894, MS 949, p. 1)
100. Peirce (1903 MS), *Collected Papers of Charles Sanders Peirce*, 6.176: "But I now define a *pseudo-continuum* as that which modern writers on the theory of functions call a *continuum*. But this is fully represented by [...] the totality of real values, rational and irrational [...]."
101. Peirce (1902 MS) and Ransdell, Joseph[721], ed. (1998), "Analysis of the Methods of Mathematical Demonstration", Memoir 4[722], Draft C, MS L75.90–102, see 99–100. (Once there, scroll down).
102. See:
    - Peirce (1908), "Some Amazing Mazes (Conclusion), Explanation of Curiosity the First", *The Monist*, v. 18, n. 3, pp. 416–44, see 463-64[723]. Reprinted *Collected Papers of Charles Sanders Peirce*, 4.594–642, see 642.
    - Havenel, Jérôme (2008), "Peirce's Clarifications on Continuity", *Transactions* Winter 2008 pp. 68–133, see 119. Abstract[724].
103. Peirce condemned the use of "certain likelihoods[725]" (*The Essential Peirce*, 2:108–09) even more strongly than he criticized Bayesian methods[726]. Indeed Peirce used a bit of Bayesian inference[727] in criticizing parapsychology (*Writings of Charles S. Peirce*, 6:76).
104. Miller, Richard W. (1975), "Propensity: Popper or Peirce?", *British Journal for the Philosophy of Science*[728], v. 26, n. 2, pp. 123–32. doi[729]:10.1093/bjps/26.2.123[730]. Eprint[731].

717 https://archive.org/stream/surveyofsymbolic00lewiiala#page/79/mode/1up
718 http://web.cecs.pdx.edu/~mm/MMScientificAncestry.html
719 https://web.archive.org/web/20141008181914/http://web.cecs.pdx.edu/~mm/MMScientificAncestry.html
720 https://en.wikipedia.org/wiki/Wayback_Machine
721 https://en.wikipedia.org/wiki/Joseph_Morton_Ransdell
722 http://www.cspeirce.com/menu/library/bycsp/l75/ver1/l75v1-02.htm#m4
723 https://archive.org/details/bub_gb_CqsLAAAAIAAJ_2/page/n544
724 https://www.jstor.org/pss/40321237
725 https://en.wikipedia.org/wiki/Likelihood_function
726 https://en.wikipedia.org/wiki/Bayesian_statistics
727 https://en.wikipedia.org/wiki/Bayesian_inference
728 https://en.wikipedia.org/wiki/British_Journal_for_the_Philosophy_of_Science
729 https://en.wikipedia.org/wiki/Doi_(identifier)
730 https://doi.org/10.1093%2Fbjps%2F26.2.123
731 https://wayback.archive-it.org/all/20190412103703/https://academic.oup.com/bjps/article-abstract/26/2/123/1513234?redirectedFrom=fulltext

105. Haack, Susan[732] and Kolenda, Konstantin (1977), "Two Fallibilists in Search of the Truth", *Proceedings of the Aristotelian Society*, Supplementary Volumes, v. 51, pp. 63–104. JSTOR[733] 4106816[734]
106. Peirce CS, Jastrow J. On Small Differences in Sensation[735]. Memoirs of the National Academy of Sciences 1885; 3:73–83.
107. Peirce (1897) "Fallibilism, Continuity, and Evolution", *Collected Papers of Charles Sanders Peirce*, 1.141–75 (Eprint[736]), placed by the *Collected Papers of Charles Sanders Peirce*, editors directly after "F.R.L." (1899, *Collected Papers of Charles Sanders Peirce*, 1.135–40).
108. Peirce (1903), *Collected Papers of Charles Sanders Peirce*, 1.180–202 and (1906) "The Basis of Pragmaticism", *The Essential Peirce*, 2:372–73, see "Philosophy[737]" at *Commens Digital Companion to C.S. Peirce*.
109. See in "Firstness", "Secondness", and "Thirdness" in *Commens Digital Companion to C.S. Peirce*[738].
110. Peirce (1893), "The Categories" MS 403. *Arisbe* Eprint[739], edited by Joseph Ransdell[740], with information on the re-write, and interleaved with the 1867 "New List" for comparison.
111. "Minute Logic", CP 2.87, c.1902 and A Letter to Lady Welby, CP 8.329, 1904. See relevant quotes under "Categories, Cenopythagorean Categories[741]" in *Commens Dictionary of Peirce's Terms* (CDPT), Bergman & Paalova, eds., U. of Helsinki.
112. See quotes under "Firstness, First [as a category][742]" in CDPT.
113. The ground ***blackness*** is the pure abstraction of the quality ***black***. Something ***black*** is something ***embodying blackness***, pointing us back to the abstraction. The quality ***black*** amounts to reference to its own pure abstraction, the ground ***blackness***. The question is not merely of *noun* (the ground) versus *adjective* (the quality), but rather of whether we are considering the black(ness) as abstracted away from application to an object, or instead as so applied (for instance to a stove). Yet note that Peirce's distinction here is not that between a property-general and a property-individual (a trope[743]). See "On a New List of Categories[744]" (1867), in the section appearing in CP 1.551. Regarding the ground, cf. the Scholastic conception of a relation's *foundation*, Google limited preview Deely 1982, p. 61[745]
114. A quale in this sense is a *such*, just as a quality is a suchness. Cf. under "Use of Letters" in §3 of Peirce's "Description of a Notation for the Logic of Relatives", *Memoirs of the*

732 https://en.wikipedia.org/wiki/Susan_Haack
733 https://en.wikipedia.org/wiki/JSTOR_(identifier)
734 https://www.jstor.org/stable/4106816
735 http://psychclassics.yorku.ca/Peirce/small-diffs.htm
736 http://www.textlog.de/4248.html
737 http://www.helsinki.fi/science/commens/terms/philosophy.html
738 http://www.helsinki.fi/science/commens/dictionary.html
739 http://www.cspeirce.com/menu/library/bycsp/bycsp.htm#NLOC-R
740 https://en.wikipedia.org/wiki/Joseph_Morton_Ransdell
741 http://www.helsinki.fi/science/commens/terms/categories.html
742 http://www.helsinki.fi/science/commens/terms/firstness.html
743 https://en.wikipedia.org/wiki/Trope_(philosophy)
744 http://www.cspeirce.com/menu/library/bycsp/newlist/nl-frame.htm
745 https://books.google.com/books?id=fSzt6_-ce-gC&pg=PA61&dq=%22Introducing+Semiotic%22+foundation+ground&sig=kgh62kOzOoFrCOYyAV04YxJOSOo#PPA61

American Academy, v. 9, pp. 317–78 (1870), separately reprinted (1870), from which see p. 6 via Google books[746], also reprinted in CP 3.63:

> Now logical terms are of three grand classes. The first embraces those whose logical form[747] involves only the conception of quality, and which therefore represent a thing simply as "a —." These discriminate objects in the most rudimentary way, which does not involve any consciousness of discrimination. They regard an object as it is in itself as *such* (*quale*); for example, as horse, tree, or man. These are *absolute terms*. (Peirce, 1870. But also see "Quale-Consciousness", 1898, in CP 6.222–37.)

115. See quotes under "Secondness, Second [as a category][748]" in CDPT.
116. See quotes under "Thirdness, Third [as a category][749]" in CDPT.
117. "Charles S. Peirce on Esthetics and Ethics: A Bibliography[750] Archived[751] 6 April 2003 at the Wayback Machine[752]" (PDF) by Kelly A. Parker in 1999.
118. Peirce (1902 MS), Carnegie Application, edited by Joseph Ransdell, Memoir 2[753], see table.
119. See Esthetics[754] at *Commens Digital Companion to C.S. Peirce*.
120. Peirce (1899 MS), "F.R.L." [First Rule of Logic], *Collected Papers of Charles Sanders Peirce*, 1.135–40, Eprint[755]
121. Peirce (1882), "Introductory Lecture on the Study of Logic" delivered September 1882, *Johns Hopkins University Circulars*, v. 2, n. 19, pp. 11–12[756] (via Google), November 1882. Reprinted (*The Essential Peirce*, 1:210–14; *Writings of Charles S. Peirce*, 4:378–82; *Collected Papers of Charles Sanders Peirce*, 7.59–76). The definition of logic quoted by Peirce is by Peter of Spain[757].
122. Peirce (1878), "The Doctrine of Chances", *Popular Science Monthly*, v. 12, pp. 604–15 (CP 2.645–68, *Writings of Charles S. Peirce*, 3:276–90, *The Essential Peirce*, 1:142–54).

    > ... death makes the number of our risks, the number of our inferences, finite, and so makes their mean result uncertain. The very idea of probability and of reasoning rests on the assumption that this number is indefinitely great. ... logicality inexorably requires that our interests shall *not* be limited. ... Logic is rooted in the social principle.

123. Peirce, *Collected Papers of Charles Sanders Peirce*, 5.448 footnote, from "The Basis of Pragmaticism" in 1906.

746 https://books.google.com/books?id=fFnWmf5oLaoC&pg=PA6
747 https://en.wikipedia.org/wiki/Logical_form
748 http://www.helsinki.fi/science/commens/terms/secondness.html
749 http://www.helsinki.fi/science/commens/terms/thirdness.html
750 http://agora.phi.gvsu.edu/kap/CSP_Bibliography/CSP_norm_bib.pdf
751 https://web.archive.org/web/20030406170524/http://agora.phi.gvsu.edu/kap/CSP_Bibliography/CSP_norm_bib.pdf
752 https://en.wikipedia.org/wiki/Wayback_Machine
753 http://www.cspeirce.com/menu/library/bycsp/l75/ver1/l75v1-02.htm
754 http://www.helsinki.fi/science/commens/terms/esthetics.html
755 https://web.archive.org/web/20120106071421/http://www.princeton.edu/~batke/peirce/frl_99.htm
756 https://books.google.com/books?id=E0YFAAAAQAAJ&pg=PA11&dq=%22art+of+devising+methods+of+research%22
757 https://en.wikipedia.org/wiki/Peter_of_Spain_(author)

124. Peirce, (1868), "Questions concerning certain Faculties claimed for Man", *Journal of Speculative Philosophy* v. 2, n. 2, pp. 103–14[758]. On thought in signs, see p. 112. Reprinted *Collected Papers of Charles Sanders Peirce*, 5.213–63 (on thought in signs, see 253), *Writings of Charles S. Peirce*, 2:193–211, *The Essential Peirce*, 2:11–27. *Arisbe* Eprint[759].
125. See rhetoric definitions[760] at *Commens Digital Companion to C.S. Peirce*.
126. Peirce (1902), The Carnegie Institute Application, Memoir 10, MS L75.361–62, *Arisbe* Eprint[761].
127. Peirce (1868), "Some Consequences of Four Incapacities", *Journal of Speculative Philosophy* v. 2, n. 3, pp. 140–57[762]. Reprinted *Collected Papers of Charles Sanders Peirce*, 5.264–317, *Writings of Charles S. Peirce*, 2:211–42, *The Essential Peirce*, 1:28–55. *Arisbe* Eprint[763].
128. Peirce, "Grounds of Validity of the Laws of Logic: Further Consequences of Four Incapacities", *Journal of Speculative Philosophy* v. II, n. 4, pp. 193–208[764]. Reprinted *Collected Papers of Charles Sanders Peirce*, 5.318–57, *Writings of Charles S. Peirce*, 2:242–72 (*Peirce Edition Project*, Eprint[765]), *The Essential Peirce*, 1:56–82.
129. Peirce (1905), "What Pragmatism Is", *The Monist*, v. XV, n. 2, pp. 161–81, see 167[766]. Reprinted *Collected Papers of Charles Sanders Peirce*, 5.411–37, see 416. *Arisbe* Eprint[767].
130. Peirce 1907, *Collected Papers of Charles Sanders Peirce*, 5.484. Reprinted, *The Essential Peirce*, 2:411 in "Pragmatism" (398–433).
131. See "Quasi-mind[768]" in *Commens Digital Companion to C.S. Peirce*.
132. Peirce, "Carnegie Application", *The New Elements of Mathematics*[769] v. 4, p. 54.
133. Peirce (1867), "Upon Logical Comprehension and Extension" (CP 2.391–426), (*Writings of Charles S. Peirce*, 2:70–86[770]).
134. See pp. 404–09 in "Pragmatism" in *The Essential Peirce*, 2. Ten quotes on collateral experience from Peirce provided by Joseph Ransdell can be viewed here[771] at peirce-l's Lyris archive. Note: Ransdell's quotes from *Collected Papers of Charles Sanders Peirce*, 8.178–79 are also in *The Essential Peirce*, 2:493–94, which gives their date as 1909; and his quote from *Collected Papers of Charles Sanders Peirce*, 8.183 is also in *The Essential Peirce*, 2:495–96, which gives its date as 1909.
135. Peirce, letter to William James, dated 1909, see *The Essential Peirce*, 2:492.
136. See "76 definitions of the sign by C.S.Peirce[772]", collected by Robert Marty (U. of Perpignan, France).

758 https://books.google.com/books?id=YHkqP2JHJ_IC&pg=RA1-PA103
759 http://www.cspeirce.com/menu/library/bycsp/question/qu-frame.htm
760 http://www.helsinki.fi/science/commens/terms/rhetoricspec.html
761 http://www.cspeirce.com/menu/library/bycsp/l75/ver1/l75v1-04.htm#m10
762 https://books.google.com/books?id=YHkqP2JHJ_IC&pg=RA1-PA140
763 http://www.cspeirce.com/menu/library/bycsp/conseq/cn-frame.htm
764 https://books.google.com/books?id=YHkqP2JHJ_IC&pg=RA1-PA193
765 http://www.iupui.edu/~peirce/writings/v2/w2/w2_23/v2_23.htm
766 https://archive.org/details/monist18instgoog/page/n201
767 http://www.cspeirce.com/menu/library/bycsp/whatis/whatpragis.htm
768 http://www.helsinki.fi/science/commens/terms/quasimind.html
769 #NEM
770 http://www.iupui.edu/~peirce/writings/v2/w2/w2_06/v2_06.htm
771 http://lyris.ttu.edu/read/messages?id=57101
772 http://perso.numericable.fr/robert.marty/semiotique/76defeng.htm

137. Peirce, A Letter to Lady Welby (1908), *Semiotic and Significs*[773], pp. 80–81:
I define a Sign as anything which is so determined by something else, called its Object, and so determines an effect upon a person, which effect I call its Interpretant, that the latter is thereby mediately determined by the former. My insertion of "upon a person" is a sop to Cerberus, because I despair of making my own broader conception understood.
138. *Representamen* (/ˌrɛprɪzɛnˈteɪmən/[774] *REP-ri-zen-TAY-mən*[775]) was adopted (not coined[776]) by Peirce as his technical term for the *sign* as covered in his theory, in case a divergence should come to light between his theoretical version and the popular senses of the word "sign". He eventually stopped using "representamen". See *The Essential Peirce*, 2:272–73 and *Semiotic and Significs*[777] p. 193, quotes in "Representamen[778]" at *Commens Digital Companion to C.S. Peirce*.
139. Eco, Umberto (1984). *Semiotics and the Philosophy of Language*[779]. Bloomington & Indianapolis: Indiana University Press. p. 15[780]. ISBN[781] 978-0253203984[782].
140. Peirce (1909), A Letter to William James, *The Essential Peirce*, 2:492–502. Fictional object, 498. Object as universe of discourse, 492. See "Dynamical Object[783]" at *Commens Digital Companion to C.S. Peirce*.
141. See "Immediate Object", etc., at *Commens Digital Companion to C.S. Peirce*[784].
142. Peirce (1903 MS), "Nomenclature and Divisions of Triadic Relations, as Far as They Are Determined", under other titles in *Collected Papers* (CP) v. 2, paragraphs 233–72, and reprinted under the original title in *Essential Peirce* (EP) v. 2, pp. 289–99. Also see image of MS 339[785] (August 7, 1904) supplied to peirce-l by Bernard Morand[786] of the Institut Universitaire de Technologie (France), Département Informatique.
143. On the varying terminology, look up in *Commens Digital Companion to C.S. Peirce*[787].
144. *Popular Science Monthly*, v. 13, pp. 470–82, see 472[788] or the book at Wikisource[789]. *Collected Papers of Charles Sanders Peirce*, 2.619–44 [623]
145. See, under "Abduction[790]" at *Commens Digital Companion to C.S. Peirce*, the following quotes:
    - On correction of "A Theory of Probable Inference", see quotes from "Minute Logic", *Collected Papers of Charles Sanders Peirce*, 2.102, c. 1902, and from the Carnegie

773 #SS
774 https://en.wikipedia.org/wiki/Help:IPA/English
775 https://en.wikipedia.org/wiki/Help:Pronunciation_respelling_key
776 https://en.wiktionary.org/wiki/representamen
777 #SS
778 http://www.helsinki.fi/science/commens/terms/representamen.html
779 https://archive.org/details/semioticsphiloso00ecou/page/15
780 https://archive.org/details/semioticsphiloso00ecou/page/15
781 https://en.wikipedia.org/wiki/ISBN_(identifier)
782 https://en.wikipedia.org/wiki/Special:BookSources/978-0253203984
783 http://www.helsinki.fi/science/commens/terms/dynamicalobject.html
784 http://www.helsinki.fi/science/commens/dictionary.html
785 http://www.mail-archive.com/peirce-l@lyris.ttu.edu/msg00850.html
786 http://www.iutc3.unicaen.fr/~moranb/
787 http://www.helsinki.fi/science/commens/dictionary.html
788 https://books.google.com/books?id=u8sWAQAAIAAJ&pg=PA472
789 https://en.wikisource.org/wiki/Popular_Science_Monthly/Volume_13/August_1878/Illustrations_of_the_Logic_of_Science_VI
790 http://www.helsinki.fi/science/commens/terms/abduction.html

Application (L75), 1902, *Historical Perspectives on Peirce's Logic of Science* v. 2, pp. 1031–32.

- On new logical form for abduction, see quote from Harvard Lectures on Pragmatism, 1903, *Collected Papers of Charles Sanders Peirce*, 5.188–89.

See also Santaella, Lucia (1997) "The Development of Peirce's Three Types of Reasoning: Abduction, Deduction, and Induction", 6th Congress of the IASS[791]. Eprint[792].

146. "Lectures on Pragmatism", 1903, *Collected Papers of Charles Sanders Peirce*, 5.171.
147. A Letter to J. H. Kehler (dated 1911), *The New Elements of Mathematics*[793] v. 3, pp. 203–04, see in "Retroduction[794]" at *Commens Digital Companion to C.S. Peirce.*
148. James, William (1897), *The Will to Believe*, see p. 124.
149. See Pragmaticism#Pragmaticism's name[795] for discussion and references.
150. "That the rule of induction will hold good in the long run may be deduced from the principle that reality is only the object of the final opinion to which sufficient investigation would lead", in Peirce (1878 April), "The Probability of Induction", p. 718[796] (via *Internet Archive*) in *Popular Science Monthly*, v. 12, pp. 705–18. Reprinted in *Collected Papers of Charles Sanders Peirce*, 2.669–93, *Writings of Charles S. Peirce*, 3:290–305, *The Essential Peirce*, 1:155–69, elsewhere.
151. Peirce (1902), *Collected Papers of Charles Sanders Peirce*, 5.13 note 1.
152. See *Collected Papers of Charles Sanders Peirce*, 1.34 Eprint[797] (in "The Spirit of Scholasticism"), where Peirce ascribed the success of modern science less to a novel interest in verification than to the improvement of verification.
153. See Joseph Ransdell[798]'s comments and his tabular list of titles of Peirce's proposed list of memoirs in 1902 for his Carnegie application, Eprint[799]
154. Peirce (1905), "Issues of Pragmaticism", *The Monist*, v. XV, n. 4, pp. 481–99[800]. Reprinted *Collected Papers of Charles Sanders Peirce*, 5.438–63. Also important: *Collected Papers of Charles Sanders Peirce*, 5.497–525.
155. Peirce, "Philosophy and the Conduct of Life", Lecture 1 of the 1898 Cambridge (MA) Conferences Lectures, *Collected Papers of Charles Sanders Peirce*, 1.616–48 in part and *Reasoning and the Logic of Things*[801], 105–22, reprinted in *The Essential Peirce*, 2:27–41.
156. Peirce (1908), "A Neglected Argument for the Reality of God[802]", published in large part, *Hibbert Journal* v. 7, 90–112. Reprinted with an unpublished part, *Collected Papers of Charles Sanders Peirce*, 6.452–85, *Selected Writings* pp. 358–79, *The Essential Peirce*, 2:434–50, *Peirce on Signs* 260–78.
157. See also Nubiola, Jaime (2004), "Il Lume Naturale: Abduction and God[803]", *Semiotiche* I/2, 91–102.

791 https://en.wikipedia.org/wiki/IASS
792 http://www.pucsp.br/~lbraga/epap_peir1.htm
793 #NEM
794 http://www.helsinki.fi/science/commens/terms/retroduction.html
795 https://en.wikipedia.org/wiki/Pragmaticism#Pragmaticism's_name
796 https://archive.org/stream/popscimonthly12yoummiss#page/728/mode/1up
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158. Peirce (c. 1906), "PAP (Prolegomena to an Apology for Pragmatism)" (MS 293), *The New Elements of Mathematics*[804] v. 4, pp. 319–20, first quote under "Abduction[805]" at *Commens Digital Companion to C.S. Peirce*.
159. Peirce (1903), "Pragmatism – The Logic of Abduction", *Collected Papers of Charles Sanders Peirce*, 5.195–205, especially 196. Eprint[806].
160. Peirce, Carnegie application, MS L75.279–80: Memoir 27[807], Draft B.
161. See MS L75.329–30, from Draft D of Memoir 27[808] of Peirce's application to the Carnegie Institution:

    > Consequently, to discover is simply to expedite an event that would occur sooner or later, if we had not troubled ourselves to make the discovery. Consequently, the art of discovery is purely a question of economics. The economics of research is, so far as logic is concerned, the leading doctrine with reference to the art of discovery. Consequently, the conduct of abduction, which is chiefly a question of heuretic and is the first question of heuretic, is to be governed by economical considerations.

162. Peirce, C. S., "On the Logic of Drawing Ancient History from Documents", *The Essential Peirce*, 2, see pp. 107–09. On Twenty Questions, see 109:

    > Thus, twenty skillful hypotheses will ascertain what 200,000 stupid ones might fail to do.

163. Peirce believed in God. See section #Philosophy: metaphysics[809].
164. However, Peirce disagreed with Hegelian absolute idealism[810]. See for example *Collected Papers of Charles Sanders Peirce*, 8.131.
165. Peirce (1868), "Nominalism versus Realism", *Journal of Speculative Philosophy* v. 2, n. 1, pp. 57–61[811]. Reprinted (CP 6.619–24), (*Writings of Charles S. Peirce*, 2:144–53[812]).
166. On developments in Peirce's realism, see:
    - Peirce (1897), "The Logic of Relatives", *The Monist* v. VII, n. 2 pp. 161–217, see 206[813] (via Google). Reprinted *Collected Papers of Charles Sanders Peirce*, 3.456–552.
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809 #Philosophy:_metaphysics
810 https://en.wikipedia.org/wiki/Absolute_idealism
811 https://books.google.com/books?id=YHkqP2JHJ_IC&pg=RA1-PA57
812 http://www.iupui.edu/~peirce/writings/v2/w2/w2_14/v2_14.htm
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816 https://web.archive.org/web/20080223094243/http://users.xplornet.com/~gnox/CSPgod.htm

the Wayback Machine[817], reprinted in part as "The Concept of God" in *Philosophical Writings of Peirce*, J. Buchler, ed., 1940, pp. 375–78:

> I will also take the liberty of substituting "reality" for "existence." This is perhaps overscrupulosity; but I myself always use *exist* in its strict philosophical sense of "react with the other like things in the environment." Of course, in that sense, it would be fetichism to say that God "exists." The word "reality," on the contrary, is used in ordinary parlance in its correct philosophical sense. [....] I define the *real* as that which holds its characters on such a tenure that it makes not the slightest difference what any man or men may have *thought* them to be, or ever will have *thought* them to be, here using thought to include, imagining, opining, and willing (as long as forcible *means* are not used); but the real thing's characters will remain absolutely untouched.

168. See his "The Doctrine of Necessity Examined" (1892) and "Reply to the Necessitarians" (1893)[818], to both of which editor Paul Carus[819] responded.
169. Peirce (1891), "The Architecture of Theories", *The Monist*[820] v. 1, pp. 161–76[821], see p. 170[822], via *Internet Archive*. Reprinted (CP 6.7–34) and (*The Essential Peirce*, 1:285–97, see p. 293).
170. See "tychism", "tychasm", "tychasticism", and the rest, at *Commens Digital Companion to C.S. Peirce*[823].
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172. See p. 115 in *Reasoning and the Logic of Things*[827] (Peirce's 1898 lectures).

1.11 External links

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