continuing his work in the Geodetic Survey and was thus carrying on a considerable range of scientific work of quite different scope. He came of a family of exact scientists among men with academic traditions. It needed no change of manner or interest to set his activities in the professorial direction. By those who knew him in other relations I am confirmed in my impression that he had more pleasure in the academic pursuits. To these he turned when he retired, recognizing in his work as a scholar surveying broadly the field of intellect, the strongest bent of his versatile mind. To those who believe that for the training of the leaders of men, nothing is more inspiring and more helpful than training by example—than the privilege of association in the cooperative spirit with a master mind—the example of Charles S. Peirce will continue to remain a cherished memory. An educational policy that makes it possible to find a place for such men as Peirce in the faculties of the great universities is a worthy ambition for those who control the educational future of America.

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CHARLES S. PEIRCE AND A TENTATIVE BIBLIOGRAPHY OF HIS PUBLISHED WRITINGS

THOUGH I have not stood in any peculiar relation to Charles S. Peirce, and can not speak authoritatively on the various phases of his extraordinarily diversified intellectual activity, I can not refuse the editors' courteous invitation to add a few words of "philosophic piety" in tribute to one of the few great seminal minds that America has produced.

Many and diverse are the minds that form the philosophic community. There are, first and foremost, the great teachers, the system builders who rear their stately palaces towering to the moon. These archetypic minds are served by a varied host of followers and auxiliaries. Some provide the furnishings to make these stately mansions of the mind more commodious, while others are engaged in making their façades more imposing. Some are busy strengthening weak places or building much-needed additions, while many are engaged in defending these structures against the imputious army of critics who are ever eager and ready to pounce down upon and destroy all that is new or bears the mortal mark of human imperfection. There are also the philologists, those who are in a more narrow sense scholars, who dig not only for facts or roots, but also for the stones which may serve either for building or as weapons of destruction. Remote from all these, however, are the intellectual rovers who, in their search for new fields, venture into the thick jungle that surrounds the little patch of cultivated science. They are not great structures, these lonely pioneers; and in their isolation they often completely lose touch with those who tread only the beaten paths, so that no one learns of their green pastures or knows their final burial ground. Those that return to the community often speak of strange things or use strange words; and it is but seldom that they prove sufficient faith for others to follow them and change their trails into high roads.

Few nowadays would question the great value of these pioneer minds; and it is often asserted that universities are established to facilitate their work, and prevent it from being lost. But universities, like other well-managed institutions, can find place only for those who can work well in harness. The restless, impatient minds, like the socially or conventionally unacceptable, must thus be kept out, no matter how fruitful their originality. Charles S. Peirce was certainly one of these restless pioneer souls with the divine gift of seeing the hitherto invisible. In his early papers, in the Journal of Speculative Philosophy, and in his later papers, in the Monist, we get indeed glimpses of a 'vast philosophic system on which he was indeed, one of the most essential gifts of successful system builders, the power to coin an apt and striking terminology. But I am not certain that he could ever have completed this work, i.e., I am not in my own imagination how the various lines of his thought can be made to meet. However, that his was a mind unusually fruitful in strikingly original suggestions, no careful, open-minded reader of his writings will deny. That these writings have been so sadly neglected—that even now no collected edition of them is available—is to be accounted for only by the fact that isolation and neglect are the penalty for those who stray from the beaten path and refuse to bow to the reigning idols.

In one respect Peirce has certainly been most fortunate. Two such gifted and powerful minds as those of William James and Josiah Royce have been able to follow some of the directions from his flights heights and have thus conquered rich philosophic domains. That further, domains await those who can decipher other of his cryptic directions can, of course, only be a question of faith. Of Royce's indebtedness to Peirce an eloquent testimony is contained in the preface to the "Problem of Christianity." In view, however, of Professor Howison's misunderstanding of that passage and its motive, 1 a student of Professor Royce may be allowed to

testify to the frequency and generosity with which Professor Royce has, in his lectures and seminars, referred to the doctrines of Peirce. Besides, did not Professor Royce already indicate his indebtedness to Peirce in the preface to the "World and the Individual," in 1899? Any one who reads Peirce's essay on the "Law of Mind" can see for himself something of the stimulus which led Royce to the utilization of modern mathematical researches in the service of idealistic philosophy. Royce's doctrines of social consciousness, of the mind of the community, and of the process of interpretation are strikingly anticipated in some of Peirce's earlier and later writings. Some of those resemblances may be due to the fact that both Peirce and Royce were close students of the frequently mentioned, but seldom read works of Schelling. But in some cases, as, e.g., in the doctrine concerning the nature of mathematical reasoning and its objects, Royce follows Peirce very closely.

James's indebtedness to Peirce in regard to pragmatism has now become widely known. But attention should be called to the fact that James was no less indebted to Peirce in regard to his radical empiricism. It was the intellectual companionship of Channey Wright and Charles S. Peirce that during his formative period steered James against the transcendentalism which dominated the Cambridge of that day. Wright's influence was mainly in the direction of the old empiricism of Mill and Bain which led James to Spencer's "Psychology." The unquestioning belief in eternal unalterable laws of nature, that everything that happens happens precisely in accordance with these laws, was one of the main tenets of that empiricism. For the distinctive note of his radical empiricism, the opposition to the "black universe" and the belief that the whole world is changing and growing, James was indebted to Peirce as well as to Renan and Boutroux.

One of our American many-volumed sources of infallible information dismisses Peirce briefly and simply as a physiocrat: This is perfectly true as far as it goes. For many years Peirce worked on the problems of geodesy and his contributions to the subject, notably his researches on the pendulum, were at once recognized by European investigators in this field. The International Geodetic Congress, to which he was the first American representative, gave unusual attention to his paper, and men like Cellrier and Plantamour acknowledged their obligation to him. This and other scientific work in

3 See preface to James's "Psychology," and dedication to his "Will to Believe.

volving fine measurement, with the correlative investigations into the theory of probable error, seem to have been a decisive influence in the development of Peirce's typhonic philosophy. Philosophers inexperienced in actual scientific measurement may naively accept as absolute truth such statements as "every particle of matter attracts every other particle directly as the product of their masses and inversely as the square of the distance," or "when hydrogen and oxygen combine to form water the ratio of their weights is 1:8." But those who are actually engaged in measuring natural phenomena with instruments of precision, nature shows us such absolute constancy or simplicity. As every laboratory worker knows, no two observers, and no two observers in successive experiments, get absolutely identical results. To the men of the heroic period of science this was no difficulty. They held unquestioningly the Platonic faith that nature was created on simple geometric lines, and all the minute variations were attributable to the fault of the observer or the crudity of his instruments. This heroic faith was, and still is, a most powerful stimulus to scientific research. But few could defend it today in its explicit form, and there is little empirical evidence to show that while the observer and his instruments are always varying, the objects which he measures never deviate in the slightest from the simple law. Doubtless, as one becomes more expert in the manipulation of physical instruments, there is a noticeable diminution of the range of the personal "error," but no amount of skill and no refinement of our instruments have ever succeeded in eliminating irregular, though small, variations. "Try to verify any law of nature and you will find that the more precise your observations, the more certain they will be to show irregular departure from the law." There is certainly nothing in our empirical information to prevent us from saying that all the so-called constants of nature are merely instances of variation between limits so near to each other that their difference may be neglected for certain purposes. Moreover, the approach to constancy is observed only in mass phenomena, when we are dealing with very large number of particles; but social statistics also approach constant ratios when the numbers are very large. Hence, without denying discrepancies due solely to errors of observation, Peirce has certainly ground for his contention that "we must suppose far more minute discrepancies to exist owing to the imperfect cogency of the law itself, to a certain swerving of the facts from any definite formula." To this belief in absolute chance variations, Peirce joined the doctrine that the limiting ratios which we call the laws of nature are
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THEMSELVES SLOWLY CHANGING IN THE COURSE OF TIME. ACCORDING TO PEIRCE'S GRANDISHE CONCEPTION, THE VERY TENDENCY, TOWARDS LAW OR REGULARITY, IS ITSELF THE RESULT OF AN ACCIDENTAL VARIATION WHICH HAS GROWN HABITUAL WITH THINGS. A GOOD DEAL OF HIS SPECULATION IN THIS FIELD SOUNDS MYTHOLOGIC, YET IT IS INHERENTLY AS PROBABLE AS THE MECHANICAL MYTHOLOGY ACCORDING TO WHICH ALL SPONTANEITY AND VOLATILITY IN NATURE ARE A DELUSION. BY DEHYDRATING THE WHOLE WORLD CAN CREATE OR INCREASE IN BEING, THE MECHANICAL PHILOSOPHY MUST DENY ALL THE SCENDING INCREASE IN THE DIVERSITY AND SPECIFICITY OF THINGS, SINCE ALL THAT REALLY MUST HAVE BEEN FROM THE BEGINNING; AND WE ARE AT CLEAR TO THE POSITION OF MAXWELL THAT THE ELEMENTARY ATOMS OUT OF WHICH ALL THINGS ARE MADE, ARE TRANSPARENTLY WHAT THEY WERE IN THE DAY OF THEIR CREATION.

THE FOLLOWING, PUBLISHED IN 1868, IS CERTAINLY THE SPIRIT WHICH LEADS TO RADICAL EMPIRICISM. "WE CAN NOT BEGIN WITH COMPLETE DOUBT. WE MUST BEGIN WITH ALL THE PREJUDICES WHICH WE ACTUALLY HAVE. THESE PREJUDICES ARE NOT TO BE DISPELLED BY A MAXIM, FOR THEY ARE THINGS WHICH IT DOES NOT OCCUR TO US TO QUESTION. A PERSON MAY, IT IS TRUE, IN THE COURSE OF HIS STUDIES FIND REASON TO DOUBT WHAT HE BEGAN BY BELIEVING; BUT IN THAT CASE HE DOUBTS BECAUSE HE HAS A POSITIVE REASON FOR IT, AND NOT ON ACCOUNT OF THIS CARTESIAN MAXIM."

"PHILOSOPHY OUGHT TO Imitate THE SUCCESSFUL SCIENCES IN ITS METHODS, SO FAR AS TO PROCEED ONLY FROM-TANGIBLE, PRECISE TERMS WHICH CAN BE SUBJECTED TO CAREFUL SCRUTINY; AND TO TRUST RATHER TO THE MULTITUDE AND VARIETY OF ITS ARGUMENTS THAN TO THE COMPLETENESS OF ANY ONE. ITS REASONING SHOULD NOT FORM A CHAIN... BUT A CRATER.

-JAMES

"PEIRCE'S UNIVERSE," WILLIAM JAMES HAS CALLED ATTENTION TO THE SIMILARITY BETWEEN THE TYCHISTIC-AGNOSTIC OF PEIRCE AND THE CREATIVE EVOLUTION OF BERGSON. BUT WHILE BOTH TEND TO RESTORE LIFE AND GROWTH TO THE NATURE OF THINGS, PEIRCE'S APPROACH HAS MARKED LOGICAL ADVANTAGES. BERGSON RELIED HEAVILY ON CERTAIN DETAILS NOT VERY ACCURATELY REPORTED, AS FOR EXAMPLE THE SUPPOSED USE OF THE RESISTANCE OF THE EVERY AND THE EYE OF THE SEA COAST OR PEDESTRIAN, WHICH IgNORES THE FACT THAT SIMILARITIES OF THIS KIND MAY BE REALIZED FROM THE MECHANICAL PRINCIPLES OF CONVERGENT EVOLUTION. PEIRCE RELIES MORE ON THE GENERAL LOGIC OF SPECIFICITY AND INDIVIDUALITY, INTO WHICH THE FACTS WERE Buffered BY DRIESCH MAY WELL FIT, BUT WHICH HAVE A MUCH WIDER APPEAL SINCE THEY ARE ALREADY APPLICABLE TO THE FACTS OF INORGANIC NATURE, AND CAN NOT BE REFUTED BY CONSIDERATIONS DRAWN FROM EXPERIMENTAL BIOLOGY.

A CLOSER SIMILARITY SEEMS TO ME TO EXIST BETWEEN THE TYCHISTIC AND THE PROBABILISM OF COURNOT. BOTH VIGOROUSLY OPPOSED TO THE VIRTUOUS OR MECHANICAL NONSENSE WHICH HAS BECOME THE SACRED COW OF SCIENTIFIC ORTHODOXY, AT THE SAME TIME THAT THEY EXTENDED THE RANGE OF OUR SCIENTIFIC KNOWLEDGE. BOTH ALSO RELIATED ON THE METHOD OF INFINITESIMALS, NOT IN THE OBSERVANTIST WAY WHICH FORMS THE BASIS OF THE GENERAL DISTRUST OF THAT CONCEPT, BUT IN A WAY TO KEEP THE RESPECT OF A MATHEMATICIAN LIKE POINCARÉ. COURNOT'S MASSIVE BOOKS GIVE THE IMPRESSION OF A MORE DELICATE AND FINISHED MIND, POSSESSED ALSO OF A GREATER POWER OF ORGANIZING HIS MATERIAL WHICH COMES WITH SELF-MASTERY, BUT PEIRCE APPEARS TO US DECISIVELY THE MORE UNCONVENTIONAL AND THE MORE FRUITFUL OF ORIGINAL INSIGHT. PEIRCE ALSO HAD A WASTLY GREATER AND MORE INTIMATE KNOWLEDGE OF FACTUAL DETAILS, BOTH OF THE HISTORY OF HUMAN THOUGHT AND OF LOGICAL MATHEMATICAL AND PHYSICAL METHODS. HE KNEW ENOUGH OF MEDIEVAL LOGICAL TERMINOLOGY TO MAKE CORRECTIONS IN A WORK AS EREUDITE AS PRANTZ'S LOGIC; AND WHENEVER HE REFERS TO WRITERS LIKE ARISTOTLE OR HARE HE ANALYSES THEM THROUGH MASTERY. THE SAME IS TRUE AS FAR AS I CAN FOLLOW HIS OF HIS REFERENCES TO MODERN MATHEMATICAL, ASTRONOMICAL, PHYSICAL, AND CHEMICAL RESEARCH. YET HIS OWN ORIGINAL CONTRIBUTIONS ENABLE HIM TO BE REGARDED AS ONE OF THE FOUNDERS OF MODERN SYMBOLIC LOGIC.

COURNOT HAS MADE MORE SUBSTANTIAL CONTRIBUTIONS TO THE HISTORY OF ECONOMY AND OF ECONOMICS. BUT WE GATHER FROM PEIRCE'S CHANCE REMARKS, SUCH AS HIS CHARACTERIZATION OF THE MUGWUMP, OR OF THAT WHICH PRODUCES DOMINANT OPINION AMONG PROFESSORS, THAT HIS EYE AND GROWTH TO THE NATURE OF THINGS, PEIRCE'S APPROACH HAS MARKED LOGICAL ADVANTAGES. BERGSON RELIED HEAVILY ON CERTAIN DETAILS NOT VERY ACCURATELY REPORTED, AS, FOR EXAMPLE THE SUPPOSED USE OF THE RESISTANCE OF THE EVERY AND THE EYE OF THE SEA COAST OR PEDESTRIAN, WHICH IgNORES THE FACT THAT SIMILARITIES OF THIS KIND MAY BE REALIZED FROM THE MECHANICAL PRINCIPLES OF CONVERGENT EVOLUTION. PEIRCE RELIES MORE ON THE GENERAL LOGIC OF SPECIFICITY AND INDIVIDUALITY, INTO WHICH THE FACTS WERE Buffered BY DRIESCH MAY WELL FIT, BUT WHICH HAVE A MUCH WIDER APPEAL SINCE THEY ARE ALREADY APPLICABLE TO THE FACTS OF INORGANIC NATURE, AND CAN NOT BE REFUTED BY CONSIDERATIONS DRAWN FROM EXPERIMENTAL BIOLOGY.

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10 Both Peirce and Bergson believe that on other than practical subjects natural selection need not favor our attaining truth.—Popular Science Monthly, Vol. X., p. 3.
15 Ibid., Vol. VII., p. 20.
for social facts was not undeveloped. At a time when it was considered a sign of scientific election or grace to regard all social changes as due to an immanent dialectic force, he saw clearly that the changes of social institutions and ideas depend on the change of conditions which facilitates the breaking up of habits. His keen psychologic insight is shown perhaps at its best in his attack on the now classical tradition that makes the process of thought consist of a succession of images.\(^{10}\)

Recent neo-realism will find many points of contact with Peirce’s vigorous anti-nominalism, and his equally vigorous opposition to the modern tendency to regard logic as a part of psychology. To the view that the laws of logic represent “the necessities of thought,” that propositions are true because “we can not help thinking so,” he answers: “Exact logic will say that C’s following logically from A is a state of things which no impotence of thought alone can bring about.”\(^{11}\) “The question of validity is purely one of fact and not of thinking. It is not in the least the question whether, when the premises are accepted by the mind, we feel an impulsion to accept the conclusion also. The true conclusion would remain true if we had no impulse to accept it, and the false one would remain false though we could not resist the tendency to believe in it.”\(^{12}\)

Since the days of Locke modern philosophy has been almost entirely dominated by the assumption that one must study the process of knowing before one can find out the nature of things known; in other words, that psychology is the central philosophic science. The result of this has been an almost complete identification of philosophy with mental science. Nor did the influence of biologic studies of the middle of the nineteenth century shake the belief in that banal dictum of philosophic mediocrity: “The proper study of mankind is man.” The recent renaissance of logical studies, and the remarkable progress of physics in our own day bid fair to remind us that while the Lockian way has brought some gains to philosophy, the more ancient way of philosophy is by no means exhausted of promise; nor has man lost his interest in the great cosmic play. Those who have faith in the ancient and fruitful approach to philosophy through the doors of mathematics and physics will find the writings of Charles S. Peirce full of suggestions. That such an approach can also throw light on the vexed problem of knowledge needs no assurance to those acquainted with Plato and Aristotle. But I may conclude by referring to Peirce’s doctrine of ideal as opposed to sensible

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The last four papers develop Peirce's thought by showing its agreement and disagreement with the pragmatism of James and Schiller. The last paper contains his Method of Existential Graphs.

E. "The Reality of God," in the Hibbert Journal, Vol. 7 (1898), pp. 90-112. (This article contains brief indications of many of Peirce's leading ideas.)

F. Five papers in the Open Court, Vols. 6-7 (1895).
2. "Hermes" (on charity towards criminals), pp. 325f.-342f.

G. Articles in Baldwin's "Dictionary of Philosophy": Individual, kind, matter and form, pragmatism, priority, reasoning, scientific method, synecism, and uniformity.


I. Numerous articles in the Nation.

II. Writings of Predominantly Logical Interest.

A. "Five Papers on Logic," read before the American Academy of Arts and Sciences. Published in the Proceedings of the Academy, Vol. 7 (1867).
1. "On an Improvement in Boole's Calculus of Logic," pp. 250-261. (Suggests minor improvements in Boole's logic, especially in the representation of particular propositions. Substitution of the notion of relative frequency for probability became a leading idea of Peirce's thought.)
2. "On the Natural Classification of Arguments," pp. 261-267. (A suggestive distinction between the leading principle and the premise of an argument. Contains also an interesting note (pp. 258-259) denying the positivist maxim that, "no hypothesis is admissible which is not capable of verification by direct observation.")
3. "On a New List of Categories," pp. 267-268. (The categories are: Being, Quality (Reference to a Ground), Relation (Reference to a Correlate), Representation (Reference to an Interpretant), Substance. "Logic has for its subject-genus all symbols and not merely concepts," Symbols include terms, propositions, and arguments.
5. "Upon Logical Comprehension and Extension," pp. 418-432. (An interesting historical reference to the use of these terms and an attack on the supposed rule as to their inverse proportionality.

B. "Description of a Notation for the Logic of Relations," in Memoirs of the American Academy, Vol. 9 (1870), pp. 331-373. (Shows the relation of inclusion between classes to be more fundamental than Boole's use of equality. Extends the Boolean calculus to De Morgan's logic of relative terms.)


E. "Brief Description of the Algebra of Relatives," Reprinted from 11, p. 4-6.


I. Miscellaneous Notes, etc.


J. Articles in Baldwin’s "Dictionary of Philosophy" on laws of thought, logic (exact and symbolic), modality, negation, predicate and predication, probable inference, quality, subject, syllogism, theory, universal, validity, verification, whole and part.

III. Researches in the Theory and Methods of Measurement.

A. General and Astronomic.


2. "Note on the Theory of Economy of Research," Report of the U. S. Coast Survey for 1876, pp. 257-260. (This paper deals with the relation between the utility and the cost of diminishing the probable error.)


B. Geodetic Researches. The Pendulum.

1. "De l’influence de la flexibilité du trépied sur l’oscillation du pendule a révésion," Conference Geodésique Internationale (1877) Comptes Rendus, Berlin, 1878, pp. 171-174. (This paper was introduced by Plantamour and was followed by the notes of Apollon.)


IV. Philology.


The following were among the papers read by Peirce before the National Academy of Sciences:

"The Classification of the Sciences," April, 1862.

"The Postulates of Geometry," April, 1862.

"The Color System," April, 1862.

"Note on the Simplicest possible Branch of Mathematics," April, 1864.


"Existence Graphs," April, 1866.

"Phaneronomy," November, 1866.

"History of Signs, Relations, and Categories," November, 1866.

Judged by the abstracts of the paper on "Topological Geometry" which appeared in the daily newspapers (an official account is published), it must have dealt with the logic of topology as an instance of the logic of non-quantitative mathematics. Peirce alludes to the subject in the Monist, Vol. 5, p. 305. Its publication would be of great value.

MORRIS R. COHEN.