

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 scientific 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 masters, the system builders who rear their stately palaces towering to the moon. These architectonic minds are served by a varied host of followers and auxiliaries. Some provide the furnishings to make these mystic 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 more are engaged in defending these structures against the impetuous 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 gregarious creatures, 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 arouse 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 working with an unusual wealth of material and apparatus. He had, 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 can not in my own imagination see 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 Pisgah 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,<sup>1</sup> a student of Professor Royce may be allowed to

<sup>1</sup> *Philosophical Review*, May, 1916, p. 240.

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"<sup>2</sup> 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 these 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 Chauncey Wright and Charles S. Peirce that during his formative period steered James against the transcendentalism which dominated the Cambridge of that day.<sup>3</sup> 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 "block universe" and the belief that the whole world is changing and growing, James was indebted to Peirce as well as to Renouvier and Boutroux.

One of our American many-volumed sources of infallible information dismisses Peirce briefly and simply as a physicist. 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 Cellier and Plantamour acknowledged their obligation to him.<sup>4</sup> This and other scientific work in-

<sup>2</sup> *Monist*, Vol. II., pp. 537 ff.

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

<sup>4</sup> See Plantamour's "Recherches Experimentales sur le mouvement simultané d'un pendule et des ses supports," Genève, 1878, pp. 3-4.

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 tychistic 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 to those who are actually engaged in measuring natural phenomena with instruments of precision, nature shows no such absolute constancy or simplicity. As every laboratory worker knows, no two observations, and no one observer 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 would defend it to-day 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."<sup>5</sup> 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."<sup>6</sup>

To this belief in absolute chance variations, Peirce joined the doctrine that the limiting ratios which we call the laws of nature are

<sup>5</sup> *Monist*, Vol. II., p. 329.

<sup>6</sup> *Monist*, Vol. I., p. 165.

themselves slowly changing in the course of time. According to Peirce's grandiose 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 novelty in nature are a delusion. By denying that the whole world can grow or increase in being, the mechanical philosophy must deny all the seeming increase in the diversity and specificity of things, since all that really is must have been from the beginning; and we are thus led to the position of Maxwell that the fundamental atoms out of which all things are made, are to-day precisely what they were in the day of their creation.<sup>7</sup>

The following,<sup>8</sup> published in 1868, is certainly in 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 *can* be questioned. . . . 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 premises which can be subjected to careful scrutiny, and to trust rather to the multitude and variety of its arguments than to the conclusiveness of any one. Its reasoning should not form a chain . . . but a cable."

James certainly shared Peirce's individualistic belief that at least in the early stages of any inquiry or branch of science "independence of thought is the wholesome attitude, and gregarious thought is really sure to be wrong"; and he undoubtedly subscribed to Peirce's attitude toward that outer thoroughness characteristic of the Germans and their admirers: "These men write the larger number of those books which are so thorough and solid that every serious inquirer feels that he is obliged to read them; and his time is so engrossed by their perusal that his mind has not the leisure to digest their ideas and to reject them."<sup>9</sup>

In his "Pluralistic Universe," William James has called attention to the similarity between the tychistic-agapism of Peirce and the creative evolution of Bergson. But while both tend to restore life

<sup>7</sup> Maxwell, in the conclusion to his text-book on "Heat."

<sup>8</sup> *Journal of Speculative Philosophy*, Vol. II., pp. 140-141.

<sup>9</sup> *Monist*, Vol. VII., p. 20.

and growth to the nature of things,<sup>10</sup> Peirce's approach has marked logical advantages. Bergson relies heavily on certain details not very accurately reported, as, e. g., the supposed identity of the vertebrate eye and the eye of the scallop or pecten, which ignores the fact that similarities of this kind may be readily explained by the mechanical principles of convergent evolution. Peirce relies more on the general logic of specificity and individuality, into which the facts adduced by Driesch may well fit, but which have a much wider appeal since they are also 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 tychism of Peirce and the probabilism of Cournot. Both vigorously opposed that blind apancism or mechanical necessity which has become the sacred cow of scientific orthodoxy, at the same time that they extended the range of our scientific knowledge. Both also relied on the method of infinitesimals, not in the obscurantist 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.<sup>11</sup> 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 me decidedly the more unconventional and the more fruitful of original insight. Peirce also had a vastly 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 erudite as Prantl's logic; and whenever he refers to writers like Aristotle or Kant his analyses show thorough mastery.<sup>12</sup> The same is true (so far as I can follow him) of his references to modern mathematical, astronomical, physical, and chemical researches. Yet his own original contributions entitle him to be regarded as one of the founders of modern symbolic logic.<sup>13</sup> Cournot has made more substantial contributions to the theory of history and of economics. But we gather from Peirce's chance remarks, such as his characterization of the Mugwump,<sup>14</sup> or of that which produces dominant opinion among professors,<sup>15</sup> that his eye

<sup>10</sup> Both Peirce and Bergson believe that on other than practical subjects natural selection need not favor our attaining truth.—*Popular Science Monthly*, Vol. XII., p. 3.

<sup>11</sup> *Revue de Métaphysique et de Morale*, Vol. XIII., p. 293.

<sup>12</sup> See, e. g., his reference to Kant's "Transcendental Esthetic," *Journal of Speculative Philosophy*, Vol. II., p. 107.

<sup>13</sup> Schroeder, "Algebra der Logik," Vol. I., pp. 107 ff. Russell, "Principles of Mathematics," pp. 23, 376.

<sup>14</sup> *Monist*, Vol. II., p. 552.

<sup>15</sup> *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.<sup>10</sup>

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."<sup>11</sup> "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 impulse 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."<sup>12</sup>

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

<sup>10</sup> *Journal of Speculative Philosophy*, Vol. II., pp. 152-154.

<sup>11</sup> *Monist*, Vol. VII., p. 27. Cf. *Journal of Speculative Philosophy*, Vol. II., p. 207; *Popular Science Monthly*, Vol. LVIII., pp. 305-306.

<sup>12</sup> *Popular Science Monthly*, Vol. XII., p. 3.

experiment, and to his treatment of the question how it is that in spite of an infinity of possible hypotheses man manages to make so many successful inductions.<sup>13</sup>

## BIBLIOGRAPHY

I. Writings of General Interest.<sup>1</sup>

A. Three papers in the *Journal of Speculative Philosophy*, Vol. 2 (1868).

1. "Questions Concerning Certain Faculties Claimed for Man," pp. 103-114.
2. "Some Consequences of Four Incapacities," pp. 140-157.
3. "Ground of Validity of the Laws of Logic," pp. 193-208.

These three papers, somewhat loosely connected, deal mainly with the philosophy of discursive thought. The first deals with our power of intuition, and holds that "every thought is a sign." The second, one of the most remarkable of Peirce's writings, contains an acute criticism of the Cartesian tradition and a noteworthy argument against the importance of "images" in thinking. The third contains, *inter alia*, a refutation of Mill's indictment of the syllogism.

B. Review of Fraser's "Berkeley," in the *North American Review*, Volume CXIII. (1871), pp. 449-472.

This paper contains an important analysis of medieval realism, and of Berkeley's nominalism. (A Scotist realism distinguishes Peirce's pragmatism from that of James.)

C. "Illustrations of the Logic of Science," in *Popular Science Monthly*, Vol. XII.-XIII. (1877-1878).

1. "The Fixation of Belief," Vol. XII., pp. 1-15.
2. "How to Make Our Ideas Clear," Vol. XII., pp. 286-302.
3. "The Doctrine of Chances," Vol. XII., pp. 604-615.
4. "The Probability of Induction," Vol. XII., pp. 705-718.
5. "The Order of Nature," Vol. XIII., pp. 203-217.
6. "Deduction, Induction, and Hypothesis," Vol. XIII., pp. 470-482.

These six papers give the most readable account of the results of Peirce's reflection on logic. The second paper is the one to which James refers as the source of pragmatism.

D. Ten papers in the *Monist*, Vols. 1-3 (1891-1893) and 15-16 (1905-1906).

1. "The Architecture of Theories," Vol. 1, pp. 161-176.
2. "The Doctrine of Necessity Examined," Vol. 2, pp. 321-337.
3. "The Law of Mind," Vol. 2, pp. 533-559.
4. "Man's Glassy Essence," Vol. 3, pp. 1-22.

<sup>13</sup> *Monist*, Vol. VII., p. 206; *Popular Science Monthly*, Vol. XIII., pp. 213 ff. and his essay in "Logical Studies," pp. 175 ff.

<sup>1</sup> The following classification is arbitrary, as some of Peirce's most significant philosophic reflections occur in papers under headings II. and III. It may, however, be useful.

5. "Evolutionary Love," Vol. 3, pp. 176-200.
6. "Reply to the Necessitarians," Vol. 3, pp. 526-570.
7. "What Pragmatism Is?" Vol. 15, pp. 161-181.
8. "The Issues of Pragmatism," Vol. 15, pp. 481-499.
9. "Mr. Peterson's Proposed Discussion," Vol. 16, pp. 147ff.
10. "Prolegomena to an Apology for Pragmatism," Vol. 16, pp. 492-546.

The first six papers give the fullest development we have of Peirce's metaphysical system, i. e., of the doctrines of tychism, synechism, and agapism. See criticism by the editor of the *Monist*, Vol. 2, pp. 560ff., and Vol. 3, pp. 68ff. and 571ff., and McCrie, "The Issues of Synechism," Vol. 3, pp. 380ff.; cf. Dewey, "The Superstition of Necessity," Vol. 3, pp. 362ff.

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 (1908), pp. 96-112. (This article contains brief indications of many of Peirce's leading ideas.)

F. Five papers in the *Open Court*, Vols. 6-7 (1893).

1. "Pythagorics" (on the Pythagorean brotherhood), pp. 3375-3377.

2. "Dmesis" (on charity towards criminals), pp. 3397-3402.

3. "The Critic of Arguments, (I.) Exact Thinking," pp. 3391-3394.

4. "The Critic of Arguments, (II.) The Reader is Introduced to Relatives," pp. 3415-3419. (The last two contain a very clear succinct account of the general character of Peirce's logic.)

5. "What is Christian Faith?" pp. 3743-3745.

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

H. "Pearson's Grammar of Science," in *Popular Science Monthly*, Vol. 58 (1901), pp. 296-306. (A critique of Pearson's conceptualism and of his utilitarian view as to the aim of science.)

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. 261-287. (A suggestive distinction between the leading principle

and the premise of an argument. Contains also an interesting note (pp. 283-284) denying the positivistic maxim that, "no hypothesis is admissible which is not capable of verification by direct observation.")

3. "On a New List of Categories," pp. 287-298. (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.

4. "Upon the Logic of Mathematics," pp. 402-412. "There are certain general propositions from which the truths of mathematics follow syllogistically."

5. "Upon Logical Comprehension and Extension," pp. 416-432. (Interesting historical references 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 *Memoires of the American Academy*, Vol. 9 (1870), pp. 317-378. (Shows the relation of inclusion between classes to be more fundamental than Boole's use of equality. Extends the Booleian calculus to DeMorgan's logic of relative terms.)

C. "On the Algebra of Logic," *American Journal of Mathematics*, Vol. 3 (1880), pp. 15-57. (Referred to by Schroeder as Peirce's *Hauptwerk* in "Vorlesungen über die Algebra der Logik," Vol. I, p. 107.)

D. "On the Logic of Number," *American Journal of Mathematics*, Vol. 4 (1881), pp. 85-95.

E. "Brief Description of the Algebra of Relatives," Reprinted from ??, pp. 1-6.

F. "On the Algebra of Logic: A Contribution to the Philosophy of Notation," *American Journal of Mathematics*, Vol. 7 (1884), pp. 180-202.

G. "A Theory of Probable Inference" and notes "On a Limited Universe of Marks" and on the "Logic of Relatives" in "Studies in Logic by members of the Johns Hopkins University," Boston, 1883, pp. 126-203.

H. "The Regenerated Logic," *Monist*, Vol. 7, pp. 19-40.

"The Logic of Relatives," *Monist*, Vol. 7, pp. 161-217. (An elaborate development of his own logic of relatives, by way of review of Schroeder's book.)

I. Miscellaneous Notes, etc.

1. Review of Venn's "Logic of Chance," *North American Review*, July, 1867.

2. "On the Application of Logical Analysis to Multiple Algebra," *Proceedings of the American Academy*, Vol. 10 (1875), pp. 392-394.

3. "Note on Grassman's 'Calculus of Extension.'" *Proceedings of the American Academy*, Vol. 13 (1878), pp. 115-116.
4. "Note on Conversion," *Mind*. Vol. I, p. 424.
5. "Notes and Additions to Benjamin Peirce's 'Linear Associative Algebra,'" *American Journal of Mathematics*, Vol. 4 (1881), pp. 92 ff., especially pp. 221-229.
- 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 parts.

### III. Researches in the Theory and Methods of Measurement.

#### A. General and Astronomic.

1. "On the Theory of Errors of Observation," *Report of the Superintendent of the U. S. Coast Survey* for 1870, pp. 220-224.
2. "Note on the Theory of Economy of Research," *Report of the U. S. Coast Survey* for 1876, pp. 197-201. (This paper deals with the relation between the utility and the cost of diminishing the probable error.)
3. "Ferrero's Metodo dei Minimi Quadrati," *American Journal of Mathematics*, Vol. I (1878), pp. 55-63.
4. "Photometric Researches," *Annals of the Astronomical Observatory of Harvard College*, Vol. 9 (1878), pp. 1-181.
5. "On the Ghosts in Rutherford's 'Diffraction Spectra,'" *American Journal of Mathematics*, Vol. 2 (1879), pp. 330-347.
6. "Note on a Comparison of a Wave-Length with a Meter," *American Journal of Science*, Vol. 18 (1879), p. 51.
7. "A Quineuncial Projection of the Sphere," *American Journal of Mathematics*, Vol. 2 (1879), pp. 394, 396.

#### B. Geodetic Researches. The Pendulum.

1. "De l'influence de la flexibilité du trépied sur l'oscillation du pendule à réversion," *Conférence Geodesique Internationale* (1877) *Comptes Rendus*, Berlin, 1878, pp. 171-187. (This paper was introduced by Plantamour and was followed by the notes of Appolzer.)
2. "On the Influence of Internal Friction upon the Correction of the Length of the Second's Pendulum," *Proceedings of the American Academy*, Vol. 13 (1878), pp. 396-401.
3. "On a Method of Swinging Pendulums for the Determination of Gravity proposed by M. Faye," *American Journal of Science*, Vol. 18 (1879), pp. 112-119.
4. "Measurement of Gravity at Initial Stations in America and Europe," *Report of the U. S. Coast Survey*, 1876, pp. 202-237 and 410-416.

5. "Flexure of Pendulum Supports," *Report of the U. S. Coast Survey*, 1881, pp. 359-441.
6. "On the Deduction of the Ellipticity of the Earth from the Pendulum Experiment," *Report of the U. S. Coast Survey*, 1881, pp. 442-456.
7. "Determinations of Gravity at Stations in Pennsylvania," *Report of U. S. Coast Survey*, 1883, Appendix 19 and pp. 473-486.
8. "On the Use of the Noddy," *Report of the U. S. Coast Survey*, 1884, pp. 475-482.
9. "Effect of the Flexure of a Pendulum upon the Period of Oscillation," *Report of the U. S. Coast Survey*, 1884, pp. 483-485.
10. "On the Influence of a Noddy, and of unequal Temperature upon the Periods of a Pendulum," *Report of the U. S. Coast and Geodetic Survey* for 1885, pp. 509-512.
- C. "On Small Differences in Sensation" (in cooperation with J. Jastrow), *National Academy of Sciences*, Vol. 3 (1884), pp. 1-11.

### IV. Philologie.

- "Shakespearian Pronunciation" (in cooperation with J. B. Noyes), *North American Review*, Vol. 98 (April, 1864), pp. 342-369.

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

- "The Classification of the Sciences." April, 1902.
- "The Postulates of Geometry." April, 1902.
- "The Color System." April, 1902.
- "Note on the Simplest possible Branch of Mathematics." April, 1904.
- "Topical Geometry." November, 1904.
- "The Relation of Betweenness and Royce's O Collection." November, 1905.
- "Existence Graphs." April, 1906.
- "Phanerescopy." November, 1906.
- "History of Signs, Relations, and Categories." November, 1906.

Judged by the abstracts of the paper on "Topical Geometry" which appeared in the daily newspapers (no 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. 7, p. 205. Its publication would be of great value.

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