Science

1893 | The Marriage of Religion and Science | CP 6.428

What is science? The dictionary will say that it is systematized knowledge. Dictionary definitions, however, are too apt to repose upon derivations; which is as much as to say that they neglect too much the later steps in the evolution of meanings. Mere knowledge, though it be systematized, may be a dead memory; while by science we all habitually mean a living and growing body of truth. We might even say that knowledge is not necessary to science. The astronomical researches of Ptolemy, though they are in great measure false, must be acknowledged by every modern mathematician who reads them to be truly and genuinely scientific. That which constitutes science, then, is not so much correct conclusions, as it is a correct method. But the method of science is itself a scientific result. It did not spring out of the brain of a beginner: it was a historic attainment and a scientific achievement. So that not even this method ought to be regarded as essential to the beginnings of science. That which is essential, however, is the scientific spirit, which is determined not to rest satisfied with existing opinions, but to press on to the real truth of nature. To science once enthroned in this sense, among any people, science in every other sense is heir apparent.

1893 [c.] | Nominalism, Realism, and the Logic of Modern Science [R] | MS [R] 860

Science is defined in the dictionaries as systematized knowledge. But considered as one of the elements of the life of civilization science is not so much characterized by knowledge as by a resolute *desire* to know. Science to be a live thing must be growing; and to grow it must be animated with the spirit of inquiry; and the most essential element of the spirit of inquiry is a swiftness to see that you have been in the wrong.

1895 [c.] | On the Logic of Quantity | MS [R] 17:5

…a *science* ought not to be defined, as it often is, as a systematized collection of ascertained truths; because it is more useful to those who know it best that it should refer to the scientific activities of its promoters. Its essence ought therefore be made to lie in the investigations and their enlightened methods and not in the results and their truth. Moreover, every inquiry which can be properly performed only by those who are engaged upon the main branch of inquiry should be included under the science.

1896 [c.] | Lessons of the History of Science | CP 1.43-45

If we endeavor to form our conceptions upon history and life, we remark three classes of men. The first consists of those for whom the chief thing is the qualities of feelings. These men create art. The second

consists of the practical men, who carry on the business of the world. They respect nothing but power, and respect power only so far as it [is] exercized. The third class consists of men to whom nothing seems great but reason. If force interests them, it is not in its exertion, but in that it has a reason and a law. For men of the first class, nature is a picture; for men of the second class, it is an opportunity; for men of the third class, it is a cosmos, so admirable, that to penetrate to its ways seems to them the only thing that makes life worth living. These are the men whom we see possessed by a passion to learn, just as other men have a passion to teach and to disseminate their influence. If they do not give themselves over completely to their passion to learn, it is because they exercise self-control. Those are the natural scientific men; and they are the only men that have any real success in scientific research.

If we are to define science, not in the sense of stuffing it into an artificial pigeon-hole where it may be found again by some insignificant mark, but in the sense of characterizing it as a living historic entity, we must conceive it as that about which such men as I have described busy themselves. As such, it does not consist so much in *knowing*, nor even in "organized knowledge," as it does in diligent inquiry into truth for truth's sake, without any sort of axe to grind, nor for the sake of the delight of contemplating it, but from an impulse to penetrate into the reason of things. This is the sense in which this book is entitled a History of *Science*. Science and philosophy seem to have been changed in their cradles. For it is not knowing, but the love of learning, that characterizes the scientific man; while the "philosopher" is a man with a system which he thinks embodies all that is best worth knowing. If a man burns to learn and sets himself to comparing his ideas with experimental results in order that he may correct those ideas, every scientific man will recognize him as a brother, no matter how small his knowledge may be.

But if a man occupies himself with investigating the truth of some question for some ulterior purpose, such as to make money, or to amend his life, or to benefit his fellows, he may be ever so much better than a scientific man, if you will - to discuss that would be aside from the question - but he is not a scientific man.

1899 | From Comte to Benjamin Kidd | CN 2:214

Science is not a fixed, unchangeable body of propositions. After a thousand years the general face of science may be modified past recognition. Scientific hypotheses are questions put to nature. In the game of twenty questions no skilful player begins by guessing what he thinks most likely. He seeks to fix one feature at a time. Scientific research is a much more intricate business, and various considerations go to determining what is the best hypothesis to try.

1901 | On the Logic of Drawing History from Ancient Documents Especially from Testimonies (Logic of History) | CP 7.186

I have said that in order to determine what the logic of the individual man should be, it would be necessary to consider what his purpose was. The same remark applies to the logic of science. It is easier to determine the purpose of science. It does not involve opening the question of ethics. Yet it is not a perfectly simple matter, either. Several definitions of the purpose of science that I have met with made it the business of science to ascertain that certain things were so, to reach foregone conclusions. Nothing could be more contrary to the spirit of science. Science seeks to discover whatever there may

be that is true. I am inclined to think that even single perceptual facts are of intrinsic value in its eyes, although their value in themselves is so small that one cannot be quite sure that there is any. But every truth which will prevent a future fact of perception from surprising us, which will give the means of predicting it, or the means of conditionally predicting what would be perceived were anybody to be in a situation to perceive it, this it is, beyond doubt, that which science values. Although some will contradict me, I am bound to say that, as I conceive the matter, science will value these truths for themselves, and not merely as useful. Mathematics appears to me to be a science as much as any science, although it may not contain all the ingredients of the complete idea of a science. But it is a science, as far as it goes; the spirit and purpose of the mathematician are acknowledged by other scientific men to be substantially the same as their own. Yet the greater part of the propositions of mathematics do not correspond to any perceptual facts that are regarded as even being possible. The diagonal of the square is incommensurable with its side; but how could perception ever distinguish between the commensurable and the incommensurable? The mathematical interest of the imaginary inflections of plane curves is quite as great as that of the real inflections. Yet we cannot say that the scientific man's interest is in mere ideas, like a poet's or a musician's. Indeed, we may go so far as to say that he cares for nothing which could not conceivably come to have a bearing on some practical question. Whether a magnitude is commensurable or not has a practical bearing on the mathematician's action. On the other hand, it cannot be said that there is any kind of proportion between the scientific interest of a fact and its probability of becoming practically interesting. So far is that from being the case, that, although we are taught in many ways the lesson [of] the Petersburg problem, - so stupidly obscured by the extraneous consideration of moral expectation, - the lesson that we utterly neglect minute probabilities, yet for all that, facts whose probabilities of ever becoming practical are next to nothing are still regarded with keen scientific interest, not only by scientific men, but even by a large public. Here, then, are the facts to be reconciled in order to determine what the purpose of science, what scientific interest, consists in. First, every truth which affords the means of predicting what would be perceived under any conceivable conditions is scientifically interesting; and nothing which has not conceivable bearing upon practice is so, unless it be the perceptual facts themselves. But, second, the scientific interest does not lie in the application of those truths for the sake of such predictions. Nor, thirdly, is it true that the scientific interest is a mere poetical interest in the ideas as images; but solid truth, or reality, is demanded, though not necessarily existential reality. Carefully comparing these three conditions, we find ourselves forced to conclude that scientific interest lies in finding what we roughly call generality or rationality or law to be true, independently of whether you and I and any generations of men think it to be so or not.

1902 | Minute Logic: Chapter II. Prelogical Notions. Section I. Classification of the Sciences | MS [R] 426:12

Science is research; and research is science, from the first moment when the researcher casts aside all desire to prove his present opinions right, and burns with ardent desire to find out wherein they are wrong. Science thus consists in a disposition of living men; and therefore, the true divisions of science will be those which divide living men.

1902 | Minute Logic: Chapter II. Prelogical Notions. Section I. Classification of the Sciences (Logic II) | CP 1.232; EP 2:129

Now if we are to classify the sciences, it is highly desirable that we should begin with a definite notion of what we mean by a science; and in view of what has been said of natural classification, it is plainly important that our notion of science should be a notion of science as it lives and not a mere abstract definition. Let us remember that science is a pursuit of living men, and that its most marked characteristic is that when it is genuine, it is in an incessant state of metabolism and growth. If we resort to a dictionary, we shall be told that it is systematized knowledge. Most of the classifications of the sciences have been classifications of systematized and established knowledge, – which is nothing but the exudation of living science; – as if plants were to be classified according to the characters of their gums. Some of the classifications do even worse than that, by taking science in the sense attached by the ancient Greeks, especially Aristotle, to the word *ἐπιστήμη*. A person can take no right view of the relation of ancient to modern science unless he clearly apprehends the difference between what the Greeks meant by *ἐπιστήμη* and what we mean by knowledge. The best translation of *ἐπιστήμη* is "comprehension." It is the ability to define a thing in such a manner that all its properties shall be corollaries from its definition. Now it may be that we shall ultimately be able to do that, say for light or electricity. On the other hand, it may equally turn out that it forever remains as impossible as it certainly is to define number in such a way that Fermat's and Wilson's theorems should be simple corollaries from the definition. I do not mean to deny that those theorems are deducible from the definition. All that is here being urged turns on the falsity of the old notion that all deduction is corollarial deduction. But, at any rate, the Greek conception of knowledge was all wrong in that they thought that one must advance in direct attack upon this *ἐπιστήμη*; and attached little value to any knowledge that did not manifestly tend to that. To look upon science in that point of view in one's classification is to throw modern science into confusion.

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Let us look upon science – the science of today – as a living thing. What characterizes it generally, from this point of view, is that the thoroughly established truths are labelled and put upon the shelves of each scientist's mind, where they can be at hand when there is occasion to use things – arranged, therefore, to suit his special convenience – while science itself, the living process, is busied mainly with conjectures, which are either getting framed or getting tested. When that systematized knowledge on the shelves is used, it is used almost exactly as a manufacturer or practising physician might use it; that is to say, it is merely applied. If it ever becomes the object of science, it is because in the advance of science, the moment has come when it must undergo a process of purification or of transformation.

1902 | Minute Logic: Of the Classification of the Sciences. Second Paper. Of the Practical Sciences | CP 7.54

The prevalent definition of a science, the definition of Coleridge, which influenced all Europe through the Encyclopaedia Metropolitana, that science is systematized knowledge, is an improvement upon a statement of Kant (Metaphysische Anfangsgründe der Naturwissenschaft: 1786): "Eine jede Lehre, wenn sie ein System, dass ist, ein nach Principien geordnetes Ganzes der Erkenntniss sein soll, heisst Wissenschaft." Yet it is to be noted that knowledge may be systematic or "organized," without being organized by means of general principles. Kant's definition, however, is only a modification of the ancient view that science is the knowledge of a thing through its causes, - the comprehension of it, as we might say, - as being the only perfect knowledge of it. In short, the Coleridgian definition is nothing but the last development of that sort of philosophy that strives to draw knowledge out of the depths of the *Ich-heit*. If, on the other hand, one opens the works of Francis Bacon, one remarks that, with all the astounding *greenness* and inexperience of his views of science, in some respects he is really a

scientific man himself. He met his death as the consequence of an experiment. True, it was rather a foolish one; but what a monument to the genuineness of his intelligence, that he, a great legal light, should, at the age of sixty-six, have perished from his zeal in performing disagreeable and dangerous laboratory work that he thought might go toward teaching him something of the nature of true science! For him man is nature's interpreter; and in spite of the crudity of some anticipations, the idea of science is, in his mind, inseparably bound up with that of a life devoted to singleminded inquiry. That is also the way in which every scientific man thinks of science. That is the sense in which the word is to be understood in this chapter. Science is to mean for us a mode of life whose single animating purpose is to find out the real truth, which pursues this purpose by a well-considered method, founded on thorough acquaintance with such scientific results already ascertained by others as may be available, and which seeks coöperation in the hope that the truth may be found, if not by any of the actual inquirers, yet ultimately by those who come after them and who shall make use of their results. It makes no difference how imperfect a man's knowledge may be, how mixed with error and prejudice; from the moment that he engages in an inquiry in the spirit described, that which occupies him is science, as the word will here be used.

1905 | Adirondack Summer School Lectures | MS [R] 1334:11-13

…what I mean by a "science," both for the purpose of this classification & in general, is the life devoted to the pursuit of truth according to the best known methods on the part of a group of men who understand one another's ideas and works as no outsider can. It is not what they have already found out which makes their business a science; it is that they are pursuing a branch of truth according, I will not say, to the best methods, but according to the best methods that are known at the time. I do not call the solitary studies of a single man a science. It is only when a group of men, more or less in intercommunication, are aiding and stimulating one another by their understanding of a particular group of studies as outsiders cannot understand them, that I call their life a science.

1906 | The Basis of Pragmaticism | EP 2:372

The word "science" has three principal acceptions, to wit:

Firstly, men educated in Jesuit and similar colleges often use the term in the sense of the Greek *ἐπιστήμη*, the Latin *scientia*; that is to say, to denote knowledge for certain. [—]

Secondly, since the beginning of the nineteenth century, when Coleridge so defined it in the opening dissertation to the *Encyclopaedia Metropolitana*, non-scientific people have generally understood "science" to mean systematized knowledge.

Thirdly, in the mouths of scientific men themselves "science" means the concrete body of their own proper activities, in seeking such truth as seems to them highly worthy of life-long devotion, and in pursuing it by the most critically chosen methods, including all the help both general and special that they can obtain from one another's information and reflection.

1906 [c.] | On the System of Existential Graphs Considered as an Instrument for the Investigation of

Logic | MS [R] 499

…I must explain in what sense I speak of a "science", – which is an abridged expression for a heuretic science, or science aiming at the discovery of new truth. Namely, I do not mean by science, as the ancients did, that doctrine which is beyond all doubt. Nor do I use the word in the sense in which Coleridge at the beginning of the XIXth century defined science as systematized or ordered truth. But I use science in the sense of a business, that is, of a total of real acts exerting reciprocal effects one upon another, and concerned with closely analogous purposes. When I speak of any given heuretic science, I mean the body of doings in Past and Future time, not too remote from the present, of the members of a certain social group. These persons constitute a social group in their acquaintance with, understanding of, and sympathy for one another's doings. And the peculiarity which make it a *scientific* group are, first, that the members are devoted to ascertaining truths of a given kind on account of their speculative interest in the matters, that they have each of them some special facilities or capacities for such research, that they employ approved methods, and that each seeks aid from the results of the others. From this point of view, the question whether a given class of investigations ought to be regarded as belonging to this science or to that is not to be settled by mere logical analysis, but is a question of fact; namely, it is the question whether the men who in our day will undertake in a scientific way investigations of the class in question will naturally mingle with one group or with another group.

1906 [c.] | L [R] | MS [R] 601:3-4

…if I am asked to what the wonderful success of science is due, I shall suggest that to gain the secret of that, it is necessary to consider science as living, and therefore not as knowledge already acquired but as the concrete life of the men who are working to find out the truth.

1910 | Quest of Quest | MS [R] 655

… how shall we define a science? Since I was brought up in intimacy with almost all the chief men of science in the United States during those years and was always attentive to their conversation, I think it hardly supposable that I should have mistaken what they meant by that word; and if I am right, what they meant by a science, was the total principal industry of a social group, whose whole lives, or many years of them, are consecrated to inquiries to which they are so devoted as to be drawn to every person who is pursuing similar inquiries, and these inquiries conducted according to the best methods so far found out, to which they were trained and for the prosecution of which every [one] of them possessed special advantages, their different inquiries being so nearly of the same nature that they thoroughly understood one another's difficulties and merits, and could after a brief preparation have generally each one have taken up and carried on the other's work, although probably not with quite his success.

It follows that the limits of a science are those of a social group, and consequently from the very nature of that sort of entity, that if our classi[fication] is to be true and yet not confused, it cannot be at all minute. For to mention only one of several insuperable difficulties, if that were attempted, it would be necessary to recognize a science that would be that of the spectroscopists, who had, and I suppose still have, their own journal and their own society. Yet every man of them must be either an inorganic

chemist, or an astronomer, or a physicist inclining toward the mathematical variety, like Rowland and Michelson. But for our purpose we prefer not to make the classification at all minute.