Topic Page: Poincaré, Henri, 1854-1912

Definition: **Poincaré, (Jules) Henri** from *Philip's Encyclopedia*

French mathematician. He worked on celestial mechanics, winning an award for his contribution to the theory of orbits. In 1906, independently of Albert Einstein, he obtained some of the results of the special theory of relativity. He attempted to make mathematics accessible to the general public in such works as *The Value of Science* (1905) and *Science and Method* (1908).

Image from: **Jules Henri Poincaré** in *The Princeton Companion to Mathematics*

Summary Article: **Poincaré, Henri (1854-1912)**
From *Encyclopedia of Time: Science, Philosophy, Theology, & Culture*

Henri Poincaré belongs to a small group of brilliant scientists who, living at the turn of the 20th century, made fundamental contributions to mathematics, physics, and philosophy. It has been said that Poincaré's mathematical knowledge comprised the whole mathematics of his time, and his lectures on theoretical physics show that he also had an encyclopedic overview of this field. Poincaré began his career as an engineer, but he quickly became famous for his great discoveries in mathematics, particularly in geometry and topology. Poincaré's results had a great impact on the history of mathematics and theoretical physics. For example, his consideration of the mechanical stability of systems composed of three bodies that attract each other by gravity led to the development of chaos theory. Poincaré's views of philosophical aspects of science, which he never presented in a systematic fashion, cannot be easily categorized as belonging to one of the main philosophical schools. This is also true of his idea of the relativity of time, which must be reconstructed from some of his papers collected in *Science and Hypothesis* (1902), *The Value of Science* (1906), *Science and Method* (1908), and the posthumous *Last Essays* (1913).

Jules Henri Poincaré was born on April 29, 1854, in Nancy, France. He was an outstanding pupil and made a very successful career in the French system of elite universities. His first academic degree was in mining engineering, and he worked for a short time as a coal-mining inspector. Yet after receiving his doctorate in mathematical sciences from the University of Paris in 1879, Poincaré began swiftly to publish important mathematical results, which brought him renowned chairs, particularly in mathematical physics, at different universities in Paris beginning in the mid-18 80s. Besides being admitted to countless French and international scientific academies and societies, Poincaré was also an important member of the Bureau des Longitudes in Paris that organized the global coordination of clocks necessary for the production of precise maps. When he died prematurely in Paris on July 17, 1912, Poincaré was hailed as one of the most renowned researchers of his time. His fame as one of the last scientists who could make most important discoveries in different fields of research and reflect on his research philosophically continues to the present day.

Poincaré's consideration of time starts, like that of Einstein, with a seemingly innocent question: How can we judge objectively that two events are happening simultaneously? Any answer presupposes that it is possible to objectify the flow of time that our consciousness experiences qualitatively. Poincaré denies that human beings, scientists included, have access to some kind of absolute time beyond the scientific means of quantifying time by measurement instruments. If every process in nature were to be equally slowed down, we could not detect this deceleration, because the processes in the instruments for measuring time would also be slowed down.

Poincaré's criticism of the idea of absolute time exemplifies his philosophical stance on fundamental problems of science. He is convinced that the conceptual system by which we describe, analyze, and explain natural phenomena is a convention in the following sense: It is always possible to use, instead of the given conceptual system, other ones that can fulfill the same task. What convention we choose depends on pragmatic criteria, particularly on how simple it is to apply a conceptual system to the phenomena we want to understand. So conventions are neither true nor false; they are disguised definitions that prove to be more or less convenient for certain purposes.

To measure time, a periodic process in nature, such as the rotation of the earth on its axis, is needed whose cycles we suppose to be of the same duration. Yet this is only approximately true: The rotation of the earth, for example, is very gradually slowing down due to the friction caused by the tides. To explain this slowing down, and to detect it empirically, science presupposes the validity of well-known physical theories, namely thermodynamics and Newtonian mechanics. Their validity must not be affected however we define our measure of time, because we rely on these theories in the very act of defining. When we conventionally select one among the possible measures of time, we do this in such a way that the fundamental laws of nature can be mathematically formulated as simply as possible. As scientists, we ought not to say that one clock is right and the other one wrong; instead, we should say that it is more convenient to use this clock and not that one.

What events we suppose to be synchronous is also a matter of convenience. We choose such criteria of synchronicity as will allow the simplest formulation of the laws of nature we are using when we explain the physical processes by which we make local time measurements and by which we communicate the results of these measurements. Exploring the physics of time means, according to Poincaré, to investigate measurement processes in order to establish conventions that we can use both for an understanding of time and for an explanation of how our clocks would behave if they were perfect measuring instruments.

So far we have discussed only the philosophical sense of the relativity of time in Poincaré's thought. The question of whether Poincaré should be regarded, together with Einstein, as the discoverer of the special theory of the relativity of time and space has been intensely debated. The historical evidence seems to weigh against Poincaré: He relied too much on physical concepts (like the ether) that stood in the way of understanding Einstein's new conception of time and space. For Poincaré, the physical principle of the relativity of time is also a matter of convention, because it makes, for the sake of convenience, the following assumption that turns out to be only approximatively true: Two bodies that are very far away from each other can be described in different frames of reference, because they do not influence each other.

See also

Einstein, Albert, Einstein and Newton, Newton, Isaac, Time, Measurements of, Time, Relativity of

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Artmann, Stefan, and Artmann. "Poincaré, Henri (1854-1912)." *Encyclopedia of Time: Science, Philosophy, Theology, & Culture*, edited by H. James Birx, Sage Publications, 1st edition, 2009. *Credo Reference*, https://search.credoreference.com/content/topic/poincar%C3%A9_jules_1854_1912. Accessed 14 Oct. 2019.