Who's A Conventionalist? Poincaré's Correspondence with Physicists

Scott Walter

Henri Poincaré's engagement with physics was an enduring one, spanning almost the entire length of his scientific career, from his doctoral thesis of 1879 to the end of his life in 1912. This interest in the problems of physics, however, represents a serious challenge for the historian of exact science, for several reasons. First and foremost, there is the hard fact that Poincaré pursued problems of physics in parallel with seemingly-unrelated interests in analysis, topology, geometry, celestial mechanics, electrotechnology, and philosophy of science. Locating the threads tying these disparate disciplines together is only part of the task; attaching them to Poincaré's actual practice of science is another matter altogether. Secondly, the turn of the twentieth century saw the emergence of the sub-discipline of theoretical physics, and a consequential remapping of disciplinary frontiers, a remapping in which Poincaré was an important cartographer, and one whose writings on the interrelations of logic, mathematics, geometry, mechanics, and mathematical and experimental physics exercised a durable influence on scientists throughout the twentieth century.

Historical studies have illustrated Poincaré's innovative approaches to questions of mathematical physics, and his critical, but apparently independent evaluation of leading theories of the day: Maxwellian electrodynamics, kinetic gas theory, Newtonian gravitation, electronic theories of matter, and quantum theory. Likewise, the effectiveness of Poincaré's disciplinary entrepreneurship is better known in part thanks to the opening of the Nobel Archives, which reveal a widespread appreciation of his contributions to physics on the part of the international scientific community.

For its several merits, this historical work has illuminated neither the why nor the how of Poincaré's engagement with physics. These are, of course, topics that Poincaré did not address himself, at least not directly. In his last four years, Poincaré's state of health declined, and he did not find the time to write his memoirs. A good scientific biography has yet to be published, although several lives of Poincaré are in the works. Adding to the difficulty of the biographer's task is the fact that only a small portion of Poincaré's Nachlass has been published. Among the unpublished portion of the Nachlass are two hundred and fifty-seven letters to and from physicists, less than ten percent of which has been exploited to any extent by historians. To obtain an idea of how Poincaré went about doing physics, and why he did so, surely this would be a good place to begin.

What then does Poincaré's correspondence with physicists tell us about his engagement with the problems of physics? One way to approach the question is by examining the relation between the image of Poincaré's physics drawn from his published works, and that arising from his unpublished correspondence. The image we form is multi-faceted, of course, but let us look briefly at just one facet: the thematic image. Are there themes in Poincaré's published work that are echoed in his correspondence? If so, which ones? What themes find no echo in the correspondence? Inversely, we can ask if there are themes addressed in the correspondence that are absent in the published œuvre.

First of all, among the problems of physics addressed by Poincaré in print, and which have an epistolary pendant, we find multiple resonance, the Zeeman effect, questions concerning Lorentz's theory of electrons, and the Rowland effect (i.e., the magnetic action of convected charge). Study of the Rowland effect, in particular, generated a significant volume of correspondence in the period 1901-1903 (38 letters), while only two published articles are linked to the topic, one of which is an edition of his letters to the French physicist Alfred Potier. The themes "missing" from Poincaré's correspondence include the foundation of the second Law of Thermodynamics, kinetic theory in general, probability, and quantum theory.

As for the inverse relation, in his correspondence Poincaré takes up, among other topics, what he called "Le Bon" rays, and N rays. The former were also known as "black light", or "lumière noire", in the coinage of their erstwhile producer, friend and editor of Poincaré, Gustave Le Bon. The latter rays were the work of one of France's leading experimental physicists, René Blondlot. The fact that both phenomena were spurious may seem sufficient to explain Poincaré's reticence to publish, but it is not, as demonstrated by his publications on the equally-spurious *absence* of the Rowland effect. Perhaps after close study of these and other cases present in Poincaré's correspondence, historians will be in a better position to understand how and why Poincaré constructed his singular—and phenomenally successful—physical world-view.

Theoretical Cosmology and Observational Astronomy, circa 1930

Craig Fraser

In popular writing and textbooks on modern cosmology it is stated that the general theory of relativity contributed in a fundamental way to the revolution in cosmology that took place in the 1920s and 1930s. Thus Peebles [1993, 227] writes "General relativity was one of the keys to the discovery of the expansion of the universe..." On the other hand, some astronomers understand the history primarily or even exclusively in terms of improvements in instrumentation and advances in the interpretation of observations, cf. Sandage [1956].

To gain insight into the relationship of theory and observation in cosmology it is useful to examine the period of the 1920s leading up to Edwin Hubble's publication of the redshift-distance law in 1929. That cosmological solutions of the equations of general relativity were derived at precisely the same time that Vesto Slipher and Milton Humason were beginning to detect large systematic nebular redshifts was simply a coincidence. The two developments were largely independent. The advances in telescopic instrumentation that made the nebular research possible followed from improvements in technology and the increased financial support for astronomy in America from government and philanthropic foundations. General relativity by contrast developed within a central European scientific culture with a strong emphasis on advanced mathematics and pure theory. In retrospect, it seems

Mathematisches Forschungsinstitut Oberwolfach

Report No. 56/2005

Mathematics in the Physical Sciences, 1650-2000

Organised by
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Tinne Hoff Kjeldsen (Roskilde)
David E. Rowe (Mainz)

December 11th – December 17th, 2005

Abstract. The workshop "Mathematics in the Physical Sciences, 1650-2000" was organised by Niccolò Guicciardini (Siena), Tinne Hoff Kjeldsen (Roskilde), and David Rowe (Mainz). By focusing on the interplay between mathematics and the physical sciences the aim was to gain an insight into developments that had a crucial impact on modern mathematics. Three particular topics emerged as central themes: 1) The period 1650-1800 raises many issues related to the role of mathematics in natural philosophy during the Scientific Revolution and the Enlightenment. Discussing these issues can enhance our historical understanding of a period in which mechanics, astronomy, navigation, cartography, hydraulics, etc., constituted an important stimulus for advances in mathematics. 2) The period 1800-1920 centred on the problem of probing the geometry of space both mathematically and empirically after the advent of non-Euclidean geometry. 3) The twentieth century was focused on mathematical modelling and the question of a change in the conception of mathematical models in various disciplines after 1900.

Mathematics Subject Classification (2000): 01-06, 01A45, 01A55, 01A61.

Introduction by the Organisers

The workshop was organised by Niccolò Guicciardini (Siena), Tinne Hoff Kjeldsen (Roskilde), and David Rowe (Mainz). During the five days of the conference 25 talks were given and one special evening lecture was organised.

The organizers developed the idea for this meeting in consultation with several other colleagues who attended the conference on early modern mathematics held in Oberwolfach January 5-11, 2003. That meeting brought together historians with considerable expertise on developments outside pure mathematics. Afterwards there was a general consensus among the participants that this format had produced fruitful interactions and some promising new perspectives. The idea behind the present workshop called for a similar, open-ended framework, but covering a broader expanse of time reaching far into the twentieth century. By focusing on the interplay between mathematics and the physical sciences the aim was to gain an insight into developments that had a crucial impact on modern mathematics.

This was achieved by inviting experts on the role of mathematics in the physical sciences who were able to approach this subject from a variety of different perspectives. The speakers addressed major developments relating to the overall theme of the conference which focused on thematic issues structured around three time periods: 1650-1800, 1800-1920, and 1920 up to recent times. Three particular topics emerged as central themes of interest:

1) Several of the talks on the period 1650-1800 concerned historical problems involving the role of mathematics in natural philosophy during the Scientific Revolution and the Enlightenment, in particular issues crossing the disciplinary boundaries between history of mathematics and the so-called mechanical philosophy in the natural sciences. Such an approach is vital for the historical understanding of this period in which mechanics, astronomy, navigation, cartography, hydraulics, etc., constituted an important stimulus for advances in mathematics.

2) For the period 1800-1920 a number of talks centred on the problem of probing the geometry of space both mathematically and empirically after the advent of non-Euclidean geometry. The Riemannian legacy and Poincaré's conventionalism served as two cornerstones for this topic, a topic that gained new impetus through Einstein's theory of general relativity and the emergence of relativistic cosmology in 1917.

3) Throughout the twentieth century, mathematical modelling became an increasingly important tool in the physical sciences, and with these developments the modern concept of mathematical models slowly emerged. Recent research on the history and epistemology of models indicates that the conception of mathematical models changed in various disciplines after 1900. This issue was addressed in a collection of talks, including the case of aerodynamical research in Germany – a topic that is part of the larger complex of issues involving "mathematics and war" now receiving widespread attention. Other problems addressed included mathematical modelling in meteorology during the second half of the twentieth century, one of several fields which exerted a strong influence on the modern conception of mathematical models.

The workshop brought together the core community of historians of mathematics, many of whom have attended past meetings in Oberwolfach, along with a number of historians and philosophers of science with strong interests in mathematical issues. The meeting was characterized by open discussions which, together with the talks, shed more light on the interplay between mathematics and the physical sciences and gave new insights into developments that had a crucial impact on the development of modern mathematics.

The organizers and participants thank the "Mathematisches Forschungsinstitut Oberwolfach" for making the workshop possible in the usual comfortable and inspiring setting.

Workshop: Mathematics in the Physical Sciences, 1650-2000

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