This is a review submitted to Mathematical Reviews/MathSciNet.

Reviewer Name: de Paz, María

Mathematical Reviews/MathSciNet Reviewer Number: 127139

Address:

Dep. de Filo., Log. y Filo. de la Cien.
Fac. de Filosofía, Univ. of Sevilla
C/Camilo José Cela S/N
41018 Seville
SPAIN
maria.depaz@hotmail.com

Author: Darrigol, Olivier

Title: Geometry, mechanics, and experience: a historico-philosophical musing.

MR Number: MR4506931

Primary classification: 51P05

Secondary classification(s):

Review text:

This is an interesting and difficult paper about the relations of physical theory and experience. In it, Olivier Darrigol deploys all his erudition regarding mechanics to argue very convincingly in favor of his interpretation of the structure of physical theory as a modular structure. This modular structure allows to establish the difference between a purely mathematical theory and a physical theory with a strong mathematical apparatus. The modular structure is composed of different modules that permit the connection of the theory to the world of experience. Within this interpretation, Darrigol also accounts for the historical development of a theory. This is quite relevant, because some philosophers of science in the past have tended to interpret physical theories as monolithic units and have struggled to correctly accommodate the historical change within theories. The paper begins with Euclidean geometry as the simplest physical theory. Of course, Euclidean geometry is in itself a mathematical theory, but it can also be considered as a physical theory through its applications in physical measurements, optics or geodesy. It is precisely through interpretive schemes and the different modules that a theory connects with the world of experience. This is best seen in the case of mechanics. After discussing statics, as the next physical theory whose structure connects with Euclidean geometry, the rest of the paper is devoted to mechanics in its several forms: Newtonian mechanics, continuum mechanics, fluid mechanics, energetics, celestial mechanics, elasticity theory and statistical mechanics. All of these evolve from the original Newtonian mechanics, but constitute different extensions and connections which, in

some cases, also imply a mathematical reformulation, a new symbolic universe or the introduction of new quantities. Darrigol divides these extensions into different modules being those the defining module, where the theory enlarges its symbolic universe; the schematic module, where new quantities measured are introduced; the specializing modules, where the operations of restriction of interpretive schemes are carried away; and the approximating modules, where the applications are done by approximation. This modular structure together with the different interpretive schemes of the theory is what constitutes a physical theory, but it also makes possible the application of the theory to different domains. Philosophically, the modular interpretation of physical theories is presented as superior to the linguistic view and also to the semantic view. In the linguistic view the theories are presented as linguistic frameworks, and the vocabulary of the theory is divided into theoretical and empirical terms, causing many troubles to translate ones into the others. The semantic view avoids this problem by establishing homomorphisms between the mathematical part of the theory and the empirical view, prompting thus a very static view, in which the mathematics defines the structure of the theory and through homomorphism it is associated with its empirical consequences. This semantic part may correspond with the symbolic universe of the theory in Darrigol's interpretation: the defining module. But the theory is not reduced to its symbolic universe and what constitutes its content is precisely the modular connections that the other modules establish. As a result, using the Darwinian metaphor of evolution and adaptation, the author explains the historical changes in theories, and stresses the relevance of action over the theories to avoid static views and stagnation.