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Mathematics and the natural sciences
The Physical Singularity of Life
Francis Bailly and Giuseppe Longo (284 pages, 27 euros), Hermann, 2007.

This book is remarkable in both the sum of competencies which it aggregates as well as in the scientific project it proposes. Following the tradition of Erwin Schrödinger's *What is Life?* (1944), the project presented by F. Bailly and G. Longo consists in confronting the theoretical status of biology with that of physics, of computer science and of mathematics in order to propose a new conceptual framework enabling to address theoretical challenges that are specific to life phenomena.

In view of suggesting new research venues, the authors begin by conducting a thorough science theoretical investigation on the nature of objectivity in the natural sciences. Two points are particularly emphasized: first, the consequences of the results of incompleteness in mathematics and in physics on the status of objectivity; second, the possibility of a non predictive determinism, once the nature and the evolution of determinism has been established.

Modern geometry is at the origin of this movement because, after having been at the basis of science for centuries, it is now making a strong comeback to the very centre of scientific rationality. This part of mathematics, which finds its source in classical geometry (the study of figures on a plane or in space) is indeed making a forceful comeback. On the one hand, this regards the mathematical notion of proof (where it is necessary to oppose construction principles that have meaning for humans and proof principles of a formal nature which happen to be provably "incomplete") and, on the other hand, the three fundamental physical theories (relativity, quantum mechanics and the physics of critical systems). These theories have all reestablished the use of geometry to an extent that enables to talk of a true geometrization of physics in the XX^{th} century.

This epistemological diagnostic is then used by the authors to identify the nature of the specificity of life phenomena within the natural sciences; it is the space of parameters and observables within which life phenomena evolves that can be distinguished from that of physics. Moreover, in physics, the observables of a system are fixed once and for all within a reference space. In the case of life phenomena, it is necessary, in order to account for the evolution of a biological form, to change the observables by changing the reference space and this, in an unpredictable way over the course of the forms' evolution. The authors then propose, basing themselves on the physical notion of critical transition, to characterize life phenomena as an "extended critical state": while a phase transition is pointwise (or instantaneous) in physics, it is specific to life phenomena to make it last spatially and temporally within an extended zone of criticality, and this also with respect to other parameters.

Let's bet that this book will meet a huge echo in the field of advanced research as well as among a scientific community interested by the internal cohesion of the project that is common to the natural sciences.

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