

Conceptual dualities at the interfaces Mathematics/Physics/Biology

Giuseppe Longo

Centre Cavallès, République des Savoires,
CNRS, Collège de France et Ecole Normale Supérieure, Paris,
and Department of Integrative Physiology and Pathobiology,
Tufts University School of Medicine, Boston.

<http://www.di.ens.fr/users/longo>

ABSTRACT

The very rich history of interactions between mathematics and physics has had a “constitutive” role for both disciplines. An “extraction of physical invariants” proposed core notions for mathematics, where invariance preserving transformations provided the fundamental structures from Euclid's geometry to contemporary mathematics. On several occasions, the autonomous invention of mathematical concepts and spaces has had a positive “feed back” on physical conceptualization and further enriched this discipline. The shared principles of conceptual construction marked their historical trajectories.

Well established and remarkable tools from this story are often transferred to biology (but also towards a “meteorology of social dynamics”). Is there a comparable co-constitutive venture? And, if not, why? What is the role of theory building in the biology/mathematics interface? A few hints will be given both for a possible history and towards tentative explorations of new theoretical settings for some dynamics of life.

Bailly F., Longo G. **Mathematics and the Natural Sciences. The Physical Singularity of Life.** *Imperial College Press*, London, 2011 (français: Hermann, 2006).

Longo G.. *Synthetic Philosophy of Mathematics and Natural Sciences, Conceptual analyses from a Grothendieckian Perspective, Reflections on “Synthetic Philosophy of Contemporary Mathematics”* by F. Zalamea, Urbanomic (UK) and Sequence Press (USA), 2012. Invited Paper, in **Speculations: Journal of Speculative Realism**, 2015.

Longo G., Montévil M., **Perspectives on Organisms: Biological Time, Symmetries and Singularities**, *Springer*, Berlin, 2014.

Longo G., Montévil M., C. Sonnenschein, A. Soto. *Biology's theoretical principles and default state*, submitted.

Montévil M., Mossio M., *Biological organisation as closure of constraints*, **J. Theor. Biology**, 2015 (in print)