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BOOK REVIEWS

The Future of Scientific Practice: 'Bio-Techno-Logos'

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This volume, which is the final result of informal discussions among the members of the interdisciplinary Bio-Techno-Practice (BTP) think tank based at the University Campus Bio-Medico in Rome, seeks to explore the process of scientific understanding through the interplay of three perspectives: 'biological' (acronym: Bio), 'technological' (Techno) and 'philosophical-theoretical' (Logos).

Notwithstanding important differences among the authors, they all agree that the concepts of 'bio' and 'techne' cannot be analyzed using traditional philosophy of science dichotomies such as that between artificial world and natural world.

In the introduction, Marta Bertolaso stresses that "the contribution of this volume is […] *methodological*", since "the emphasis is not on the different disciplines involved, but on how different tools (conceptual, technical, explanatory) are simultaneously involved in the process of scientific understanding" (p. 3).

There is a strong unitary idea that connects the contributions, that is, that there is a dynamic relationship between 'Bio', which can be understood as "biological world, physical world or, in general way, world of phenomena", 'Logos', which designates the scientific representation of the world, and 'Techne', that is, "how we conceive (Logos) natural world (Bios) and their mutual relationship" (p. 2).

Part I ("Biological Dynamics") focuses on biological sciences from an interdisciplinary point of view. The prefix 'bio' returns in different fields, from informatics to robotics, and asks for a deeper philosophical reflection, which develops in the course of the volume. In Chapter 1 ("Microscopic and Macroscopic Insights of Dynamic Cell Behaviour") Kumar Selvarajoo describes the dynamic behavior of living cells at microscopic and macroscopic scales, using concepts such as attractor and landscape. He writes: "Biology, […] like any other complex system, possesses both microscopic (single cell) and macroscopic (population average cell) dynamics. Combining cell population and single cell behaviours suggest that biology is regulated by deterministic governing equations, and is sensitive to parameter variations (noise) over specific range, as witnessed in other disciplines such as physics, chemistry and engineering" (p. 29).

In "New from 'Twilight Zone': Protein Molecules between the Crystal and the Watch", Alessandro Giuliani analyzes protein molecules between what he calls crystal (structuralist) and watch (functionalist) views, stressing that the analysis of protein structure allows us to go in-depth into the dynamical relation between 'Bio', 'Techno' and 'Logos': the most important point is that proteins "are 'smart and sensible crystal' that *can be used as watches*" (p. 39).

In chapter 3 ("Limits to Deterministic-Linear Causality in Biomedicine: Effects of Stochasticity and Non-Linearity in Molecular Networks") Sui Huang discusses the common notion of causality in biology, which assumes a deterministic and linear relationship between cause and effect. He takes into account the implications of the stochastic non-linear biological dynamics for the way of thinking of life scientists.

In chapter 4 ("Embodied Intelligence in the Boimechatronic Design of Robots") Dino Accoto, Eugenio Guglielmelli and Cecilia Laschi introduce the reader into the Part II of the volume. They call attention to the field of biomechatronic, which is defined as the engineering approach that combine methods and information originated by mechanical engineering and biological sciences.

Part II ("Reflecting on Scientific Understanding and Understanding by Building") develops the epistemological analysis of the biological sciences. It focuses on *how* life sciences generate knowledge in some new (technological) ways.

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In chapter 5 ("Managing Complexity: Model-Building in Systems Biology and its Challenges for Philosophy of Science") Miles MacLeod presents some of the specific novel features of systems biology that characterize structure and approach of the field to complex model-building task. Mathematics and computational simulations are tools by which the scientific community asks questions about the biological world. In general, the diverse goals systems biologists pursue, the lack of a standardized methodology, and the diversity of epistemic strategies modellers use to extract information from complex systems, require a more novel philosophical account than is currently available, and show that the integration between engineering and traditional biology implies novel concepts and practices irreducible to traditional scientific ones.

In chapter 6 ("Stratification and Biomedicine: How Philosophy Stems from Medicine and Biotechnology"), Federico Boem, Giovanni Boniolo and Zsuzsa Pavelka focus on molecular biology and biotechnology, showing how they can change our perceptions of disease, diagnosis and therapy; by analyzing the concept of molecular stratification in medicine, they highlight the epistemological and ontological questions which arise in connection with powerful technological tools.

In chapter 7 ("Epistemology of Robotics: An Outline"), the triad 'Bio-Techno-Logos' is interpreted, in dialogue with chapter 4, in the context of robotic. The author, Giampaolo Ghilardi, highlights the epistemological implications of the relationship between humans and robots. Agency as applied to the robots is the central problem of this paper and serves as the introduction to the last and more directly philosophical part of the volume.

Part III ("Towards as Development of a Philosophy of scientific Practice") offers a philosophical analysis of the scientific practice and the relationships between biological sciences and technology, starting from different perspectives.

In "Prediction and Prescription In Biological Systems: The Role of Technology for Measurement and Transformation", Weceslao J. Gonzalez highlights the role of prediction and prescription in biological sciences as applied sciences. In chapter 9 ("Teleology and Mechanism in Biology") Marco Buzzoni analyzes the possibility of recovering the concept of teleology, as methodological tool, in biological mechanistic investigations: the concept of mechanism seems to be incomplete without an implicit reference to final causes. In "Scientific Understanding and the Explanatory Use of False Models", Antonio Dieguez addresses the problem of scientific understanding and argues that scientific knowledge and explanation depend on the elaboration of models of reality.

Finally, in the conclusive chapter 11 ("Bio-Techno-Logos and scientific Practice"), Marta Bertolaso, Nicola Di Stefano, Giampaolo Ghilardi and Alfredo Marcos argue that there cannot be a primate of Bio, Techno or Logos in scientific practice because there is a close relationship between phenomena (Bios), instruments (Techne) and theory (Logos). This relationship is rooted in scientific practice that "always remains a *human* attitude" (p. 191).

No cursory sketch can do justice to the richness and variety of the book. But these brief remarks should suffice to show that it makes original contributions to novel, but already much discussed topics in the contemporary philosophy of biology.