



Georges Chapouthier

The Mosaic Theory of Natural Complexity A scientific and philosophical approach

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Preface

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Preface

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Readers of *The Mosaic Theory of Natural Complexity*, the internationally distinguished French neuroscientist and philosopher Georges Chapouthier's outstanding recent work, will most likely want to reflect critically on several central issues in science and philosophy today¹. For his well-considered title raises at least three important, and persistent, questions: What is a theory?, What is a theory of natural complexity?, and, specifically, What is Chapouthier's mosaic theory of natural complexity?

Assembling here some linguistic reminders proves useful. Take the still vexed issue of theory. Scientists and philosophers continue to disagree about just what the overly familiar English language word "theory" denotes. No wonder. For in everyday British English, the expression "theory" standardly² denotes any one or more of four progressively more abstract matters.

Thus, according to the examples in the latest edition of the two volumes *Shorter Oxford English Dictionary*³, the word "theory" may denote a speculative (esp. fanciful) view or an "unsubstantiated hypothesis", as in the citation from E. M. Forster, "He had a theory that musicians are incredibly complex." "Theory" may also denote a "statement of rules or principles of doing something," as Day Lewis's observation, "My aunts and uncles had... no theories about child upbringing." Again, "theory" may denote "the exposition of the general principles of an art or science..." as in R. Warner's recollection, "We studied the whole theory of flight." Or finally "theory" may also denote "the systematic conception of something... established by observation or experiment esp. as distinguished from the practice of it," as in A. Koestler's allusion to "Contradictory theories about the forces which make planets revolve."

¹ For a brief sketch of Georges Chapouthier's professional career and many publications see David Viterbo, « *Françoise Tristani-Potteaux et Georges Chapouthier, Le chercheur et la souris* », *Histoire de la recherche contemporaine*, Tome III, N°2 (Paris : CNRS, 2014), 190-192 ; also available [on line: <http://hrc.revues.org/878>].

² Although understanding such cardinal terms usually requires rather lengthy argumentative treatment, here I understand these terms in the standard senses on record in current professional reference works.

³ *SOED*, 6th ed. (Oxford: OUP, 2007). By comparison, note that for American English *The American Heritage Dictionary of the English Language* (4th ed., Boston: Houghton Mifflin, 2000) provides six basic senses of the polyvalent word, "theory."

Now when, unlike lexicologists, scientists talk of “theory,” they often focus sharply on the last of these everyday uses. Accordingly, they usually understand the expression “theory” mainly with respect to “law” and “hypothesis.” Thus scientists take a scientific law standardly as any “descriptive principle of nature that holds in all circumstances covered by the wording of the law,” whereas they call any such descriptive principle that “has not achieved the incontrovertible status of a law” a theory. By contrast, a hypothesis is either a law or a theory that “retains the suggestion that it may not be universally applicable⁴.”

In turn, philosophers generally narrow the scope of the expression “theory” even more so⁵. In the positivistic era of the philosophy of science for instance, acceptable scientific theories were considered largely according to the strict terms of those that fully satisfied all the demands of axiomatic systems. Satisfactory scientific theories were those where empirical observations served as foundations for all theoretical terms. Much later, however, many working scientists adopted a looser understanding of theory. Similarly, many philosophers of science also began to think of theory in less formal ways. These more recent approaches included historically inspired ideas about theories, not as always necessarily closed axiomatic systems, but as, sometimes, open-ended heuristic models.

The point then of these representative linguistic reminders is that special care must be taken when talking in both scientific and philosophical contexts today of “theory.”

What then are we to make of Georges Chapouthier’s concerns not just with theory but with what he calls a “theory of naturalistic complexity?” What kind of a theory is that?

In his professional contexts of contemporary science and philosophy, the complexity Chapouthier mainly has in mind does not centrally concern the physical complexity of certain physical systems. In such systems complexity is the characteristic that enables them to accommodate different physical states by allowing for phase transitions from one state to another. Examples are the phenomena of change from the solid to the liquid state, or change from the liquid to the gaseous. Nor is it the physical complexity of certain physical systems that enables them to exhibit over long range spatial coherence, as in the phenomena of superconductivity and the emission of laser radiation. Rather, the complexity at issue here is naturalistic in the particular senses of being on exhibit especially in theoretical biological contexts and not in theoretical physical ones.

Thus, complexity here means generally the levels of self-organization not of a physical system but of a biological one. And the self-organization at issue is the

⁴ See “Laws, Theories, and Hypotheses,” in *A Dictionary of Science*, 6th ed. John Daintith and Elizabeth Martin (Oxford: OUP, 2010), p. 466.

⁵ Cf. Simon Blackburn, *The Oxford Dictionary of Philosophy*, 2nd ed. (Oxford: OUP, 2005), p. 363-364.

spontaneous order arising not in any physical or chemical system, but particularly in a biological system open to its environment⁶.

Now the idea of naturalistic biological complexity draws attention to the different rates in which some different parts of a biological organism may evolve with respect to its other parts, whether relatively slowly or relatively quickly. What permits great flexibility in the observable characteristics of an organism, its phenotype, is its genes, “the dominance relations among their alleles,” and their evolutionary interactions with their environments. Standardly, then, “when a population is faced with new selection procedures in a changing environment, only the most crucial components need evolve, not the entire phenotype.” This phenomenon is called “mosaic evolution⁷.”

But what then, specifically, is Chapouthier’s “mosaic theory of naturalistic complexity?”

This book of course gives his answer. But perhaps we may say here, however briefly, that Chapouthier’s mosaic theory of naturalistic complexity is “a description of complex systems, from living beings to mind processes, based on two general principles: juxtaposition of similar units and then integration of these units, once modified, into structures at a higher level of which they become parts. As in a mosaic, these parts within the higher level structure retain some independent properties and autonomy.”

Finding a truly authoritative and commendably concise scientific and philosophical discussion of a mosaic theory of natural complexity that forces second thoughts about such salient issues today as the nature of scientific theories and the shifting ideas of naturalistic complexity is exceedingly difficult. Thanks to his truly excellent essay, Georges Chapouthier has not only crystallized his distinguished work of many years; he has put a number of reflective persons today deeply in his debt.

⁶ Note however the related but contrasting discussion of “self-organization” in computer theory in Arthur W. Burks, “Computer Theory,” in *The Cambridge Dictionary of Philosophy*, ed. Robert Audi, 3rd ed. (Cambridge: CUP, 2015), p. 189-192, esp. p. 191 on “human-computer combines.”

⁷ See “Mosaic Evolution” in the *Oxford Dictionary of Science*; cf. the entries there on “Complexity” and “Self-Organization” which I have also relied on here. For the larger contexts see, among others, Peter Godfrey-Smith, *The Philosophy of Biology* (Princeton: Princeton UP, 2014), esp. p. 68-75.