Chapter XII

Perspectives for Strong Artificial Life

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ABSTRACT

This chapter introduces the twin deadlocks of strong artificial life. Conceptualization of life is a deadlock both because of the existence of a continuum between the inert and the living, and because we only know one instance of life. Computationalism is a second deadlock since it remains a matter of faith. Nevertheless, artificial life realizations quickly progress and recent constructions embed an always-growing set of the intuitive properties of life. This growing gap between theory and realizations should sooner or later crystallize in some kind of "paradigm shift" and then give clues to break the twin deadlocks.

INTRODUCTION

"The ultimate goal of the study of artificial life would be to create 'life' in some other medium, ideally a virtual *medium where the essence of life has been abstracted from the details of its implementation in* any *particular hardware. We would like to build models that are so life-like that they cease to be* models *of life and become* examples *of life themselves." (Langton, 1986, p. 147, original emphasis)*

This statement launched a large debate among biologists, philosophers and computer scientists. It defined what is now known as *strong artificial life,* that is, the fact that artificial life is not limited to theoretical biology or biomimetic artifacts, but can be extended to the creation of new instances of life, possibly independent of any material medium. With the emergence of artificial life as a scientific field, the question of the

creation of life by men therefore left the fields of religion or superstition to join the scope of science.

Nearly two decades later, the debate about strong artificial life remains very active. Despite remarkable realizations — such as *Venus* (Rasmussen, 1990), *Tierra* (Ray, 1992) or *Cosmos* (Taylor, 1999a) — and pompous declarations such as the famous *How I Created Life in a Virtual Universe* (Ray, 1993), we still have no strong demonstration of the feasibility of strong artificial life.

The problem was nicely introduced by a provocative reasoning presented by S. Rasmussen at the second artificial life workshop (Rasmussen, 1992):

I.   A universal computer at the Turing Machine level can simulate any physical process (Physical Church-Turing thesis).
II. Life is a physical process (von Neumann).
III. There exist criteria by which we are able to distinguish living from nonliving objects.

Accepting (I), (II) and (III) implies the possibility of life in a computer.

IV. An artificial organism must perceive a reality R_2, which for it is just as real as our "real" reality R_1 is for us.
V. R_1 and R_2 have the same ontological status.
VI. It is possible to learn something about fundamental properties of realities in general, and of R_1 in particular, by studying the details of different R_2s. An example of such a property is the physics of a reality.

Even though points (IV) to (VI) tend to justify the huge potential contribution of "artificial realizations" to science, yet, point (I) (computationalism) on the one hand and points (II) and (III) (concept of life) on the other hand found what can be called the *twin deadlocks of strong artificial life*.

This chapter will first present both deadlocks and show the current limits of purely theoretical approaches. It will then present some recent realizations and show the growing gap between the relative stagnation of theory and the progress of experiments. Finally, it will examine the consequences of this hiatus.

ON THE CONCEPT OF LIFE

Life is obvious; a five years old boy can easily distinguish an inert object from a living one. Nevertheless, thousands of pages have been written since Aristotle about the concept of life, and the problem remains clearly unsolved. Some definitions are essentially conceptual; they try to propose a strong theoretical basis for life. Because of the difficulty to define a unifying concept, other definitions are mainly empirical and based on the observation and the research of apparent invariants.

Limits of Conceptual Definitions of Life

According to Dawkins, the word "living" does not necessarily refer to something definite in the real world (Dawkins, 1996, p. 39). For him, the systems we call "living" emerged from a cumulative and very progressive process favoring the most efficient

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