Super-Computers, Evolution and the Fabrication of Life:
How can Science and Technology Studies (STS) Contribute to More Reflexive Developments in Systems and Synthetic Biology?

Ana Delgado, University of Bergen, Norway

Silvio Funtowicz, University of Bergen, Norway

Dorothy Dankel, University of Bergen, Norway

ABSTRACT

As biology moves into the digital realm, new ways of representing, manipulating, and appropriating life are emerging. In this paper, the authors examine systems and synthetic biology and map imaginaries of the making of life. The authors present how they have worked with scientists in three different laboratories in Europe and the U.S. by exploring those imaginaries with them. Focusing on scientific images, methods, and scientific traditions through a number of dialogic sessions, three imaginaries became apparent: living systems as networks, life as building blocks, and living systems as circuits. By working in this way, the authors could explore how scientists imagine their relations with nature (i.e., in terms of ownership) and their role as scientist. Exploring imaginaries of the making of life can open plural and broadly oriented and normative debates on nature, society, technology, and their relations. This kind of dynamic, interactive, and reflexive societal talk is, from the authors' point of view, a central condition for possible sustainable futures.

Keywords: *Imaginaries, Reflexivity, Science and Technology Studies (STS), Sustainable Futures, Systems and Synthetic Biology*

1. INTRODUCTION: ENCOUNTERS BETWEEN STS, ETHICS, AND THE NEW BIOLOGY

Science and technology studies (STS) aims to study the social dimensions of science and technology. We aim to propose reflexivity as a key aspect for sustainable developments in systems and synthetic biology. Only if scientists are aware of their role and the possible implications of their work both in society and in nature, can we start thinking seriously about sustainability in the fields of systems and synthetic biology and beyond. We understand sustainability in systems and synthetic biology to mean that the

DOI: 10.4018/jsesd.2012040102

scientific agenda is in line with the ethical, sociocultural and economic aspirations of society and our environment. Without this harmony, trust in the scientific agenda will erode and conflict may arise. President Eisenhower anticipated this scenario in his 1961 farewell address (YouTube, 2009), warning that "public policy could itself become the captive of a scientific-technological elite" where efforts followed funding rather than the needs of society. That concern is a crucial premise informing the RSB project. RSB stands for "Reflexive Systems Biology: Towards an Appreciation of Biological, Scientific and Ethical Complexity." The project's goal is to build bridges between the natural sciences, STS and ethics: it aims at situating systems and synthetic biology as they emerge in contexts of social action. It does so by focusing on *imaginaries of the making of life*, defined as shared representations of how life works. Building on previous work in STS (Jasanoff & Kim, 2009; Delgado et al., in press; Harvard University, 2011), we think of imaginaries as broad interpretative frameworks that people use to make sense of nature, technology and society and the relations among them. To the extent that people position themselves in the world through these frameworks, imaginaries have important political and normative dimensions.

By focusing on *imaginaries of the making of life*, the RSB project has developed collaborations with scientists, proposing one way of understanding STS encounters with the new techno-sciences, biology in particular. We propose RSB as a way to explore plural visions of the relation between nature and society and the limits of human interventions in nature, in pursuit of more sustainable futures. We understand our work with scientists as an exercise of "anticipatory governance" (Barben et al., 2008), assuming that promoting reflexivity at an early stage of scientific development may have an impact on scientific practices and policies.

We include both systems and synthetic biology within the scope of our paper and refer to them as "the new biology." Attempts at synthesizing life and at applying a systems approach can be traced back through the history of biology (Fox Keller, 2009). Even so, we presuppose that systems and synthetic biology are "new" insofar as within these fields biology is becoming digitalized. A heavy dependence on computers brings together new methods, techniques and validation strategies. As new technologies of representing and intervening (Hacking, 1983) with life are becoming dominant, biology increasingly appears as a technoscience (Fox Keller, 2009; Carrier & Nordmann, 2011). Relatedly, systems and synthetic biology are emerging within larger policy contexts in which science is increasingly oriented to specific contexts of application (European Science Foundation, 2005; Nowotny, 2008).

As emergent research fields, synthetic and systems biology are interrelated (Fox Keller, 2003), and occasionally conflict in interesting ways. The border between these two fields is not always easy to draw: sometimes systems biology is understood as providing valuable theoretical basis for synthetic biology and sometimes theory is understood to be a hindrance to the advance of synthetic biology, following Richard Feynman's well-known quote: "What I cannot create, I do not understand." Within the two fields, there is a whole spectrum of approaches, framings and methods (O'Malley et al., 2008). Those approaches also entail a diversity of values and political positions as they point to broader ways of imagining life. In Sections 3 and 4 of this paper, we map three of those imaginaries and discuss further implications for governance. Our aim is not to provide a comprehensive overview of different positions in systems and synthetic biology, but rather to propose a way in which bridges between STS, ethics and the new biology can be built. In the following section, we elaborate on how we started to explore *imaginaries of the making of life* in collaboration with scientists.

2. THE DIALOGIC CHALLENGE: INTERDISCIPLINARITY AND REFLEXIVITY

As a knowledge field, STS has built on the idea that the scientific endeavour is a social practice (Ravetz, 1979; Shapin & Shaffer,