Dream Sequence

Prof. Martyn Amos
Manchester Metropolitan University

Developing technologies are often presented in fiction as divisive, with the "haves" reaping the benefits, at the expense of the "have-nots" (the film *Gattacca* being a case in point). But any single piece of predicted technology quickly dates in the annals of science fiction, through being easier to achieve than we thought (take the on-board video link-ups of shows like *Battleship Galactica* - Skype gave us this technology, for free, over a decade ago), or eluding us completely (interstellar travel). Perhaps for this reason, many of the best science fiction stories place technology in the background, where contradictions and nerdy nit-picks may be overlooked. As Stanislaw Lem writes about Philip K. Dick's *Ubik*, in the context of the latter's other books, "Essentially it is always one and the same world that figures in them – a world of elementally unleashed entropy, of decay that not only, as in our reality, attacks the harmonious arrangement of matter, but also even consumes the order of elapsing time … All the technological innovations, the magnificent inventions, and the newly-mastered human capabilities … ultimately come to nothing in the struggle against the inexorably rising floodwaters of Chaos"[1].

Sarah Schofield's story plays out against the backdrop of a world that has embraced *synthetic biology* – an emerging field of research at the intersection of the life sciences, engineering, computer science and biochemistry. Researchers in so-called "synbio" are predominantly interested in the (re-)engineering of natural living systems (e.g., bacteria, or yeast) for the purposes of "persuading" them to perform useful, human-defined tasks (eg., to produce biofuels, deliver drugs, or detect pollution). The goals of synbio are ambitious in scope, and scientists such as J. Craig Venter have ensured that its profile has been consistently high. Synbio could potentially revolutionise food production, energy, and the environment (to name just a few possible application domains). More fundamentally, it could also usher in entirely new forms of *artificial life*.

In the course of her story, Schofield references many recent "real world" developments; the bacterial synchronized swimmers are a nod towards ongoing work into directed pattern formation in motile bacteria, the caviar containing the works of the Bard are based on the recent embedding of the entire text of a book in DNA strands[2], and the "bactogarden" concept derives from the *E. chromi* project, which engineered "living colour" in bacteria[3]. The two central

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[1] Stanislaw Lem (1984) Philip K. Dick : A Visionary Among the Charlatans. In *Microworlds: Writings on Science Fiction and Fantasy* (Franz Rottensteiner, ed.), London:Secker & Warburg (1985), p. 117.

[2] George M. Church, *et al*. (2012) Next-generation digital information storage in DNA. *Science* **337**:6102, p. 1628.

[3] http://www.echromi.com/

technological devices are also completely plausible, referencing the creation of "high-end" food products created by synbio[4], and the so-called "bacilla-filla" concept – engineered *Bacillus* bugs that will, one day, fill cracks in concrete by crawling into crevices before quietly expiring (generating calcium carbonate in the process)[5].

The Bactogarden Project imagines a future in which synthetic biology is utterly ubiquitous; the story then becomes less about the "tech" *per se*, and more about connecting the *characters* and exploring *impossibilities*. Here, synbio is used predominantly as a vehicle for exploring issues of *control*; of personal destiny, relationships, scientific developments, and even our management of the planet. Kay and Stevie were never equals, even as children, and now Kay is a literal outsider, dangling outside Stevie's building while she ministers to the elite. Stevie uses cutting-edge technology to generate her prize-winning gastronomy, but her emphasis on the transient nature of her art, her unwillingness to allow Kay to take home the apple (ancient symbol of beauty and knowledge) and, later, her appropriation of the bactogarden, serve only to underline her insecurity. Kay fixes buildings using engineered organisms, while her father slowly dies from a failing heart. We imagine that synbio could offer a possible route towards geo-engineering the planet away from environmental catastrophe, and yet climate refugees are an uncomfortable and visible reality in Schofield's world of 2070. In this, Sarah emphasizes what those working in synbio already understand; that it will never be a panacea.

Sarah also does a fine job of considering the notion of what *creativity* might mean in the context of this emerging technology. The use of complex *living* material as an artistic medium raises important questions of agency and intentionality. Microbial colonies form structures that are inherently (and fundamentally) *functional* (e.g., they might protect the colony from dangerous chemicals), yet we often find in them – completely accidentally - great beauty (see, for example, the work of Eshel Ben-Jacob[6]). Are we artists, or simply supporting technicians? The Synthetic Aesthetics project asks of speculative collaborations between artists/designers and scientists: "Should these projects be considered art, design, synthetic biology, or something else altogether?"[7] The story also raises deep issues of *ownership*. Writer, broadcaster and geneticist Adam Rutherford has

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[4] Erika Check Hayden (2014) Synthetic-biology firms shift focus. *Nature* news, 29 January. http://www.nature.com/news/synthetic-biology-firms-shift-focus-1.14602

[5] http://phys.org/news/2010-11-bacillafilla-concrete.html

[6] http://tamar.tau.ac.il/~eshel/gallery.html

[7] Daisy Ginsberg, et al. (2014) *Synthetic Aesthetics: Investigating Synthetic Biology's Designs on Nature*, MIT Press.

referred to synbio as "genetic remixing"[8], and draws parallels between it and urban music, in that a "deeply creative and youthful science with sampling as its soul … faces the same ownership issues that killed hip hop." He argues that issues of patenting and intellectual property may hinder future important developments in synbio in exactly the same way that copyright issues have reduced the ability of artists to remix existing beats and snippets of music. More fundamentally, though, can we ever truly *own* biology, in the way that some might to want to? Can we "own" *physics*, or chemistry?

In the end, though, Sarah's story encourages us to seek out beauty in the everyday and the mundane. Stevie's work is destined to be ever transient, only captured when fossilized, lifeless, in resin. Deep down, she craves her mother's approval, forever seeking to recreate the rejected ceremonial bactogarden. Yet, for a time, at least, Kay finds peace through the release of her own colony into a uniquely personal space; engineered biology reclaiming her mother's shop.

[8] Adam Rutherford (2013) *Creation: The Origin of Life/The Future of Life*, Viking.