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Hacking Together a New Biology

Sophia Roosth, *Synthetic: How Life Got Made*. University of Chicago Press, 2017. ISBN-13: 978-0-226-44046-0. Cloth (\$105), Paperback (\$35), & E-book (\$35). 256 pages.

“Life,” Sophia Roosth begins her fascinating ethnography of synthetic biology, “is no longer what it used to be.” Whereas previous generations of molecular biologists had sought to analyze life in its most fundamental terms—elucidating the structures of molecules and their influence on cellular development—the twenty-first century synthetic biologists that Roosth follows in Boston and the San Francisco Bay Area seek not to come up with theories which explain life, but with forms of life that instantiate those theories. Roosth’s synthetic biologists take their cues from an epigram by the physicist Richard Feynman, “I what I cannot create, I do not understand.” In creating new forms of life, synthetic biology perturbs our understandings of kinship, creativity and even death. Yet the same time, as *Synthetic*’s chapters pair to demonstrate, the forms of life created by synthetic biologists are connected to the ways that they fashion their own forms of social and political life.

In chapters one and three Roosth’s actors grapple with the vexing question of defining what synthetic biology is. These arguments about definition often turn into arguments about origins and metaphors. For one group, often found around MIT, life as information and DNA as computer code provide dominant metaphors for their work. Biochemistry provides the ability to “edit” genomes—stripping out “junk” DNA to improve their efficiency or transportability, as embodied by Andrew Endy’s ambitious “bio-brick” initiative. Meanwhile, among many biologists in California, Roosth finds a view of living things as machines. Here, the question is not editing DNA for informational simplicity but functionally altering organisms to serve as “factories” for the production of valuable chemical compounds, such as the antimalarial compound artemisinin.

The different genealogies of synthetic biology clash most clearly in debates over the patentability of its inventions. If life were a machine and synthetic biology heir to genetic engineering, then the products of synthetic biology might be patented like any other invention. However, for those who identify life with software and synthetic biology with programming, synthetic biology was an heir to the open source movement, a field where intellectual property was deeply contentious. Moreover, in these debates over creativity and property, the very notions of creation and novelty from nature were challenging concepts for synthetic biologists. Working in the shadow of ongoing debates over the teaching of “intelligent design” in American schools, synthetic biologists alternately embraced and distanced themselves from the idea that they were supernatural creators of new “life” rather than following or extending its preexisting evolutionary logic.

In chapters two and six, Roosth explores another set of confounding effects arising from the the emphasis that synthetic biology places on the genotype—sequences of genetic information—rather than the phenotype—the traits an organism develops. Roosth traces

“promiscuous” ease with which engineering efforts swap genes “for” enzymes between species on distant branches on the “tree of life.” Roosth suggests that the diminished emphasis on evolutionary proximity in gene exchanges mirrors forms of “queer” kinship in society—groups based not on biological affinity but on choice. A genotype-first focus can have similarly confounding effects on notions of time. Synthetic biologists such as George Church are prominent members of the “de-extinction” movement, using salvaged DNA to clone animals such as woolly mammoths. These efforts raise difficult questions about where the essence of species identity lies—in its genetic material or in its relationships with an environment long past.

Finally, in chapters four and five Roosth explores the deskilling of biological work. Most forms of genetic engineering have historically relied on workers with years of training in molecular biology, an impediment to many of the fast-moving methods synthetic biologists favor. However, while in an academic setting synthetic biology had appeared to be engaged in new acts of creativity, the commercial firm that Roosth observes has managed to regiment and automate many procedures to the point that little background in biology is required to carry them out—a “biology without people.” As the process of synthetic biology becomes automated, the role for creativity and craft in biological laboratory work diminishes. Yet alongside the increased automation of industrial synthetic biology “bio-hacking” groups have emerged around Cambridge, drawing on the cheap equipment and resources. These groups use these tools in the service of creative and expressive endeavors—suggesting a new, or renewed, relationship between synthetic biology and creativity.

Throughout Roosth emphasizes that, as much as it might fashion itself as an avant-garde field, synthetic biology retains substantial continuities with longstanding questions in the practice and theory of biology and art. In a series of interludes between chapters Roosth provides cues to the conversations that her work is in conversation with ranging from Adorno to Zoloff. These simulating essays ideas such as the definition of life, synthesis, or enhancement are in themselves microcosms of the intellectual worlds that Roosth’s book opens up for its readers. For this reason, *Synthetic* will retain an important place in conversations about life, art, and biotechnology for years to come.