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Raymond McCauley tests dietary supplements on himself in his home lab.

BIOTECHNOLOGY

DIY biology

Bart Penders relishes an account of 'biohackers' who experiment beyond the confines of the lab.

In laboratories across the world, people with multiple degrees work at hygienic benches kitted out with globally recognized brands of scientific equipment. It is there, we assume, that the knowledge of how life works is assembled.

In his book *Biopunk*, science journalist Marcus Wohlsen unpeels a parallel universe of amateur knowledge-gathering — that of do-it-yourself biology, also known as biohacking. Wohlsen introduces us to a subculture of bioenthusiasts in the United States, Europe and Asia who tinker with life in their kitchens and garages. DIY biology may be less sterile and less well-equipped than that done in your average lab, but it is functional and fascinating, as his engaging account of biohackers shows.

Whether or not they have official qualifications, DIY biologists — or biopunks, as some of them dub themselves — are driven to study the stuff of life. They make up a colourful crew. Kay Aull, for instance, is a Boston-based lab technician and graduate of the Massachusetts Institute of Technology who designed and built a genetic test for the iron-overload disorder haemochromatosis in her apartment, using vintage equipment. Texan bioinformatician Raymond McCauley trawled through his own genome sequence in his home lab, even carrying out a small clinical trial, to test whether he can prevent macular degeneration through diet.

Biopunk: DIY Scientists Hack the Software of Life
MARCUS WOHLSEN
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Wohlsen reminds us that professional scientists have never had a monopoly on knowledge-making. These days, professionals might be at the forefront initially, but often a science or technology develops in interesting ways only when it goes beyond the confines of a laboratory. Aull and McCauley's audacious experimentation exemplifies how shifts in the availability of data, reagents, technology and knowledge have altered how society interacts with the biological. Engaging with the genetic code is no longer just for the biotechnological elite.

That does not mean that DIY biology is an innocent pastime. A lot can be at stake. While experimenting, Aull and McCauley put their bodies on the line: blood, tissue and code. There is also a political agenda. As Wohlsen says, "Biopunks want to see whether the wall around the fortress of Big Science is really as high as it seems." The biopunk manifesto, declared by biohacker Meredith Patterson last year at the Outlaw Biology symposium at the University of California, Los Angeles, is a call for the democratization of science and a vow to put the tools of science into the hands of all (see go.nature.com/nyipbu).

But the drive has hit hurdles. The existing system of institution-based inquiry and innovation confines the tools and right to do biology to the elite, and thus resists democratization. Intellectual-property rights and restrictions on the availability of biological materials can prove problematic for home-based research.

But necessity forces invention and solidarity, Wohlsen explains. Biohackers are drawn towards open-source options, and make their research data and protocols freely available. Even so, their working conditions place limits on what DIY biologists can use: for instance, some dumped the preferred lab organism *Escherichia coli* in favour of *Lactobacillus* because it can endure garage conditions much better. As a result, Wohlsen writes, "the raw materials of biotechnology are always just a supermarket away", citing Patterson's use of spoilt milk and yoghurt to get bacterial cultures up and running.

Wohlsen urges us to reflect on how we organize science and how the power to define the biological is distributed. And he highlights the intrinsic messiness of innovation, using historical examples of experiments by the gentlemen scientists of yesteryear that we might now consider to be ethically dubious. Wohlsen reminds us that every encounter with the unknown is inherently uncertain, and potentially brings new ethical challenges. Some authorities might also suspect the motives of people who mess about with Petri dishes, flasks, chemicals and microorganisms in their basements, leading to allegations of bioterrorism. The position of DIY biology in our society has yet to be established.

In my view, no clear line can or should be drawn between institutional life sciences and DIY biology, and the dichotomy between expert and layperson does not stand firm. Most biopunks, including Aull and McCauley, have jobs at universities or in biotech companies. Ultimately, biohacking is more concerned with getting biology out of the lab and into the streets than with making major scientific breakthroughs. The objective, after all, is the democratization of science. French sociologist of science Michel Callon has called it "research-in-the-wild", in which the professional and the amateur increasingly overlap.

Biopunk carries a convincing message that slowly, steadily, we could all become authors of a ubiquitous and democratic biology. ■

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