Build your own lab: Do-it-yourself biology and the rise of citizen biotech-economies

Morgan Meyer

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1. INTRODUCTION

Most articles on garage biology and do-it-yourself (DIY) biology – whether academic papers or media reports – highlight its somewhat "immaterial" cultures or ideologies. The issues usually raised include: the ways in which do-it-yourself biology potentially democratizes science and fosters a citizen science (Wolinsky, 2009), that its practitioners are a "creative proof of the hacker principle" (Ledford, 2010: 650), that the field is an illustration of the open source movement, that concerns about control, security and safety need to be addressed (Sawyer, 2011). However, rather than focusing on such relatively abstract cultures, this article focuses on the more materialaspects of do-it-yourself biology: its locations, its equipments, its objects. I thus follow Watson and Shove's (2005) approach and focus on the tools and materials, rather than the symbolic meanings and effects of, do-it-yourself practices (see also Shove et al., 2007: 41-68). This article presents three sites of DIY practices: a community laboratory in Paris, a private laboratory in Boston and, third, cheap alternatives to scientific equipment, such as the *DremelFuge*. The argument I am concerned with is that the circulability, the affordability and the mutability of objects play a key role in do-it-yourself biology and, at the same time, that we witness the emergence of a "citizen biotech-economy".

But first, a few words about the multiple sites of do-it-yourself biology. There is quite a diverse set of places in which laboratories, associations, and networks around do-it-yourself biology have emerged. DIYbio, created in the Boston area in 2008, describes itself as an "Institution for the Amateur Biologist". It now counts around 2000 members and has a website (www.diybio.org) which is arguably the worldwide focal point for people interested in DIY biology. Associations like DIYbio are today present in many countries across the globe: in European countries like Denmark, the UK, Spain, France, Germany, in Canada and in India and, above all, in the US. The emergence of do-it-yourself biology is mainly located in the Western world, especially in major US and European cities. Beyond these territorial aspects, the more distributed geographies of protocols, ideas and objects that circulate via Internet forums and collaborative platforms play a key role in the emergence of do-it-yourself biology. In fact, the various communicative devices that do-it-yourself biologists use – i.e. the diybio.org website, the blogs, open source tools, forums, videos, etc. – are part and parcel of the material infrastructure that allows for the circulation of knowledge to take place and for collectives of do-it-yourself biologists to emerge.

2. LA PAILLASSE: A COMMUNITY LABORATORY IN PARIS

An example of a community laboratory is the association called *La Paillasse* which was established in Paris by Thomas Landrain, a PhD student at the Institute for Systems and Synthetic Biology. *La Paillasse* describes itself as "a physical and web platform for citizen scientists, amateur biologists, researchers and entrepreneurs that fosters open-science, debates and hands-on practice of Biotechnologies" and as "a group of passionate people about biology, each with his or her own area of expertise, interest and dedication". Informally created in 2008 and officially launched in 2011, the association works in a "DIYbio spirit", is "accessible to anybody" and aims for "very open, diverse and possibly opposed approaches to biology". The mailing list of the association counts some 70 members of which there are 10 "core" people.

La Paillasse is currently located in two spaces. The first one is "totally open" and is dedicated to discussions and projects "that don't necessitate particular materials (computer projects, electronic projects or "light" biology for example)". The second space, more regulated, contains machines and equipment for projects that are "more weighty". The latter is based at the Electrolab at Nanterre (an area north east of Paris). If at the beginning of its history, the association only disposed of a very small surface (only a few square metres of a working bench in the Electrolab laboratory), since November 2011 *La Paillasse* occupies a real laboratory of 15 square meters. It was above all Génopôle, the prime institution for genetics research in France, and a former laboratory from the municipality of Paris that have donated scientific equipment to the lab, including centrifuges, fridges, a PCR machine, and shakers. But getting other material proves more difficult. One of the founding members of *La Paillasse*explains: "We still lack consumables, enzymes, bacteria. I don't knowhow we will get our material fromsuppliers, they are not used to dealwith associations. It'sthe unknown,we are the firstin France". In terms of scientific tools, the association's aims include "developing and distributing the tools needed to perform biological studies and experiments" and thereby to be "contributing to the international biohacker community by releasing our tools in an open source format".

La Paillasse works on several projects: a bioethics workshop that aims to define the current limits of French and European legislation concerning the manipulation of biological and chemical samples and thereby "help La Paillasse to provide a legal framework for its experimental and social activities"; the construction of kits to detect GMOs in food; the creation of renewable energy from waste, bacteria and algae; projects to do with informatics, and so on. However, besides being a scientific project, *La Paillasse*is also explicitly a project with a political aim. One of the founders of the association argues: "Citizens must have in their hands a counter-power to participate in the societal choices concerning the use of these technologies".

There are other examples of community laboratories worth to mention: BioCurious, an association founded in 2009 by DIYbio near San Francisco which has leased and turned a 220-square-meter office into a laboratory (funded via Kickstarter); BiologiGaragen, located in Copenhagen, "a laboratory and open creative space" that "will encourage citizen science in biology and make knowledge, tools and software available for people" and on whose website a call for donations of used scientific equipment is made (freezer, refrigerator, pH-sensors, incubator, etc.); Genspace in Brooklin, New York, etc.

3. KAY AULL'S PRIVATE LABORATORY IN HER APARTMENT

A famous story of a private laboratory is that of Kay Aull, a PhD student at the University of California, San Francisco. Aull's story has been reported in many media (Le Monde, Sky News, Wall Street Journal, etc.) as well as in academic journals (Alper, 2009; Wolinski, 2009). For the price of around 1000 dollars, Aull set up a laboratory in her closet in her apartment in Boston.

Aull built many devices for her experiments herself (see Eudes, 2009; Wohlsen, 2011; Moore, 2009). For instance, she uses a rice cooker to distil water. Instead of buying an incubator, she put one together out of apolystyrenepackaging box, a thermostatfroman aquarium, a fan, a heating pad, and a digital thermometer. In order to be able to separate DNA, she constructed anelectrified box out of a picture frameanda plastic boxlined withaluminium foil. A blue Christmas light serves her to produce blue light to be able to seeDNA. But she also bought some tools from eBay: a thermocycler and an electrophoresis supply.

Using these rather basic tools she was even able to build a hemochromatosis test. Her father was in fact diagnosed with the genetic disease called hemochromatosis and she wanted to find out if she also carried the mutation (which she does). Commenting Aull's story about this test, Wohlsen (2011: 15) writes: "Aull's test does not represent new science but a new way of doing science. A practical piece of biotechnology based on the most sophisticated science available was built in a closet using tossed-off gear".

There are other stories of people who, like Kay Aull, have experimented with biology at home. Another "success story" (Nair, 2009) is that of Meredith Patterson, who works on a way to test milk for melamine poisoning. Like Aull, she uses mundane objects as alternatives for scientific equipment: a salad spinner as a centrifuge, ziploc plastic bags as containers for samples, a brake cylinder as a gene-copying machine, etc.

4. THE DREMELFUGE AND OTHER "CREATIVE WORKAROUNDS"

The above two examples illustrate a key issue for do-it-yourself biology: the cost and procurement of scientific equipment. Purchasing scientific equipment was, at least until very recently, expensive, difficult, uncommon, or just impossible. However, there are now various ways through which people can get hold of cheap scientific equipment. Do-it-yourself biologists might steal, buy used equipment, or use other people's university address to get material shipped (Delfanti, 2010: 117). The paths through which the costs of setting up a laboratory at home (or a community lab) are becoming more affordable include: buying used equipment, transforming equipment, or finding alternatives to equipment.

Examples of alternative and transformed equipment that frequently feature on websites, blogs, videos, or articles devoted to garage and do-it-yourself biology include: the conversion of webcams into microscopes; the *Open PCR* and the *LavaAmp* (as alternatives to PCR machines); the *Open Gel Box* to do gel electrophoresis; incubating test tubes in one's own armpits instead of using a conventional incubator; purifying DNA with a mix of non-iodized table salt, meat tenderizer, and shampoo; or using the *DremelFuge* instead of a centrifuge.

The *DremelFuge*, for example, was created in 2009 by Cathal Garvey in Ireland. This device can be used as a substitute to a conventional centrifuge. The idea is to put an adapter on a power drill or any other rotary tool in order to spin test tubes. Through this device, the costs for centrifuging are decreased from 500 to around 55 dollars. Garvey advertises his invention as follows: "A centrifuge attachment for drills or rotary tools which spins them with even more power than the official thing, and costs a tiny fraction of the price to make and operate". On a video posted on YouTube1, instructions for how to use the device are given: we see Cathal Garvey explaining the device, showing how it works, how to put tubes into the device, with what speed of rotation it works, and giving some precautionary notes, etc. The *DremelFuge* has some key advantages for do-it-yourself biologists: it is rather cheap, easy to use, small and combinable with a tool found in many households, a power drill. In other words, it is a relatively mobile object. (This transportability of tools and materials helps to explain why some scientific fields are more open to amateurs than others (see Meyer, 2008)). Another example is the *Open Gel Box*, which is delivered as a package including documents (assembly instructions and usage protocols), wires and other pieces, which people can assemble at home (like IKEA furniture) and then use or even improve.

Do-it-yourself biologists can buy these artefacts either via the websites of producers or, in the case of used equipment, via eBay, Amazon, or Craiglist. For these and other kinds of equipment (i.e. the *DremelFuge*), there are video instructions to build and use them on sites such as YouTube or Vimeo. And, on many blogs and websites dedicated to do-it-yourself biology, there is information about where and how to purchase, get for free, build, or transform equipment. The Internet plays in fact an important role for do-it-yourself biologists: it allows and encourages people to "freely reveal" (see von Hippel, 2005: 77-91) their innovations; it provides platforms through which used equipment can be sold and bought, ways for people to share instructions and information for how to find and build alternative tools, and, more generally, a medium to connect people interested in do-it-yourself biology. In fact, the Internet is part and parcel of the emerging, alternative, and multifarious economy of scientific equipment that sustains do-it-yourself biology.

Another way for people to learn how to use equipment is, of course, through workshops. An example here is the *SymbioticA Biotech Art Workshop*, a series of workshops organised at the University of Western Australia. Workshop participants are taught, for instance, alternative methods for biotechnical experiments, i.e. for DNA extraction, for the preparation of culture media, for building a sterile laminar flow hood out of home construction material (Catts and Cass, 2008: 150; da Costa, 2008: 373). The *Biotech Hobbyist* is yet another example of a forum (a magazine in this case) that offers "step-by-step instructions and advice on how to obtain the necessary materials", distributes its own kits, and calls for people to build laboratories at home (da Costa, 2008: 373, 376).

We see that do-it-yourself biology is not only dependent on scientific equipment becoming cheaper and more available, the *mutability* of objects is also crucially important. Do-it-yourself biology favours so-called "creative workarounds" (Ledford, 2010) that is, inventive ways to work without conventional and expensive scientific material. This article has revealed two kinds of creative workarounds. First, people use creative workarounds *around objects* when they transform and combine them and use them in unusual ways. And, on the other hand, they use creative workarounds *around institutions*, when they try to circumvent established industry-university business linkages (i.e. via donations, stealing, or using university addresses).

5. CONCLUDING REMARKS

I want to conclude with two points. First, to be able to "domesticate" biology, people need various tools and material objects to serve as scientific equipment. These objects often need to be transformed, combined, and (re)made. Do-it-yourself biologists rely on various practices to make this happen: transforming mundane household objects into other objects, making some objects from scratch and, in general, replacing, replicating and imitating scientific objects.

Do-it-yourself biology can be a site of creative "workarounds" around objects and around institutions. These workarounds open up new spaces for amateur science: they enable people to build shared community laboratories as well as laboratories in their own garages, kitchens, or basements. The relationships between amateurs and professionals are thus not only located "in" disciplinary fields (such as natural history, botany, or astronomy) or specific places (such as the field, the museum, or the home). Relationships between amateurs and professionals are also made possible "through" objects. The affordances of objects – as much as their mobility and their malleability – play a key role in garage and do-it-yourself biology and, I would argue, disserve further analysis.

The second point I want to stress is that do-it-yourself biology does not only represent an instance of "citizen science" (on this notion see Irwin, 1995), but that it also points to another issue: the formation of what we could call citizen economies of scientific equipment, or "citizen biotech-economies". (I use the word economy in an open sense here, since in many cases we actually observe *non-market* economies at work; economies that, interestingly enough, also bring us back to the original meaning of the word economics, namely "managing a household"). In order to set up a laboratory in a garage, people depend on a multitude of objects, networks, and people. They heavily depend on other people interested in do-it-yourself biology, they rely on scientific institutions (even if indirectly), they rely on the sharing of information, on the circulation of objects, on Internet platforms, on emails, on donations, etc. In short, people who want to practice do-it-yourself biology need to tap into these emerging and open collectives of people, ideas and objects that are currently materialising around the notions of garage biology, DIY biology, biohacking, etc.[2]

These citizen biotech-economies are to be open, collective, distributed, and accessible. Their openness manifests itself in at least three ways.[3] First, we observe an openness in terms of peoples' *material access* toknowledge, to affordable objects, to infrastructures. Second, this openness is also socio-political: the networks, associations, laboratories and equipments dedicated to do-it-yourself biology are also imagined and presented in more general terms as means to *democratise science* and to engage and provide an access to biology to various kinds of people, each with their own background, motivation, and interests. Third, these economies are portrayed as an alternative, and sometimes even as opposed to, other, more "closed" economies (i.e. big business).[4] These citizen biotech-economies thus come to stand for three things at once: a material re-distribution, a democratisation, and an alternative to established, technoscience.

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1 YouTube (2011) "DremelFuge Intro", available at: http://www.youtube.com/watch?v=86WnXeTZO_Y (last accessed: 15 November 2011)

2 For a discussion about the different notions such as "hackers", "outlaws" and "amateurs" and a critical engagement with DIY biology see Kelty (2010).

3 Delfanti (2010: 119) makes a somewhat similar argument when talking about the "different faces" of hacking, noting that: "DIYbio embodies very different faces of hacking such as openness in data and knowledge sharing as well as openness of the doors of scientific institutions, but also rebellion, hedonism, passion, communitarian spirit, individualism and entrepreneurial drive, distrust for bureaucracies".

4 One might be tempted to trace the various ways through which citizens work to co-produce this economy and how, in so doing, they are at once consumers and producers (see i.e. Dujarier, 2008). Yet terms such as "consumer" or "work" might not do justice to our case here since most DIY biologists do not consume/produce any market products (they often oppose such moves) and since DIY biology cuts across work and leisure. See also Conz's work (2006) on the grassroots biodiesel movement as an example of "citizen technoscience" which resembles at once institutionalized science, a business, and a social movement.

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