

The Two Biocuriouses: Works and Shoots

In 2011 a cohort of individuals opened a Do-It-Yourself biology (DIYbio) laboratory in a Sunnyvale, California office park (Scroggins 2017; 2019). They named the laboratory Biocurious and began referring to themselves as Biocurians. The individuals hailed from a range of backgrounds: experienced nonprofit volunteers, veteran entrepreneurs, aspiring entrepreneurs, startup consultants, retired engineers, undergraduate students from San Jose St and Santa Clara, postdoctoral researchers from Stanford and Berkeley, a computer scientist from Lawrence Livermore National Laboratory, independent researchers without institutional affiliation, science teachers, faculty from Singularity University, and the recently unemployed looking to improve their skills (see Gershon 2017). Among this cohort, a simmering conflict took hold between those who believed Biocurious should act as a Silicon Valley startup and move to disrupt industries and institutions through innovation and those who believed that Biocurious should become “a laboratory for the community” where people could “experiment with friends” in the relaxed environment of a “garage lab.” The crux of this conflict were the tenants of two competing visions of how innovation should work and who it might work for. Is innovation the province of a special social class, makers in Silicon Valley parlance, who are fluent in taking technology to market? Or is innovation something that bubbles up from the ordinary business of tinkering and playing with technology?

Propelling the dream of a public DIYbio lab was one of the first successful crowdfunding campaigns. The Biocurious organizers raised more than thirty-thousand dollars on Kickstarter.com, enough to put down a deposit and pay several months’ rent. This success was due in no small part to the well-placed pitch on Biocurious’ Kickstarter website. The organizers not only promised to revolutionize Biotechnology, they also promised that the revolution would offer something for everyone. Entrepreneurs would find co-founders while pioneering new markets, hackers would find a do-ocracy where democratic norms reigned, and job seekers would be able to gain laboratory experience and network with company hiring managers (See Souleles and Scroggins 2017). While you might think that a single institution could not possibly hold so many contradictory norms and aspirations, the organizers believed the heat and hype of their new approach to Biotech could fuse these contradictory ideas into a unitary institution.

This chapter examines the early years of Biocurious, between 2011 and 2013, when the direction and purpose of Biocurious was an unavoidable topic of deliberation, debate, and conflict among Biocurians. One case probes the neoliberal Biocurious, predicated on disruptive innovation and attracting venture capital, that came and went, the other case examines what I will call the do-ocratic (Zacchioli 2011) Biocurious of more modest aim and scope, predicated on volunteer labor, community education, and mutual aid, that still exists in Sunnyvale.

As might be surmised, one answer to the question how innovation should work lies in the nature of social ties at the two Biocuriouses. The neoliberal Biocurious directed its activities from the top down through a board of directors in consultation with corporate sponsors, and mediated relationships between the laboratory and members and volunteer staff through the norms of

human resources. This Biocurious had a brief but spectacular existence, beginning with a barrage of friendly media coverage, seeing an infamous startup launched from within its laboratory, and ending with the departure of the original board members and the election of new board members drawn from the ranks of Biocurious' members and volunteers. Another answer to the question of how innovation should work lies in the purpose of the two Biocuriouses. Should innovators aim to disrupt industries by using the democratization of a technology, in this case synthetic biology, as a lever to implement the classic disruptive strategy of entering low-end and opening new markets, such as direct to consumer genetically modified organisms? Or should innovation proceed on a slower and more deliberate path, without market forces and the promise of funding (and the fame that comes with it) pulling innovation into the same predictable shapes?

The Neoliberal Biocurious

Early in my fieldwork at Biocurious I received a lesson in how innovation happens in Silicon Valley. A Biocurious member, who had turned down a seat on the board because of Biocurious' nonprofit status (he thought Biocurious should have been a for-profit), explained to me the current state of play in Silicon Valley. Talking about the numerous synthetic biology startups then attracting venture capital, he opined that early in the life of a new company the main product is always is heat and hype. Attracting attention, he said, is the entire game. If you have to make outrageous claims, make them. If you have to stretch the truth about a product into a white lie, stretch it. The companies that survive their early days are those that attract attention because attention can be turned to dollars and dollars into survival. And being one of the two or three companies to survive the early days of a new industry leads to pivoting, and pivoting, he explained, is where profitability lies. This, in a nutshell, is the neoliberal model of innovation.

I am going to suggest a metaphor drawn from American Professional Wrestling to describe neoliberal innovation. American Pro wrestling has a complex and subtle vocabulary for describing the interplay between staged events (works), real events (shoots), and staged events presented as real events (a worked shoot). Wrestling also has a complex and subtle vocabulary for discussing the audience's relationship to fact and narrative. There are viewers who mistake the staged for the real (marks), those who discern the difference between staged and real (smarts), and those who enjoy searching for the boundary between the staged and the real (smarks).

The lesson I urge you to take from my informant's story of heat and hype in the life of innovation is that some of what passes for innovation in Silicon Valley and elsewhere is a staged event, a shoot, but more often what is called innovation is a staged event presented as a real event, a worked shoot. Success in this world depends on more than being a smart, you must be a smark and have a keen eye for the line between the real and the staged.

The Setting

The place was Silicon Valley. The year 2011. This was the year the United States officially (if you follow official metrics) recovered from the Great Recession of 2008. Silicon Valley led the

recovery, with Google, Apple, Facebook, and newcomer Netflix all posting banner profits. It was a time of renewed optimism in Silicon Valley, with new faces, new technology, new business models and, most importantly, new money, flowing into the valley.

Biocurious opened that year in what, by most measurements, is the geographical heart of Silicon Valley. A stone's throw from 843 Stewart was the original Intel chip factory and the other hardware companies that emerged in the post-war silicon boom that gave the valley its moniker. A generation prior it had been the economic heart as well, though by 2011 the action had largely moved north to Palo Alto, home to a steady pipeline of software engineers and entrepreneurs pumped out by Stanford and near to the powerful venture capital firms affronting the south side of campus. It had become common by then for would-be tech titans to follow Mark Zuckerberg's path of using Stanford to scout potential co-founders and collaborators, coding and taking meetings with venture capitalists at the many coffeeshops near campus.

By contrast, the organizers of Biocurious belonged to an older style of Silicon Valley entrepreneurship. They were heir to the hardware and software entrepreneurs of previous generations who made fortunes by democratizing access to tools and techniques. They aimed to do for biology what the integrated circuit had done for electronics and the personal computer for the software industry – make available democratic design tools and techniques that anyone could use to decode DNA and create novel organisms.

Physically, the two Biocuriouses shared the same location; socially they were worlds apart. Biocurious was populated by the following classes of people, each with attendant rights and responsibilities: six board members, a couple dozen paying members, a few professional scientists (graduate and postdocs from Stanford and Berkeley) and several dozen volunteers. The neoliberal Biocurious was populated by the six board members and about half of the paying members: that half with entrepreneurial experience in the software and hardware industries. The board and entrepreneurial members were bound together by a set of overlapping and interlinking elective affinities. Half the board members were young with Ivy League degrees, half older with experience in the entrepreneurial trenches. With the members, they shared focus on startup companies, venture capital, and shared networks of funding and startup infrastructure.

The Solution in Theory

The theory of the case I present in the next section was elucidated by the Biocurious board members during their Kickstarter campaign. During my fieldwork several board members told me this part of the Kickstarter appeal was intended to attract entrepreneurs looking for new industries to disrupt and angel investors and venture capitalists looking for new companies to invest in. In a section explaining what they expected Biocurious to become, they opined:

Entrepreneurship Incubation, Mentoring, Angel Investment.

The Bay Area is home to many networks that help entrepreneurs launch web businesses with a shoestring budget and a dream. Similar support infrastructure does not yet exist for biotech ventures. Until recently, biotech has required large

start up costs. An ecosystem of mentor ship and a network of investors who understand the possibilities for lean-biotech-start ups to leverage shared resources and amplify their creative efforts to have disproportionate commercial impact, is urgently needed. BioCurious will catalyze the formation of this system.

The call to action above is couched rhetoric that was at once new to Silicon Valley, in conceptualizing biology as a technology, and traditional in Silicon Valley, in claiming that like the hardware and software industries before it a new era of democratized access to tools and equipment was at hand. Rhetorically, this was entirely normal for a Silicon Valley startup. Innovation demands claiming the mantle of both revolution and tradition, e.g. claiming the means of revolution is low-cost access to high-powered tools is a traditional strategy. More telling were the lines about the ecosystem of mentors and investors Biocurious would bring into existence. At the neoliberal Biocurious this ecosystem worked by using corporate sponsors to raise money and pay expenses, thus avoiding the problem of sharing management decisions with do-ocratically enabled members. Like the warmth of the sun, the constant flow of corporate money made life easy at Biocurious. Corporate sponsors also allowed the Biocurious board to shape the space in subtle ways by forcing out those who do not fit the image the board wished to circulate through media accounts of the lab. As well, "the right" fit became a de facto argument for exclusion of members or volunteers based on the needs and desires of the corporate sponsors.

The Solution in Practice

While the theory put forth by Biocurious seemed workable, albeit with a few open questions, such as whether or not Biocurious was the startup of interest or, like Y Combinator, a highly publicized incubator. In practice, a story as old as Fairchild's Traitorous Eight unfolded at Biocurious. For those unfamiliar with the story of the Traitorous Eight, it refers to the eight original employees of Shockley Semiconductor (many his former Stanford graduate students who found Shockley's management style oppressive) who left Shockley Semiconductor, thus putting it out of business, to form Fairchild Semiconductor. From Fairchild Semiconductor, and the Traitorous Eight, sprung the dozens of startup companies – including Intel and AMD – leading to the moniker Silicon Valley.

Like the semiconductor industry when Fairchild Semiconductor was formed, it was believed that the first direct to consumer Genetically Modified Organism would inaugurate a new industry and create new fortunes. For the Biocurious board, who were managing Biocurious like a startup company/business incubator, this was a great thing until they ran across an entrepreneur who saw the game of creating new markets for what is was – a staged event presented as real, i.e. a worked shoot.

Like Biocurious. The Glowing Plant startup used crowdfunding as a strategy to build a customer base, a media profile, and raise money that otherwise would have come from Angel investors. Also, like Biocurious, the Glowing Plant kickstarter campaign was sponsored and supported by a number of startup companies associated with Singularity University and maintained close ties to its startup ecosystem. The core team consisted of a technical founder, a Stanford trained

laboratory scientist, one Stanford post-doc, a software engineer with a background in biological applications, and a former Bain & Company consultant. Prior to their crowdfunding campaign Glowing Plant hired a digital marketing firm to manage the Kickstarter and advise on a public relations campaign. Though crowdfunding is often portrayed as the product of the wisdom of the crowd, the pump was primed well before the Kickstarter campaign was underway.

What happened at Biocurious was this: Glowing Plant poached the most active teach at Biocurious, elevating him from mentor to former tech entrepreneurs, and de facto leader of a popular community project at Biocurious to the technical founder of a heavily hyped startup company. And though the founders of Glowing Plant met at Biocurious, they left without giving anything back to the laboratory. There was no contractual reason (read neoliberal rationale) to do so, but it would have been a gesture of good faith. Most disconcertingly, though, the existence of the Glowing Plant startup left the broader DIYbio community in a no-win situation. If Glowing Plant was an utter failure (which it ultimately was) then DIYbio would be seen as largely ineffective. On the other hand, if Glowing Plant was successful then DIYbio might be subject to heavy regulation and negative scrutiny from the media.

From Glowing Plants perspective, however, the situation was a win-win. If they were an utter failure (which they were) they would still be lionized as visionaries who pioneered a new market strategy and would find ready employment in the startup world (in fact, this is what happened). On the other hand, if they succeeded any regulation they faced would be as a for-profit corporation and could easily be handled using strategies pioneered by Monsanto and Dupont in previous decades. And here we come to another truism of neoliberal innovation: the benefits of success can adhere to only one party, here Glowing Plant, while the risks of failure are spread widely.

To give a brief technical overview, Glowing Plant intended to take a luciferin system from the marine bacteria *Vibrio Fischeri*, found in squid, and place it into an *Arabidopsis* plant, thus causing the plant to bioluminescence, or light up, at night. You might think that such a company would surely be illegal and in Europe or Asia where the rule of thumb is that if something is not explicitly allowed it is illegal, and you would be right. But in the United States, the rule is the opposite – that which is not explicitly banned is legal. For example, in the United States, effecting a bacterial transformation via bacteria is regulated as a potential plant pest but using a gene gun (yes, a literal gun used to shoot plant callus cells) to effect the transformation is unregulated. Glowing Plant planned to drive their product through this regulatory loophole straight to market and ship their genetically modified organism (GMO) to consumers without regulatory oversight. In doing so, Glowing Plant was just following a strategy pioneered by Monsanto years before to market genetically modified Bluegrass.

Glowing Plant had a brief, but spectacular existence. Once they left Biocurious, they were accepted into Y Combinator as the first non-software startup in their history. Though, as you can probably guess from the lack of bioluminescent lighting in your house, Glowing Plant came to an inglorious end. As the years went by, and failed attempt followed failed attempt, the technical founder left followed by the software engineer. At the end, the man from Bain was vainly trying to pivot from manufacturing a Glowing Plant to creating a software platform for genetic analysis called TAXA. TAXA raised just over USD750,000 from 53 investors in a crowdfunding

investment scheme. But even in Silicon Valley there is a finite number of marks willing to put cash on the table based on a dramatic story of heat and hype. Eventually TAXA, too, failed and the audience left for greener pastures.

Analysis

At a time when Biocurious' Kickstarter honeymoon was over and they needed cash and peer support in the laboratory, their own neoliberal rhetoric came to haunt them. Instead of support, the founders of Glowing Plant tried to run the weakened Biocurious into the ground in order to purchase the intellectual property built into the Biocurious brand. I participated in several conference calls in the months following Glowing Plants departure from Biocurious in which Biocurious members, volunteers, and the Glowing Plant founders schemed ways to lower Biocurious' membership and revenue in a bid to take over the laboratory and, therefore extract what was valuable from Biocurious, its brand.

Then there was the broader question of Glowing Plant itself. Despite the huge Kickstarter – nearly USD 500,000 – and the promise made to 2,000 supporters that they could make a common model organism, the plant *Arapadopsis*, glow after dark like a household lamp, was this actually possible? Of course not. Did their Kickstarter backers believe it was possible, for many of these marks the answer was yes. Was this fraud? Not exactly. Many knew it was impossible but were invested in the effort, or, more accurately, the performance of effort. It was a shoot for some and a worked shoot for others. But most disconcertingly, Glowing Plant was a gamble with the good reputation of DIYbio which, to that point, had carefully avoided negative publicity.

The Do-ocratic Biocurious

Despite the neoliberal overlay, much of the spirit of the Bay Area counterculture lives on in Silicon Valley. By this I mean the cliched version of the counterculture. The one in which people pursue self-study despite the lack of immediate material gain, and the one in which people work together in the spirit of mutual aid towards a common goal that none alone can reach. In the ordinary business of creating, maintaining, and repairing the laboratory at Biocurious, this happened.

The do-ocratic Biocurious emerged slowly, animated from the bottom up by the work of laboratory volunteers and members who cared for and repaired Biocurious' mishmash of new and old, purchased and homemade equipment, taught classes, and took out the biotrash. This Biocurious was built on durable social ties that hold it together to this day. This Biocurious had more modest aims, seeking to “experiment with friends” in the informal atmosphere of a garage lab by connecting the earliest Biocurians to the newest Biocurians in an unbroken chain of curiosity and scientific education directed by the interests of laboratory members and volunteers.

If neoliberal innovation is comparable to professional wrestling in its uncertain relationship with reality and complex plot lines, then do-ocratic innovation is comparable to the rambling, improvised, and carnivalesque business practices of the Grateful Dead (Drobnik 2000). And the power of do-ocratic innovation lies in the flexibility and durability of weak ties and the, well fun, of jamming with friends and fellow travelers.

Like the Grateful Dead, the project I will describe towards the end of this section, the Bioprinter Community Project (BCP), received little media attention in its early years; ignored industry trends; avoided singular authorship and middlemen (or investors); exhibited a tinkerer's, not a businessman's, interest in technology. But most of all, like the Grateful Dead, the BCP played the long game by maintaining relationships with and networks of like-minded tinkerers.

Before continuing, dear reader, I need you to understand something important about the do-ocratic Biocurious: it was boring. One advantage of neoliberal reason is the constant invention of crisis and interventions. It lends a ready-made dramatic element to any story about innovation you wish to tell. The do-ocratic Biocurious lacked all drama. There will not be the hubris and flameout of Glowing Plant in what follows. Here is the impossible to dramatize story of slow and steady progress made possible by slow and steady democratic deliberation. So I must warn you before we go further, do not expect to be entertained with tales of ambitions run amok. Innovation, the kind that brings real and lasting change into the world, takes time, focus, and a lot of help and coordination from friends and like-minded fellow travelers.

The Setting

Physically the setting was the same. Both Biocuriouses occupied 843 Stewart in Sunnyvale, California. The two Biocuriouses used the same laboratory equipment, shared the same storage racks, and used the same reagents. If a visitor were to walk into the laboratory, they would have a difficult, if not impossible time telling the two Biocuriouses apart. Many policy researchers, innovation specialists from government agencies, visitors, and media audiences visited and only saw the neoliberal Biocurious. When you fly in for a visit of no more than a few days, it is easy to focus on hype and heat and ignore the slow and mundane. To see the democratic Biocurious, you had to look more closely. In fact, you have to start on the inside and look outwards.

If the physical setting was the same, socially the settings diverged. The do-ocratic Biocurious consisted of part of the membership - a handful of independent scientists working on personal projects, some engineers who enjoyed tinkering with technology of all kinds, volunteers who had membership privileges because they volunteered more than 20 hours per month, and volunteers who were at Biocurious to augment graduate training or to change careers. In short and ironically, those at Biocurious for reasons other than innovation.

The Solution in Theory

During the Kickstarter campaign, Biocurious also announced itself as a hackerspace for biology with member input in governance. Rhetorically, this was smart. Biocurious promised something

to everyone interested in biotech: entrepreneurs had an incubator and networking, hackers had free reign to hack, anarchists had a new space to engage in do-ocratic organizing, and those curious about biology had a selection of curated class experiences to try. From a governance angle, however, promising something to everyone caused predictable problems.

"Curious about Biology? Find out more at the new biology collaborative lab space where citizen science moves out of the classroom and into the community. Following the successful example of hackerspaces such as Noisebridge, Langton Labs, Hacker Dojo, and co-working spaces such as the Hub, we're pleased to offer the first Bay Area space dedicated to Non-Institutional Biology. Got an idea for a startup? Join the DIY, "garage biology" movement and found a new breed of biotech. Meet cofounders and friends, and make things you'd never dreamed possible."

In practice Biocurious was managed by the board more as a place to meet cofounders than as a place to make friends, i.e., nothing like the hackerspace Noisebridge. This manifest itself in two techniques deployed by the Biocurious board: a) a surveillance technology deployed, called an "incident report" designed to police the space ensure that volunteers were adhering to board set policy, rather than improvising, and b) a design language designed to ensure, as one board member artfully put it, "a consistent look and feel," to the interior spaces at Biocurious. As you may have guessed, these twinned techniques were in service to promoting the Biocurious brand. Per the board's actions, the first step for a "a new breed of biotech" was building a recognizable and durable brand name. And building a brand does not include the kind of deliberation and debate found at hackerspaces like Noisebridge.

The Solution in Practice

Though set up along an organizational model pioneered in a corporate environment, the in-situ organization of the lab followed a path described more by the doctrine of mutual aid than corporate governance. The idea of meeting and "experimenting with friends" was persuasive at Biocurious. Many members told me over the course of my fieldwork that if it wasn't for the people at Biocurious they would have left to set up private labs in kitchens, basements, spare rooms, or actual garages. One member, who was very active in the lab, moved out of state and established a laboratory in his basement on the east coast, yet continued to participate in meetings and classes at Biocurious. He went so far as to create a video conferencing system at Biocurious so he could coordinate his own lab work with groups working at Biocurious. Which is to say that personal relationships among members and volunteer generally followed the impulse to make friends rather than meet cofounders. And making friends encouraged a do-cratic organization based on reciprocity and shared resources.

Beneath the corporate gloss designed to paint Biocurious as an innovation space amenable to cofounders and investors, the work of democratizing biotech was undertaken by volunteers and members in the form of self-organization and self-education. Solutions to common problems were often and openly discussed in informal conversations around the lab, following a discussion solution were often improvised and implemented without notify or involving the board. A

notable example of self-organization involved maintaining and repairing the laboratory equipment.

From the start and despite the board's desires, Biocurious maintained a junk pile of uncertain paternity hidden away in a storage room. Additionally, the working equipment in the lab always threatened to stop working and move to the junk pile. Some of the equipment was donated, other was sourced from the numerous laboratory liquidations happening in the Bay Area. Sometimes the equipment was repaired and put in service, other times it served as the basis for a class, and more often it served as a repository of hard-to-find spare parts. Which is to say, a working DIYbio laboratory requires fix-it person who can repair and maintain equipment. This skill is difficult to acquire, unappreciated and often unrecognized (M. J. Scroggins and Pasquetto 2020). Incidentally, lack of working equipment was one reason Glowing Plant left Biocurious for a professional laboratory set up inside a shipping container in San Francisco.

More quotidian was the discipline to regularly clean and calibrate the laboratory equipment. Cleaning and calibrating were even more vital at Biocurious than a professional laboratory due to the number of amateur biologists taking classes at the lab, many of whom were encountering scientific instruments for the first time and lacked the dexterity and knowledge required to handle precision instruments. Most of what could charitably be called the scientific program was about two decades behind the cutting edge, making the old equipment, along with an organically growing library.

As few of the volunteers and members had laboratory experience, they were often in the same position as the would-be biotech innovators at Biocurious in that they knew little, or nothing, about laboratory norms, techniques, and equipment. While bringing in graduate students and postdocs from nearby Stanford and UC Berkeley went some way to rectify the educational gap, it did not go far enough. This gap became consequential when Biocurious' only autoclave, their lifeline to preparing media for experiments and sterilizing biotrash, broke. A new autoclave was purchased by a helpful member, but it needed to be cleaned and calibrated for a biological laboratory with its agar preparation and plastic petri dishes, rather than the dentist's office with its stainless-steel tools where it was previously used.

Luckily, the self-organized library provided an answer in the form of a donated book titled *At The Bench* which had directions for calibrating and cleaning common laboratory equipment, including autoclaves. Through close consultation of the book, a group of volunteers was able to work up operating protocols for the new autoclave, test those protocols, and teach them to everyone working in the laboratory. Unfortunately, and despite the utility of the library, it became a controversy at Biocurious when its disorderliness clashed with the board of director's design language and branding efforts. The controversy came to a crisis when a board member deemed the library an eyesore and threw it in the trash. The incident throws the difference between the neoliberal and do-ocratic Biocurious into sharp focus.

Trashing the library led to a sharp exchange of emails because board members and volunteers. The crux of the conflict was whether or not old scientific journals and textbooks should be classified as periodicals and removed every three months, as per board dictated policy, or whether they were essential scientific resources for a group of hobbyists with no formal

background in biology. The board argued, with words and the concrete deed of emptying the trash, that old scientific journals and textbooks detract from the appearance of the laboratory and offered no value as scientific journals are available online. After a volunteer fished his copy of *At the Bench* out of the trash, he offered the counterargument that not everyone at Biocurious had journal access (with my university access, I was the main source of journal access to those working in the lab), the textbooks were both useful and relevant and, more to the point, many of the materials were loaned by members and volunteers, not donated. This last argument exposes the difference between the neoliberal and the do-ocratic approaches to innovation. In the former, ownership of the innovation is centralized in the hands of a few. Innovation, both the intellectual and physical property, belong to the corporate person. In the do-ocratic, innovation, both physically and intellectually, is a collective achievement.

And collective innovation, though slow and, at times, tedious, is durable. For example, in contrast to Glowing Plant, through self-organization, self-education, and a do-ocratic approach the BCP is approaching a decade of uninterrupted work. As of this writing (January 2021) the Bioprinter project, started in January 2012 is still meeting twice a week (virtually through the pandemic) and its long-term goal of printing human organs for medical use is unchanged. Yet, the heat and hype of its ultimate goal has not prevented the BCP from adopting a series of practical intermediate steps to slowly advance their end goal of printing human organs. Often, these intermediate steps are both simple and practical; evolving their original printing chassis, a primitive desktop inkjet printer, to a sophisticated 3D printer and switching from printing bacterial cultures to printing plant callus cells, a rough approximation of the animal or human stem cells required to print an organ. Along the way, they have used plant callus cells to show genetic variations useful for plant breeding programs (callus cells have many uses including developing therapeutics). Supporting these efforts is a public wiki where instructional materials for building a 3D bioprinter and beginning experiments with plant tissue culture can be found, along with video links to join in the weekly Biocurious meetings.

Members have come and gone over the years and the long-term goal is still in the distant future, yet, the collateral effects of this community project have included the unemployed finding work in biotech, Science Faire projects being launched, admissions to graduate schools, and hundreds if not thousands learning the basics of software programming and electronics as they attempt to create their own bioprinters at home from the template published by Biocurious.

Perhaps a more telling development for those primarily interested in the products, rather than the process of innovation is the fate of Glowing Plant's technical founder. He left the excitement and hype of Glowing Plant to work for a smaller, slower, but more substantive startup. Endura Bio has been a so-called stealth startup throughout its life, quietly pursuing the work of engineering crops to grow in the saline conditions found where freshwater aquifers become inundated with saltwater. Endura Bio benefits from and contributes to the Bioprinter Community Project in subtle but telling ways – sharing protocols developed in their work with the BCP and benefitting from the community of potential investors and researchers created by the BCP. And here we come to a truism of do-ocratic innovation: the risks of failure are trivial and local, but the benefits of success are global and important.

Analysis

Where Glowing Plant was focused on producing a product – a glowing plant and laboratory/innovation space respectively - the do-ocratic Biocurious focused on the process of innovation. It might seem common sense and obvious that making a product is innovation. However, the history of the biotech industry belies this assumption.

The durable pattern of innovation in the biotech industry is this: small companies or groups of university researchers do the speculative work of research and development while larger companies move those ideas into production. Biotech is notorious for its long development cycles and investment rounds that occur only in the early and last stages of research, leaving long stretches with seemingly little development. The do-ocratic Biocurious and the BCP fit this model. Both are a place where ideas are tested, preliminary research carried out, and proof of concept established. In short, the unfunded and forgotten middle of the biotech business cycle where most of the work is actually done. And it is not only Biocurious where do-ocratic innovation is being carried out. The last few years have seen projects to develop an open-source supply of insulin, Open Insulin, and work towards making fully vegan cheese, the Real Vegan Cheese project. Currently, there are no fewer than three DIYbio led efforts to develop a COVID-19 vaccine.

During my fieldwork at Biocurious, I joined the Bioluminescence Community Project rather than the Bioprinter Project. Why? Because I, like the technical founder of the Glowing Plant and so many others, was caught up in the glow of possibility around hacking novel organisms. I now pass this lesson onto you: beware the heat and hype and keep your eyes open for the slow, serious, tedious and boring work of preparing the ground for durable change. That is where your efforts can be most effective.

Conclusion

The neoliberal view of innovation views innovation narrowly as a driver of economic activity. Accompanying this view is an assumption that what is vital and important about innovation is the essential qualities of the innovation itself. In contrast a do-ocratic approach emphasizes that the process of innovation and the innovation itself exists as a set of relations. In this view, the innovation itself is less important than the relations it engenders and the economic activity it generates in the short-term than the potential it carries over the long-term.

Indirectly, I have contrasted these two approaches in terms of attention and outcome. The neoliberal model flits from innovation to innovation in an endless, and often fruitless, search for the what was described at Biocurious as “the next big thing.” The do-ocratic model patiently pursues a line of work over years or decades. The outcomes of the two approaches are often radically different. The neoliberal approach is predicated on extraction, Glowing Plant extracted resources from Biocurious then, with Biocurious in a weakened state, tried to take over what branding and intellectual property was left. The do-ocratic approach, on the other hand, largely saved Biocurious from this fate. It is an additive and constructive approach to innovation,

strengthening relationships and networks and mobilizing the capacity for self-organization and self-education.

I have also described neoliberal innovation in terms of professional wrestling, insisting that it is always a mixture of the real and the staged. More often than we might care to consider, neoliberal innovation is a staged event, a work. Consider the lean startups, where a... well let's politely call it a business model, is tested by offering a prospective product for sale then forming a company around that product on the hopes it can produce the product while there is still interest. Or consider the lean startup's cousin, vaporware. Vaporware is a concept or idea floated as a finished product. Astute readers will notice that this leap requires one more act of faith than the lean startup. The smarts on the inside of Silicon Valley and other startup hubs know the difference between startups with solid business models and working products and act accordingly. But beware hopeful business student, many businesspeople who think they are smarts are actually marks. Woe be to the balance sheets of those investors who mistake a work for a real event, a shoot. Rarer, but still too common, is innovation as a worked shoot. That is, as a fake event that appears, and is presented as, real. The poster child for this kind of innovation is Theranos, whose fake blood test managed to raise billions in venture capital while fooling its own board of directors, its advisors, and medical regulators in a couple states into believing the blood test was real.

In contrast, I have compared the do-ocratic approach to innovation to the business practices of the Grateful Dead. As counter intuitive as this exercise might seem, I am proceeded by a general revaluation of the Grateful Dead's legacy by recent work in business and entrepreneurship (Drobnik 2000; Barnes 2011; Gazel and Schwer 1997; 1997). The main difference I have drawn is that the Grateful Dead, and the BCP, were relentlessly process, not product, focused. Again, like the BCP, the Grateful Dead produced no hit records, encouraged recording at their concerts, constantly increased their circle of collaborators, and were open to improvisation (as opposed to pivoting). The thread running through these practices, and separating them from the neoliberal approach to innovation, is the constant focus on community over commodity and process over product.

In closing, I exhort you to judge innovations not only for what they do (their bare functionality) but for the kinds of people, social relations, and futures they make. Self-education and tinkering, and most importantly the ability to experiment with friends in an environment free of commercial pressure; that is, to be critical, experimental, artistic, and to explore new and perhaps controversial ideas remain the condition of possibility necessary for the slow, deliberative work of innovation.

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