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Entrepreneurial Science : Yarden Katz

'Entrepreneurial science' is not the most intellectually scintillating concept, but I chose it because it seemed politically urgent. So, what is 'Entrepreneurial Science'?

We can begin by asking: who is the entrepreneurial scientist? But for that, we will need to know: Who is the scientist?

In his elegantly written book *The Scientific Life* (2008), historian Steven Shapin tackles this question. Shapin chronicles how the lives of scientists have changed, from Aristotle's day to the present. His final chapters are about the "scientific entrepreneur."[1]

Shapin paints the scene. It is a sunny afternoon in San Diego, and we are at a stylish cocktail party at the University of California. Scallops are served. There are scientists, venture capitalists, and intellectual property lawyers, all mingling harmoniously. The gathering, he writes, "is a sign that the university is fulfilling one of its major acknowledged functions in a late modern economy, building bridges between knowledge making and wealth

making." In this social milieu, Shapin says, "Business is business"—and your gender, religion, or parental wealth matter less.[2]

For Shapin, entrepreneurial science is the obvious next phase in the long arc of scientific life. Entrepreneurs, in his telling, are the risk-takers who interconvert knowledge and wealth. Shapin praises, for example, the biotech firm Genentech for commercializing the production of drugs using recombinant DNA techniques, originally developed by academics. Genentech's products and patents are often held up as a success story of entrepreneurial science.

However, Shapin omits one part of this story—a part so big it was reported in the *Washington Post*, but small enough it could be glossed over safely in scholarship. On New Year's Eve in 1978, a group of men sneaked into a laboratory at the University of California, San Francisco (UCSF). The men were from Genentech. Frustrated that they could not clone the gene needed to make the Human Growth Hormone, they came to campus to steal it. They grabbed the vial from the freezer. They published a *Nature* paper, produced a drug, and made billions.[3]

Twenty years later, one of the thieves, Peter Seeburg—by then a famous professor at Max Planck Institute—wrote a confessional in *Nature* magazine. As a witness in the ensuing court case between Genentech and the university, he said "It was dishonest…I regret it, but that's the way we did it twenty years ago."[4] Although theft did not make it into Shapin's account, he does cite literature that he describes as "complaining" about universities and entrepreneurship.[5]

* * *

In this vignette, we have the beginnings of a theme. We have violent theft from what looks, at least superficially, like a 'commons' (i.e., a university funded by the public). And we have professional historians naturalizing entrepreneurial theft.

I want to elaborate this theme, but my perspective will be different from that of a professional science historian. I am writing from the midst of scientific inquiry, from the lived experience of working in the American scientific enterprise. My aim is to articulate some of the violence of the scientific enterprise that surrounds me; not just the violence it often throws upon the world, but also the violence against scientists participating in it. I consider 'Entrepreneurial Science' to be an important concept, even if not the most analytically accurate, in this project.

There are, however, some pitfalls in trying to interpret 'entrepreneurial science'. Powerful arguments for the "disunity" of science, by historians such as Peter Galison (among others), compel us not to talk about science as a monolith.[6] Different scientific communities are made of different fabrics and so the manifestations of 'entrepreneurial science' will vary as well. My focus here will be on American academic biomedical science.

But there is another danger, still: the risk of producing what Stefano Harney and Fred Moten called "laments" for the university. I take to heart Harney and Moten's premise that "It cannot be denied that the university is a place of refuge, but it cannot be accepted that the university is a place of enlightenment."[7] Critical inquiries into scientific practice and its relation to the academy (including this one) are plagued by this tension, and it's a tension worth grappling with.

* * *

Let us rewind, and approach entrepreneurial science instead by asking: Who is the entrepreneur?

The term 'entrepreneur' is attributed to the nineteenth century French economist Jean-Baptiste Say, who became an icon of free market ideology. Say defined the entrepreneur as one who "shifts economic resources out of an area of lower and into an area of higher productivity and greater yield."[8] This is in effect a sanitized formulation of exploitation: taking (or stealing) what is available and using it for self-interest. It is therefore fitting that, in 1828, a French ship carrying enslaved Africans to Martinique was named The Entrepreneur. It may also not be surprising that Say admired the white European settlers in America, who apparently brought agriculture to the indigenous population, thereby creating higher value for all.[9] As Say wrote to Thomas Jefferson in 1803:

> The United States are the offspring of Europe, but the children have more merit than their fathers. We are elderly parents, raised with stupid prejudices…You will show us the right way to free ourselves, for you did more than just conquer your freedom: you affirmed it.[10]

In the US, 'entrepreneur' became associated with glorified notions of freedom, risk, and ingenuity. Say's 'entrepreneur' was in fact sometimes translated as 'adventurer' (preferred to the more banal translation, 'undertaker'). Some American economists of the early twentieth century thought the adventurous quality put entrepreneurs in a category of their own. For these thinkers, the entrepreneur transcended traditional divisions, offered by socialist rivals, between capital and landowners, on the one hand, and workers on the other. According to a 1927 article in *The Journal of Political Economy,* "a person may be at once entrepreneur, capitalist, landowner and laborer in a single small business; or, he may be at the same time entrepreneur only in one business, capitalist only in another, laborer only in a third, and landowner only in a fourth."[11] Entrepreneurs are thus a hybrid kind of manager. Through their own risk-bearing labor, they organize capital and laborers into enterprises.

This celebration of entrepreneurs as boundary-crossing risk takers persists to this day (as Shapin's account shows). It functions as a preemptive strike against perspectives that speak of 'exploitation' or 'solidarity' among workers. How can the 'adventurer' be exploited? And how could 'adventurers' be 'workers' anyway?

* * *

In English, the usage of 'entrepreneur' rose sharply in the late 1970s and early '80s. It moved far beyond economics and business into other spheres, including academic science. I would like to revisit this important period through a somewhat neglected book by the journalist David Dickson, titled *The New Politics of Science* (1984). Dickson analyzed what we might call 'Entrepreneurial Science'—and ways to resist it. By contrast to many science studies scholars who have focused on the relations between individuals in a network, and the politics embedded in devices, Dickson recognized the importance of more planned, top-down initiatives to reorganize the scientific enterprise. He wrote as important changes were taking place, making his account invaluable.

Dickson traces moves by the Carter and Reagan administrations to elevate the role of corporations in academic research while cutting back publicly funded programs. He reminds us of Reagan's science advisor, George Keyworth, who spoke in 1983 of the need to impart a "better sense of reality" to basic researchers by putting them in touch with "the marketplace."[12] There were legislative changes that made it easier to patent academic work; there was the rise of so-called "public-private" partnerships; the expansion of university administration; the

increased competition for funds; and more. Each change is sometimes exaggerated, but the sum is significant. The result is familiar from other instances of neoliberal restructuring—privatization, outsourcing, and increased competition—which have since enabled a variety of fraudulent, but lucrative, scientific research endeavors.[13]

But it is not only that academic science was viewed as indispensable for profit-making and global hegemony. These structural changes were meant to erode the (already miniscule) democratic control over the spheres of professional knowledge. For Dickson, this affair was *hybrid all the way down*. As he wrote, "universities and industry have teamed up to challenge the democratic control of knowledge." In other words, universities were not being meddled with by nefarious external entities called corporations and the military. Rather, the three spheres—academic, corporate, and state-military—were partners in crime.

* * *

Today, many universities effectively act as micro neoliberal states, enforcing what Noam Chomsky called "investor rights agreements" on behalf of entrepreneurial faculty and corporate partners.[14] A recent situation at the University of California, Los Angeles (UCLA) is a case in point. With public funding, UCLA chemists developed and patented a prostate cancer drug. The university then sold the patent to a biotech company (later acquired by Pfizer), who then went to court in India to challenge a law that would have allowed the manufacture of cheaper generics. UCLA enlisted in the legal battle—and is now helping the company make it so that Indian cancer patients would have to pay over $100,000 annually for treatment. Activists, including medical students at UCLA, have challenged the university for several years, thus far with no change.[15]

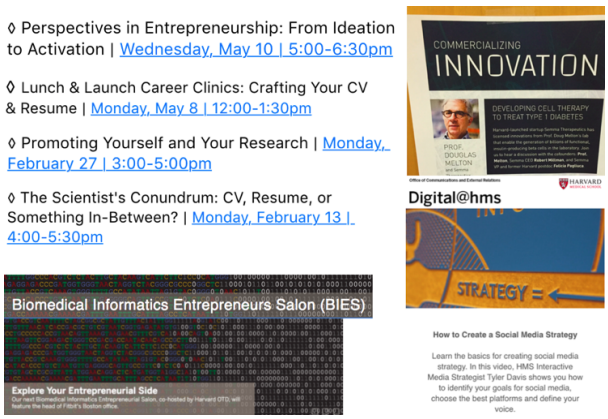

Fig. 1. What is on the menu in an entrepreneurial American biomedical campus?

An assortment of events and flyers from the Harvard Medical School campus. (Compiled by author)

How does this configuration work? What are the epistemic premises that underlie it?

The neoliberal vision—by now embraced by North American and European universities (see Fig. 1) —is structured around enterprises, as Foucault pointed out in the late 1970s. From that perspective, as Foucault put it so well, "What is a house if not an enterprise? What is the management of these small neighborhood communities if not other forms of enterprise?" Likewise, what is a university, or a laboratory, if not an enterprise? Foucault argued that this "multiplication of the 'enterprise' from within the social body" demands constant interventions. There is a need to perpetually create and defend markets, which is why a neoliberal society would be, as he claimed, a "judicial" society marked by legal conflict.[16] Regimes of intellectual property, of the kind UCLA helps maintain, grow as a result. In highlighting this interventionist aspect, Foucault anticipates today's common apologetics for neoliberalism, which sometimes conflate it with free market ideology and use the incoherence that results to deny the existence of neoliberalism altogether.[17]

Building substantially on Foucault, thinkers such as Philip Mirowski and Wendy Brown have distilled the neoliberal enterprise to two main epistemic ingredients.[18] First, there is the concept of *self-as-entrepreneur*: the individual as a builder of portfolios, whose worth is constantly re-evaluated on some imagined, ever-expanding market. I say 'imagined' because the boundaries and nature of this totalizing market are nebulous, left to the imagination of those bound by it, which gives neoliberal ideology its bankable disciplining effect. Second, there is the notion that centralized power (i.e., the state) must create the conditions for said market to make decisions. As Mirowski pointed out, neoliberal theorists such as Friedrich von Hayek believe this (supposedly) monolithic market to be a better judge than any person or human collective.

In the uncontrolled sprawl of enterprises, scientists too are expected to be entrepreneurs, to build portfolios consisting of publications, citations, patents, data sets, and software. Digital platforms are being introduced to evaluate and broadcast these portfolios in order to foster the sense of a neoliberal 'marketplace of ideas'. Examples of this abound in and around science. To take a recent case: neuroscientists from Brown University teamed up with MIT Press and Peter Thiel's foundation to form the DiscoveryEngine, described as "the first and only quantifiable measure of Discovery."[19] It is yet another, more computationally sophisticated metric for identifying, in real-time, those publications that are "actionable" and "change[s] your understanding of the subject." The metric is to be used by funders to rank individuals, institutes, and fields. Yet it is promoted as open and democratic.

Similar thinking is used by the National Institutes of Health (NIH), the largest sponsor of biomedical research in the world. The NIH has contemplated quantifying the so-called "return on investment" by measuring "citations per dollar" of funding given to individual scientists.[20] On this view, the state pours in dollars in order to maximize citation count as output—as if it were a macro-economic statistic like GDP. This fosters a mode of inquiry premised on an empty feedback loop whose only goal is to produce maximally citable products. The different interests, logics, and histories of scientific communities are erased.

This mode of inquiry would not be sustainable without propaganda, which is part and parcel of entrepreneurial science. It is produced by hybrid alliances across corporate media, university press offices, and scientific journals.

Consider, for example, the heated legal dispute between MIT and UC Berkeley over the patent to the genome-editing system CRISPR.[21] Whole wings of universities were recruited to a war of narratives over the rightful so-called 'inventors' of CRISPR. The dispute unfolded on social media, and the pages of *The Economist*, as much as in the courts. Arguments crafted by intellectual property lawyers flowed into the official social media accounts of universities. Science journalists regurgitated institutional narratives, but never scrutinized the premise that there is a rightful 'inventor' of CRISPR. The burning question was: does genome-editing belong to Berkeley or MIT?

The CRISPR affair may be exceptional in some respects, but the vehicles of propaganda surrounding it are not. Entrepreneurial science depends on a pipeline where publications in prestigious academic journals become university press releases and are then recycled as news by science journalists. The role of journalists is decisive, in fact, and merits attention. Dedicated science journalism is relatively recent: the *New York Times*, for one, did not have a science section until the 1970s. But from the start, science coverage was about raising public support for science. In 1894, H. G. Wells, the novelist and journalist, urged that science must be "popularized" in order to avert the "danger of supplies being cut off."[22]

Since then, the tightening links between mainstream media, universities, and scientific publishers have shaped a genre of scientific writing that caters to the entrepreneurial ethos. Under the heading of "Storytelling," for example, a variety of experts have come together to ostensibly tell scientists how to write better. "Scientific storytelling" offers a rather narrow notion of story, however. It is better thought of as a marketing discourse, concerned with crafting narratives that rise through the web of social media and 'glamour' scientific journals (like *Nature* and *Science*). Storytelling experts speak of concepts such as "narrative analytics" (see Fig. 2). Their advice is published in prestigious scientific journals and taught in science graduate programs. Journalists from the *New York Times* even teach elite scientists how to frame scientific projects in a form the press can run with. The most entrepreneurial of scientists cultivate such relationships.[23]

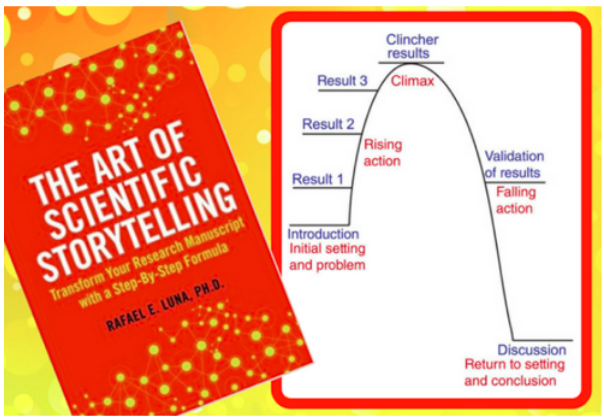

Fig. 2. What "storytelling" means to the emergent storytelling experts in biomedical science. Materials from *The Art of Scientific Storytelling* by Rafael Luna.

Just as elite universities like MIT and Harvard are not just universities but also real estate agents who own hotels, vineyards, and even timber plantations in New Zealand, *Nature* magazine is not just a scientific journal; it is also a full-blown media outlet on a continuum with CNN. And *Nature* magazine is not just a media outlet; it is also an advertising consultancy. Through a platform called *Nature Index*, the magazine ranks institutes and fields by elaborate metrics. For a fee, *Nature Index* will help organizations climb up the magazine's own rankings.

While fungible and mostly meaningless, metrics like these affect promotion and funding. This is how the mythic neoliberal market gets made tangible, at least partly. Some universities pay tens of thousands of dollars to faculty members per publication in a 'top-tier' journal, while others pay per citation. Metrics thus function as a glue for entrepreneurial science. They offer a loosely shared language for 'impact' across seemingly disconnected arenas: corporate media, corporate scientific journals, and academia. This approach bulldozes over differences across scientific communities and practices—for recognition of these differences would suggest that communities and social structures do exist—in an attempt to erect a totalizing 'marketplace of ideas'.

A curious contradiction thus emerged: actor-network theory, as described by Bruno Latour and colleagues, became part of the science curriculum. In other words, entrepreneurial scientists are consciously operating in a crudely Latourian frame. They openly write about getting the optimal 'story' out by using social networks and alliances, carefully tuning for the metrics. They teach the importance of considering hierarchies of authority in every step of research—from choosing the project, to writing the paper, and promoting it on social media.[24]

Yet, the same scientists also promote familiar fantasies of science as detached from politics. Consider the discourse around the March for Science, following Donald Trump's election in 2016. Initially, 'diversity' issues were part of the agenda, but even that came under attack. The prominent Harvard cognitive scientist and writer Steve Pinker declared on Twitter, "Scientists' March on Washington plan compromises its goals with anti-science PC/identity politics/hard-left rhetoric."[25] While there were important exceptions, the mainstream March for Science heeded Pinker's call. The March focused on what was deemed most important, like the threat of cuts to NIH's budget. In this way, entrepreneurial scientists portray themselves as shrewd participants in some type of Actor-Network, while also promulgating a vision of scientific inquiry as apolitical, disinterested, and even objective.

* * *

Entrepreneurial framing shapes the substance of scientific work, not just its infrastructure. As platform companies like Google and Facebook move more aggressively into academic biomedicine, they leave a significant imprint. Take for instance The Human Cell Atlas, one of the latest 'big science' projects, fashioned after the Human Genome Project. The Human Cell Atlas is funded by Silicon Valley moguls and capitalizes on their computational tools. But it is about more than just tools. The Human Cell Atlas describes itself as developing a "Google Maps" for the human body, a notion enthusiastically embraced by science writers (see Fig. 3).[26]

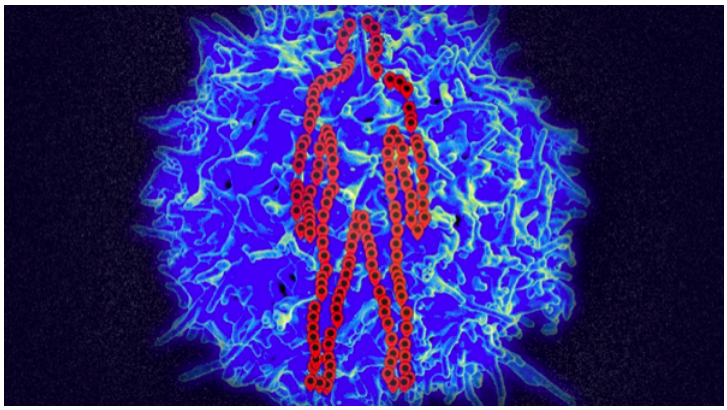

Fig. 3. “A Google Maps for the Human Body.” Source: Ed Yong, “A Google Maps for the Human Body,” *Atlantic* (October 14, 2016).

The Human Cell Atlas should be viewed as an imperial cartography of the body. The project thus exemplifies how a rich history of feminist theorizing about biology gets marginalized. The map metaphor employed by the Human Cell Atlas is essentially static and presumes a universal set of ‘cell types’ to be unearthed, and conquered, in positivistic fashion. Yet far richer, dynamic models for thinking about cells and organisms have been developed by feminist biologists and critics. Perhaps the most obvious here is Developmental Systems Theory, as articulated by thinkers such as Susan Oyama, Esther Thelen and Linda Smith, and Anne Fausto-Sterling.

Entrepreneurial biologists are generally unaware of, and sometimes poorly reinvent, this line of thinking. This is because their experiments are supremely guided by measurement techniques, like DNA sequencing, that can be scaled up to serve the growing commercial enterprise of so-called ‘precision’ and ‘personalized’ medicine. It is no wonder, then, that the same corporate-academic institutes that theorize this way about cells also produce the most reactionary science, which attempts to predict and explain all “traits”—including “same-sex sexual behavior”—by statistical association with bags of alleles, an approach that depends on the commodification of genomes and human behavior.[27]

* * *

What I have described so far can be seen through the lens of neoliberal epistemology, as interpreted by critics engaging with Foucault’s analyses, such as Philip Mirowski or Wendy Brown. On this view, academic work is essentially being restructured in the image of a mythic marketplace. And though this marketplace is an epistemic fiction, as these critics point out, it is a politically useful one, which is accompanied by real restructurings—from privatization of institutions to the use of various metrics and legal instruments to funnel inquiry down favored paths.

Compelling as they may be, there are traps in these forceful critiques of neoliberalism. First, these critiques put us to work as interpreters of neoliberal theorists like Friedrich von Hayek, George Stigler or Milton Friedman. In doing that work, we risk imbuing their project with a coherence that it in fact lacks. Second, in becoming expert critics of neoliberalism, we start to see it everywhere. Perhaps it begins to occupy our imaginations. Maybe some of us lose sight of real resistance, as Bonnie Honig has observed.[28] Maybe others, like the academics among us, begin to see themselves as enterprises. Is it not possible to turn even the critique of neoliberalism into one’s own successful academic enterprise?

I think that neoliberal epistemology does not need to be critiqued so much as *deflated*. The neoliberal framework—in which a singular market governs all decisions—is at best a madman’s aspiration. No space inhabited by human beings is fully neoliberalized that way. After all, to return to our main subject, what scientific insights have ever been obtained through ‘information-processing’ by ‘The Market’? None; it is a silly fabrication.

More importantly, even under neoliberal restructuring, scientific work is filled with acts that the historian Peter Linebaugh has called “commoning.”[29] Commoning is what makes resources available for collective use, a part of the potential commons. You can find commoning throughout scientific practice—from small things, like the way enzymes are organized in the freezers of molecular biology labs, to bigger systems of reagent and data sharing.

Even publishing, in its corporatized forms, is premised on commoning. Consider the labor that sustains Google Scholar—a platform that is not shy about presenting scholars as portfolios of publications, with citation counts and *h*-indices slapped on their foreheads. From the Google’s eye-view of the world, a trajectory of intellectual work, which produces some papers along the way, is merely a “citation graph”: a data structure that lists, for each paper, all the papers that it cites (each paper is a node and edges represent citation relations). Where does this graph come from? It is built by the people who write the papers and decide what to cite, and at least so far, there are no tolls for citing other people’s work (though entrepreneurs might try to change that). What appears in the impoverished graph representation is oftentimes the product of genuine curiosity and real impulses to share and engage (despite efforts to turn any digital platform into a noxious “Facebook for Science”).[30]

What about the papers, the nodes of the citation graph? The papers are in large part written by academics who are publicly funded. We know the fate of these papers. They will typically be submitted to journals owned by corporate publishers, where they will be delayed by middle management. Eventually, the papers will be peer-reviewed by other academics for ‘free’ (i.e., paid for by the public) and then placed by the journal behind paywalls where most people, and even most universities, could not afford to access them. The multi-billion-dollar publishing industry that steals these papers will then charge universities, libraries and other organizations exorbitant subscription fees, through a variety of journal ‘bundle’ deals and other swindles. People pay multiple times for the same work: pay to fund the researchers, pay to sustain and attend universities (so that universities can pay journal subscription fees), pay fees to the corporate publishers to access papers, and so on. Academic laborers who try to use the products of their own labor in ways unsanctioned by the corporate publishing apparatus will be criminalized.[31]

And what is the fate of the citation graph? It will be used by Google and others to compile another slew of metrics. Administrators at universities, non-profits and government agencies—many far better paid than the authors of papers—will then use these metrics to rank and judge individuals, projects, and institutes. The subjects of Google Scholar cannot access the data being used to judge them; Google relentlessly blocks any person or software that tries to download citations data in bulk. Furthermore, it is only companies like Google that have the money and legal leeway to slurp up the world's papers and assemble the citation graph. Thus, Google turns acts of commoning by intellectual laborers against them, using whatever resembles a 'commons' to build neoliberal infrastructures that surveil and discipline.

My broader point is that if acts of commoning were to stop, the scientific enterprise would collapse, as there would be nothing left for entrepreneurs to steal. The laboratory would collapse too, as the social bonds between laboratory members, crucial for its function, would erode. But neoliberal epistemology blinds us to commoning, partly because it only acknowledges two entities: the individual entrepreneur and the state. The former is a person that builds portfolios in accord with market signals, the latter a powerful entity that makes room for said market. No real collectives, including those that take shape in the laboratory, are admitted.

And yet, acts of commoning in the laboratory should not be confused with having robust commons. As Eugenia Zuroski pointed out, "Academic labor is, in general, multifaceted and every one of those facets is currently being exploited…by institutions."[32] The laboratory is in fact a prime site of exploitation. Principal Investigators ("PIs" as they are called) build little empires on the backs of students, postdocs, technicians and other workers who make scientific research possible. The most entrepreneurial laboratories produce so many papers that the PI cannot even read all of them. In the US and Europe, this process depends on graduate students and postdocs, a cheap and large labor force, while postdocs are increasingly given short-term contracts with few benefits.[33] The system is stacked in such a way that PIs can play dice with their subordinates' futures. Only a handful need succeed for the PI to thrive. The denominator rarely counts, so PIs can freely speak of "burning through postdocs" on the quest to build portfolios glittering with *Nature*, *Science*, and *Cell*.

The PI is therefore made in a patriarchal image, an employer with nearly unlimited powers over subordinates (although universities and funding agencies insist on characterizing the relationship as one of 'mentorship' and 'training'). Those who come to the US from abroad experience labor precarity in other ways, with PIs holding visas over their heads: perform quickly or lose your legal status.[34] The prevalence of sexualized violence in academia alone makes clear that what takes place on campuses, and by extension laboratories, goes on with little accountability.

In these conditions, science workers continually experience what Lisa Sigl has called "embodied anxiety," and, in an atmosphere that valorizes entrepreneurial portfolio-building, they also have more limited "epistemic freedom."[35] One can glimpse these conditions from the words of scientists:

> • "Seen from the outside, they were very successful…But nearly all students from this group were so disappointed, frustrated, drained after their PhD, that they all left science…To me, that is a very sad thing. And it is because their group leader [PI] pressured them so much, he kind of squeezed them like lemons"
>
> • "When I said I couldn't work 80 hours a week, he said I would never make it in academia"
>
> • "The pounding remained in my stomach, throat, and head throughout the day. My appetite disappeared. I cried each evening…I got less and less sleep, and nothing I did calmed my anxiety"
>
> • "All researchers are put in the same box somehow… it is so normative because… what counts is the amount of publications that you have and if you have been abroad or not"
>
> • "I don't want to sit alone somewhere right out in the sticks at a university and without my social environment. I personally need my social environment to somehow function…that's why an academic career is not right for me"
>
> • "I wish that my postdoc was still here. She used to supervise me and there is a good chance that she would know what to do now! But the university wouldn't let her stay; they don't want us to stay for too long"
>
> • "When you are the boss [PI] or when it is about money, the case is very clear: young people don't cost anything and they work twice as much as those who sooner or later, when they get older, start being more interested in private life"
>
> • "I don't want to…decide for this [academic career] path and [then discover]…there is no funding… What would I do then, right? Then I am… so specialized that no one can use me anymore. Really, what can I do then?"
>
> • "Because in a young scientific career you cannot speak of independence. In fact, we have a lot of it, not in the way we work but we have it, right?"
>
> • "The currency with which we are paid is completely weird… it's not about whether it was scientifically nice, whether it was something important in your field. It only counts how many publications you have, right? How many… points you have… We do so many other things too…[and] that's not considered at all…I can't really find my way around that"
>
> • "It's not good if a person in power [PI] is out of their fucking mind"

These are the cries of science workers.[36]

To carry on in these conditions, the entrepreneurial laboratory depends on gendered labor: the caring for peers in precarious states—labor that is not reducible to GDP-style metrics coined by entrepreneurs. This labor is of paramount importance in the US, where the facilities of even the wealthiest entrepreneurial universities cannot handle the mental health crises that pervade their campuses, notably at laboratories. For this reason, the testimonies of scientists are also punctuated by acts of care, real mentoring and collaboration.[37]

All the voices above might belong to the laboratory's uncounted denominator—those individuals who are used up and spat out, mostly without real consequences for PIs or institutions. They may also be the voices of those who later will be disciplined into compliance with, perhaps even embrace of, the entrepreneurial ethos, and go on to

preside over laboratories where others will suffer. Either way, my point is that these testimonies are not special. And the labor of these individuals, emotional and scientific, is crucial to sustaining laboratories and amassing portfolios that will preferentially benefit PIs. In the entrepreneurial science regime, however, this labor is systematically devalued and rendered invisible. And to be clear, we have mostly touched on the more privileged of science workers—scientists—not the even more precarious university cafeteria workers, animal facility technicians, glasswashers, and others, who are lower paid, given fewer benefits (often via privatization), monitored on an hourly basis, and whose labor is indispensable to laboratories and campuses.[38]

With this in mind, we can now come to a working definition. What is entrepreneurial science? It is the mode of inquiry that arises when you try to maximally exploit the available commons, while violently hindering acts of commoning.

* * *

What about resistance to entrepreneurial science? And what do prominent academic critics of entrepreneurial science have to offer in this vein?

There is no doubt that the self-as-entrepreneur holds a grip over academics, and it matters little if one's portfolio is enriched by writing articles and books about neoliberalism. Consider the book *Academic Capitalism* by Sheila Slaughter and colleagues. Building on Foucault, the book perceptively describes many of the trends discussed above. *Academic Capitalism* has been a great success by the standards of academic capitalism: with two distinct editions published under the same title, the book(s) accumulated a total of over 10,000 citations. And by way of resistance, *Academic Capitalism* merely offers us academic capitalism with a friendlier face. Perhaps, the authors suggest, universities should reinvest a portion of the revenue they make from patents back in activities like research or education.[39] Multiple layers of theft are naturalized once more. This is to say that critical scholarship on neoliberalism hardly implies resistance; it often nestles rather comfortably in the neoliberal university.

But the question of resistance is really a question about movements, not scholarship. It is hard to even begin to address it without considering the 1.5 trillion dollars of student debt in the US, hanging over the heads of some 44 million people. When people cannot afford health care, let alone education, concerns over academic science (like many of those I have expressed thus far) can seem detached and misplaced.

Resistance therefore demands that we expand our scope, as David Dickson had urged. Dickson aligned himself with groups such as Science for the People, who saw efforts to transform science as part of a global solidarity struggle to be pursued jointly with other social movements.[40] Any effort to change science, he wrote, would require challenging "the current distribution of wealth and power in U.S. society" and so this cannot be an inward-looking struggle that takes place just inside laboratories or universities.[41] Dickson also wanted activists to recognize that the conditions under which science is produced are entwined with the *substance* of the science. A science that is entrepreneurial in process will produce racist, gendered, and classed theories. That is why, as Dickson wrote, a movement to transform science would need to "democratize the laboratory."[42]

To Dickson's analysis, we can add that any such move that does not take seriously the roles of American universities in broader settler-colonialist projects is a non-starter. A certain whiteness oftentimes undergirds critiques of neoliberalism, though, and settler-colonialism throws a wrench in narratives of a sweeping and recent entrepreneurial turn at universities and other institutions. The university is entrepreneurial, to be sure, but its enterprising activities began much earlier, with (to give one example) land theft in the form of land-grants.[43]

This understanding draws us closer to Say's nineteenth-century world (and earlier), to his admiration of white colonists in America, and to seeing the dispossession of peoples and theft of lands as a primordial entrepreneurial activity. Taking commoning and the commons seriously can perhaps bring these processes into focus. Put another way, American universities acting as real estate agents and gentrifying forces is not the crescendo of a neoliberal symphony, written in the post-war period and belting out of speakers everywhere since the 1970s, but a foundational element—a condition that animates universities' existence and purpose. Moves to resist entrepreneurial science should be anchored in this recognition.

Openings for such moves present themselves unexpectedly, and sometimes surface even in mainstream media. For instance, they are visible in the recent media discussion of US Senator Elizabeth Warren's quest to "prove" her Native American identity with DNA testing, or the Trump administration's efforts to erase transgender identity by appeal to an 'objective' birth sex.[44] Both are enabled by long-standing racialized and gendered biomedical science. Perhaps when rejection of the imperialist substance of such science is more fully linked to the exploitative conditions in laboratories and universities, and their settler-colonialist present and past—and when alternative visions of scientific practice, which reject entrepreneurial science's empty feedback loops, are collectively imagined–then the scientific enterprise could be transformed.[45]

But in the meantime, recall Harney and Moten's adage: "It cannot be denied that the university is a place of refuge, and it cannot be accepted that the university is a place of enlightenment." Their next sentence is less polite: "In the face of these conditions one can only sneak into the university and steal what one can."[46]

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1. For Shapin, the scientific entrepreneur is "the sort of person who *takes risks* in commercializing knowledge that they themselves or others have produced" [italics mine]. Steven Shapin, *The Scientific Life: A Moral History of a Late Modern Vocation* (Chicago, IL: University of Chicago Press, 2008) 210. Shapin's book is littered with techno-utopianisms, e.g., "The closer you get to the leading edges of technoscientific change, the greater the degree of normative uncertainty…Will there be a market for a product that is not an improved

razor blade—which people are reasonably believed to want—but a disruptive technology that is substantially new thing in the world, that people at the time of an investment decision do not *know* they want?" Steven Shapin, *The Scientific Life,* 269.↩

2. As Shapin puts it, "Business is business…well-networked people tend to do better than poorly-networked people, but the networks… don't seem to have much to do with traditional 'old boy networks' based on religion, school, and parental wealth." Shapin, *The Scientific Life,* 310. Shapin also states that scientific entrepreneurs "make a lot of money, for themselves, for investors, and for the city and region whose tax rolls benefit from the high-paying jobs and the activities they produce" (306).↩

3. Genentech funded UCSF's campus later as part of a legal settlement.↩

4. Justin Gillis, "20 Years Later, Stolen Gene Haunts a Biotech Pioneer," *Washington Post*, May 17, 1999.↩

5. "The list of recent scholarly and journalistic writings complaining about these, and other aspects, of academic scientific entrepreneurship, and the commercialization of the American research university is very large." In this footnote, Shapin references works by authors such as Sheldon Krimsky, Sheila Slaughter, and Philip Mirowski.↩

6. See for instance: Peter Galison, "Introduction: The Context of Disunity," in *The Disunity of Science: Boundaries, Contexts, and Power*, eds. Peter Galison and David J. Stump (Stanford, CA: Stanford University Press, 1996), 1-36.↩

7. Stefano Harney and Fred Moten, *The Undercommons: Fugitive Planning and Black Study* (Wivenhoe: Minor Compositions, 2013), 26.↩

8. "Entrepreneurship," *The Economist*, April 27, 2019. The term "entrepreneur," as Say uses it, has been translated into English as "adventurer" or "undertaker." Of the entrepreneur, Say wrote: "He is the link of communication, as well between the various classes of producers, one with another, as between the producer and the consumer. He directs the business of production, and is the centre of many bearings and relations; he profits by the knowledge and by the ignorance of other people, and by every accidental advantage of production." Jean-Baptiste Say, *A Treatise on Political Economy: Or, The Production, Distribution & Consumption of Wealth* (New York, NY: (1803) 1971), 332. The concept of entrepreneur is older than Say, but in the interest of space and focus, I will not attempt a proper genealogy here. My apologies to Étienne Balibar for this admitted gap.↩

9. Much like liberal political thinkers such as John Locke, Say is often painted as a staunch abolitionist and opponent of colonialism. For a different view, see: A. Plassart, "'Un Imperialiste Liberal'? Jean-Baptiste Say on Colonies and the Extra-European World," *French Historical Studies* 32 (2009): 223–250.↩

10. Jean-Baptiste Say, "To Thomas Jefferson from Jean Baptiste Say, 2 November 1803," *The National Archives: Founders Online,* https://founders.archives.gov/documents/Jefferson/01-41-02-0486.↩

11. Charles A. Tuttle, "The Entrepreneur Function in Economic Literature," *The Journal of Political Economy* 35 (1927): 501–521.↩

12. David Dickson, *The New Politics of Science* (The University of Chicago Press, 1984), p. 47.↩

13. See: Sergio Sismondo, "Ghosts in the Machine: Publication Planning in the Medical Sciences," *Social Studies of Science*, 39.2 (2009), 171–98; Philip Mirowski, *Science-Mart: Privatizing American Science* (Harvard University Press, 2011).↩

14. Noam Chomsky, "Free Trade," Excerpted from *Secrets, Lies, and Democracy* (1994), https://chomsky.info/secrets03/.↩

15. Alexander Zaitchik, "Why Is UCLA Doing Big Pharma's Dirty Work in India?," *AlterNet* (March 28, 2018), https://www.alternet.org/2018/03/ucla-big-pharmas-dirty-work-india/.↩

16. Michel Foucault, *The Birth of Biopolitics,* 148. "The more you multiply enterprises…and the more you force governmental action to let these enterprises operate then of course the more you multiply the surfaces of fiction between each of these enterprise, the more you multiply opportunities for disputes, and the more you multiply the need for legal arbitration. *An enterprise society and judicial society… are two faces of a single phenomenon*" [italics mine] (149–50). ↩

17. On these denials, see: Philip Mirowski, "The Political Movement That Dared Not Speak Its Own Name: The Neoliberal Thought Collective Under Erasure," September, 2014, 1–31. ↩

18. Wendy Brown, *Undoing the Demos: Neoliberalism's Stealth Revolution* (Zone Books, 2015); Mirowski, *Science-Mart: Privatizing American Science.*↩

19. "Home," DiscoveryEngine, http://www.thediscoveryengine.org/.↩

20. Yarden Katz and Ulrich Matter, "Metrics of Inequality: The Concentration of Resources in the US Biomedical Elite." *Science as Culture* (2019): 1–28.↩

21. For background on the battle for CRISPR patents, see: Yarden Katz, "Who Owns Molecular Biology?," *Boston Review* (October 28, 2015).↩

22. H.G. Wells, "Popularizing Science," *Nature* 50 (1894): 300–301.↩

23. The Broad Institute of Harvard and MIT, for instance, hosts an annual "Media Boot Camp," described by the institute as a program where "Ahead-of-the-curve journalists will engage with ahead-of-the-curve scientists to imagine possible future storylines and build relationships. The program format will include presentations, discussions, and lab tours." "2020 Media Bootcamp Now Accepting Applications," Broad Institute, last modified March 28, 2019. https://www.broadinstitute.org/journalists/2020-media-boot-camp-now-accepting-applications.↩

24. Several perceptive commentators have long ago diagnosed the neoliberal epistemology and politics that undergird Latour's work and that of related STS scholars. Their conclusions became clearer to a broad audience, it seems, when Latour began writing on climate change and ecological crisis. For instance, see: Dayton Martindale, "Nature Defends Itself," *Boston Review* (July 9, 2018). ↩

25. Azeen Ghorayshi, "Bill Nye And The Science March's White-Dude Drama," *BuzzFeed* (30 March 2017).↩

26. Ed Yong, "A Google Maps for the Human Body," *Atlantic* (October 14, 2016).↩

27. To see what I mean by 'reactionary', it is worth considering the conditions that enabled the research described in a recent *Science* magazine article against the background of work published almost twenty years earlier: Anne Fausto-Sterling, *Sexing the Body: Gender Politics and the Construction of Sexuality* (Basic Books, 2000); Andrea Ganna and others, "Large-Scale GWAS Reveals Insights into the Genetic Architecture of Same-Sex Sexual Behavior," *Science* (2019). ↩

28. Bonnie Honig, *Public Things: Democracy in Disrepair* (New York City, NY: Fordham University Press, 2017).↩

29. Peter Linebaugh, *Stop, Thief!: The Commons, Enclosures, and Resistance* (Dexter, MI: PM Press, 2013).↩

30. Philip Mirowski, "The Future(s) of Open Science," *Social Studies of Science*, 48.2 (2018): 171–203.↩

31. See: "The Cost of Knowledge" campaign (thecostofknowledge.com); Michele Catanzaro, "Colombian Biologist Cleared of Criminal Charges for Posting Another Scientist's Thesis Online," *Nature* (May 24, 2017).↩

32. Zuroski writes: "It's likely our understanding of labor has helped you better understand your own unexpected experience of being overworked or undervalued. We know what it's like, and what it means, to work hard in ways that are invisible to those who benefit from our work. We forged the arguments for emotional labor, for affective labor, for intersectional vigilance, for the material duress of what the institution considers ineffable. The academy has manufactured a state of crisis that means we all (well, almost all) must work harder for less and you welcome our insights, to the extent that they resonate with your experience—we seem to have things to say about this. We have learned the importance of holding one another up, and are skilled in recognizing when someone needs that support." Eugenia Zuroski, "Holding Patterns: On Academic Knowledge and Labor," *Medium* (April 5, 2018), https://medium.com/@zugenia/holding-patterns-on-academic-knowledge-and-labor-3e5a6000ecbf.↩

33. For the tip of the iceberg, see: Paula Stephan, "How to Exploit Postdocs," *BioScience* 63.4 (2013): 245–46. See also the rise of postdoc unions at various US universities: Colleen Flaherty, "The (Possible) Postdoc Union Boom," *Inside Higher Ed* (October 31, 2017). ↩

34. Editorial, "Stop Exploitation of Foreign Postdocs in the United States," *Nature* (October 21, 2018). When the influx of certain cheap academic labor is thought to compromise US state interests, though, visa regulations can tighten: Jeffrey Mervis, "Stricter Chinese Student Visas Raise Alarm," *Science* 360 (2018): 1161.↩

35. Lisa Sigl, "Embodied Anxiety: On Experiences of Living, Working and Coping with Conditions of Precarity in Research Cultures of the Academic Life Sciences," PhD Diss., Universität Wien, 2012, http://othes.univie.ac.at/22788/; Ruth Müller, "Racing for What? Anticipation and Acceleration in the Work and Career Practices of Academic Life Science Postdocs," *Forum: Qualitative Social Research* 15.3 (2014).↩

36. These testimonies were quoted from: Maximilian Fochler, "Variants of Epistemic Capitalism: Knowledge Production and the Accumulation of Worth in Commercial Biotechnology and the Academic Life Sciences," *Science Technology and Human Values*, 41.5 (2016): 922–48 (p. 934); Azeen Ghorayshi, "He Fell In Love With His Grad Student — Then Fired Her For It," *BuzzFeed*, 17 January 2016; Alyssa Rudelis, "How MIT Makes Work-Life Balance Impossible," *The Tech*, 26 September 2019; Lisa Sigl, "Embodied Anxiety," August, 2012, 1–235 (p. 76,81,3,90,82,83,114); Ghorayshi, "He Fell In Love".↩

37. Jeff Rosenberg, Sarah Cowles, and Nick Selby, "Graduate Student Mental Health Is in Crisis," *The Tech* (October 10, 2019). As Lisa Sigl describes, there is a "*collective mode of coping to be the often invisible and unrepresented practices of commonalising – i.e. sharing – resources amongst the lab collective according to the rationales of mutual support and reciprocity that is experienced as largely egalitarian. They build on social negotiation processes by providing individual skills and tacit knowledge to the lab collective. Protection is – primarily – granted by self-organised solidarity"* [italics in original] Sigl, *Embodied Anxiety*, 142. As one of Sigl's interviewees stated, "I still have people…with whom I can utterly exchange…it is often the case that I go to a colleague and say: 'It doesn't work for me. How are you doing that?' Or: 'Can you do that for me? I am desperate and give up, because I just don't get it right.'…I think that's crucial" Sigl, *Embodied Anxiety*, 71. One can find more of this in the unglamorous acknowledgment pages of academic works, or in the conversations that take place in labs, sometimes late into the night and definitely outside the gaze of the PI (or even intrepid science and technology studies scholars).↩

38. These are also the workers who have staged some of the most important protests for better wages and conditions around campus; for instance, see: Jessenia N. Class, "The HUDS Strike: A Year in Review," *The Harvard Crimson* (October 9, 2017); Sarah Leonard and Rebecca Rojer, "Housekeepers Versus Harvard: Feminism for the Age of Trump," *The Nation* (March 8, 2017).↩

39. Slaughter and Rhoades write: "the educational mission of higher education could be reinvested in by judicious use of the proceeds from intellectual property" Sheila Slaughter and Gary Rhoades, *Academic Capitalism and the New Economy: Markets, State, and Higher Education* (Johns Hopkins University Press, 2004), 337. For a similarly sad example, see the so-called "Leiden Manifesto": Diana Hicks, Paul Wouters, Ludo Waltman, Sarah de Rijcke, and Ismael Rafols, "Bibliometrics: The Leiden Manifesto for Research Metrics," *Nature* (April 22, 2015).↩

40. For background on Science for the People and their alliances with groups such as the Young Lords, see: Sigrid Schmalzer, Alyssa Botelho, and Daniel S. Chard, *Science for the People: Documents from America's Movement of Radical Scientists* (Amherst, MA: University of Massachusetts Press, 2018).↩

41. David Dickson, *The New Politics of Science* (Chicago, IL: The University of Chicago Press, 1984).↩

42. "Democratizing the laboratory" would, I think, necessarily require contesting the nature of the traditional laboratory, and examining engagements with science that take place outside those space. See for instance: Britt Rusert, *Fugitive Science: Empiricism and Freedom in Early African American Culture* (New York City, NY: NYU Press, 2017).↩

43. For a thoughtful discussion of this and much more, see: la paperson, *A Third University Is Possible* (Minneapolis, MN: University of Minnesota Press, 2017).↩

44. See Adrienne Keene, Rebecca Nagle, and Joseph M. Pierce, "Syllabus: Elizabeth Warren, Cherokee Citizenship, and DNA Testing," *Critical Ethnic Studies* (December 19, 2018), http://www.criticalethnicstudiesjournal.org/blog/2018/12/19/syllabus-elizabeth-warren-cherokee-citizenship-and-dna-testing. ↩

45. I am thinking here of Robin Kelley's *Freedom Dreams* and its basic question: "What are today's young activists dreaming about? We know what they are fighting against, but what are they fighting for? These are crucial questions…Revolutionary dreams erupt out of political engagement; collective social movements are incubators of new knowledge." Robin D. G. Kelley, *Freedom Dreams: The Black Radical Imagination* (Boston, MA: Beacon Press, 2002), 8. What would the liberatory surrealist-feminist visions that Kelley so beautifully highlights mean for scientific practice?↩

46. Stefano Harney and Fred Moten, *The Undercommons*, 26.↩