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Forgotten Histories of DIYbio, Open, and Citizen Science: Science of the People, by the People, for the People?

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Introduction

The rise of makerspaces and hackerspaces in 2007 was followed by a surge of open, citizen, and community science projects which enabled public around the world to gain direct access to various tools, laboratory equipment, protocols, and technical know-how. These means of scientific and technological production, previously limited to corporate R&D institutes and university laboratories, suddenly became democratised, literally “open” (Pearce 2012) and available even in the Global South (Kera 2015). Instead of only serving scientific innovation and economic growth, science and technology became a means for political, activist, and equally for highly personal and idiosyncratic projects (Kera 2017).

DIY (Do-It-Yourself) and DIWO (Do-It-With-Others) tools, spaces, and projects make scientific and technological interests and knowledge a personal and political matter. They align epistemic, ontological, and scientific explorations and know-how with normative interests. Rather than using science solely to pursue discovery or serve industry, these movements emphasise the diverse publics that can utilise science to embrace various goals related to engagement, governance, knowledge, justice and divides. They strive to democratise or even decolonise science and technology (Boisselle 2016; Wylie et al.

2014; Egert and Allen 2017; Kera 2014b), acknowledge indigenous knowledge (Kera 2012a; Sillitoe 2007) or at least to increase reproducibility and engagement in science in various parts of the world (Seyfried, Pei, and Schmidt 2014; Pearce 2014).

The surge of DIY or DIWO projects, tools, and spaces is often discussed as a continuation of the Whole Earth Network counterculture movement (Davies 2018; Toombs 2017; Turner 2006) which deflated in the 1980s into Silicon Valley myth about disruptive start-ups solving all world problems. We can follow a similar dynamic in the case of the DIYbio movement which embraces bio-entrepreneurship and betrays the political agenda of the open and citizen science goals (Delfanti 2013, 2014; Tocchetti 2012; Söderberg and Delfanti 2015). Instead of discussing this neoliberal “demise” of the counterculture movement morphing into “California ideology” (Barbrook 2007), we will emphasize that such movements are also heirs to the 1970s calls for the personal to become political (Crow 2000), which are equally important for understanding their past and present ambiguity (Meyer 2015, 2013).

In this paper, I will step back from the aspirations of the DIY and DIWO movements, and the related critique of their Californian beginnings and neoliberal ends, to discuss the forgotten origins

of our attempts to make science more inclusive and responsive to personal and community needs. The genealogy of our pursuit for democratic and socially engaged science goes back to the late 18th century Jacobin calls for patriotic science, and offers a cautionary story on the clash between the moral, aesthetic and natural orders. The rift between contemporary ‘mainstream science’ and the DIY movements revives this tension that emerged in the

The personal is political, scientific, and technical

Sometime around 2009, early DIY science activities by individual hackers and makers rapidly evolved into movements described in literature as DIYbio, open biology, garage biology, fringe biology, bio-hacking, grassroots science, etc. (Seyfried, Pei, and Schmidt 2014; Kuznetsov et al. 2012; Kera 2014a; Landrain et al. 2013; Vaage 2017; Wolinsky and Wolinsky 2009; Ledford 2010). Practices such as fermentation, building of open science hardware (microscopes, PCRS, microfluidic plates), or engaging with Synthetic Biology and later CRISPR kits became common in makerspaces and hackerspaces around the world. These DIY science activities led to the idea of developing independent citizen and community science labs exclusively dedicated to these pursuits.

The emphasis on open source tools and collaborative practices offered an alternative to professional, academic and normalised science as practiced in universities and corporate R&D labs. Instead of pursuing a purely scientific agenda or applied research that serves industry, these emerging practices and spaces mobilised new narratives and ideas about the purpose of science, emphasising the issues of engagement, governance, knowledge, justice and divides. While the critique of the neoliberal agenda of biohackers as bioentrepreneurs is well covered (Meyer 2015; Delfanti 2013, 2014; Tocchetti 2012),

18th century as a reaction to the age-old discussions between atomism and stoicism, between our curiosity for nature and passion to improve society and define some meaning to human existence. Instead of offering a final verdict on the role of science and technology in society, or politics in science, the DIY and DIWO movements provoke us to question and rethink the value of knowledge, autonomy, freedom, and justice on new grounds.

the aspirations of the open and citizen science activist are usually admired and supported (Kera 2015, 2012a), but as I will argue, for the wrong reason.

We admire open and citizen science practitioners because they strive to democratise or even decolonise science, acknowledge the values of indigenous knowledge or at least increase the reproducibility and engagement in science in various parts of the world (“Global Open Science Hardware (GOSH) Manifesto” 2016). Their curiosity about nature follows closely the goals of improving society through inclusivity, diversity, justice, and creativity. They also support current science policy agendas (Kera 2014b), such as responsible research and innovation (RRI)(de Jong, Kupper, and Broerse 2016; Pellé 2016), and anticipatory governance of emerging science and technology (Nordmann 2014; Davies and Selin 2012; Guston 2014).

I argue that the problem with these aspirations is that they will be prone to populist excess if they do not reflect the earlier forgotten populist attempts to bring science and technology closer to the community. The genealogy of the pursuit of democratic and socially engaged science includes the cautionary tale of the populist Jacobin misuse of science. This episode paradoxically confirms the importance of exploratory and non-utilitarian research at the core of independent science and technology practices.

The exploratory research in “artisanal science” (Kera 2017) depends on the use of crafts to support science as a personal and leisurely activity with an open agenda in terms of its community values and goals.

Artisanal science describes creative, unexpected and non-utilitarian uses of science protocols in the private and everyday lives of citizens, which create conditions for both good science and politics. Here I will contrast the term against the dangers of anti-science and pro-science populisms that refuse to connect facts and values, or insist on only one

Jacobin science by the people for the people

The ambition to make science more responsive to community needs has a problematic history going back to the infamous Jacobin attack against the “unpatriotic” atomist science during the French Revolution. This offensive led to the public execution of Antoine Lavoisier, the father of modern chemistry, and the creation of the infamous law of August 8th 1793, that abolished the learned academies of France as incompatible with the republic. The Jacobin search for a “moral and human” use of science is echoed in many contemporary sentiments and calls for publicly useful and engaged science that supports jobs and various patriotic agendas.

The main problem for the Jacobins were the “inhuman” atoms, which did not care about society or “polity”, nor presented nature as a model in line with human ideals of social justice, good life or community. The violent history of this longing for unity between facts and values is well summarised in the seminal 1957 article by the historian of science, Charles Coulston Gillispie (Gillispie 1959). He discusses the abolishment of the French Academy of Sciences (Académie Royale des Sciences) by Jacobins in 1793 as a result of a clash between the ideals of virtue (political action) and the knowledge of

proper way of connecting emancipatory goals with facts and knowledge. The non-utilitarian, artisanal science is pluralistic and experimental in terms of how to connect values and facts. It insists on the freedom for everyone to probe and decide on how the personal will become political and scientific. Instead of technocratic and anti-scientific excesses, it gives an opportunity to reflect upon how science serves various political and social agendas, and sees this as a part of an older issue and clash between our moral, aesthetic, and natural orders and aspirations.

nature going back to the Stoic and Atomist discussions. The Jacobins shared the Stoic sentiment that nature and morality should mirror each other, and rejected the Atomist knowledge of nature as indifferent to human ideals and norms, as evidenced by Lavoisier’s new chemistry.

The populist call for science to serve the needs of the common man was also inspired by Jean-Jacques Rousseau’s idea of an original “state of nature”, representing an ideal and natural community to which we need to return. Coupled with Denis Diderot’s embrace of craftsmanship as the model for meaningful scientific work, it led to the rejection of any knowledge that does not immediately serve societal needs, translate into something patriotic and useful, or understandable by the masses. The atomised and mathematised Newtonian universe, that inspired Lavoisier’s chemistry, ignored and even problematised the political view of a harmonious nature and a crafts-based science serving humanity. The biblical purpose of a universe created for humans in Jacobin “science” was challenged by emerging scientific insights into fragmented molecules and atoms that serve no teleological nor even immediate practical goals.

The nature of atoms, which was perceived to be fragmented and unintentional, did not offer any immediate benefits to humanity nor did it give any ideas on how to govern society. This provoked the Jacobins to label Lavoisier as a representative of an un-patriotic science that threatened the social fibre of the new Republic as this pinnacle of historical development and natural perfection.

Jacobin sentiments are the predecessors of contemporary views that consider applied research

Facts and values in DIY science and anti-science populism

DIY, open and citizen science movements bring science to some unexpected venues outside of the disciplined work done in laboratories or policy offices where people improve the knowledge of nature or develop regulations for society. Generating knowledge and experimenting with nature within DIY science movements go hand in hand with various aesthetic, artistic and personal explorations of materials in nature, but also ethical, social and political dilemmas and agendas (Kera 2017). In this sense, the emancipatory calls for open, citizen, etc. science are a continuation of the 1970s calls for the personal to become political, but we must be careful about the excesses.

Epistemic, ontological, and scientific explorations are always aligned with normative and personal interests and projects in the intricate and complex relationship between the worlds of atoms (molecules) and humans, facts and values. The tension between the knowledge of nature and our aspirations for good life or justice, goes back to the Atomist and Stoic debate on the indifference of the universe comprised of disorderly atoms and the moral agency of the individual and society (Edmunds 1972; Atomism n.d.). While Atomists insisted that the random swerve of atoms and reality oblivious to human struggles will never provide

as a responsible way of spending public money. The current maker and DIY scene's engagement with craftsmanship also shares similar ideas, which is the reason why we need to be aware of their violent history. The Jacobin example offers a cautionary tale of how defining good science through civic virtue and what serves the Republic can lead to tyranny and inhumane politics, but also bad science.

any reason for social order and meaning, the Stoics insisted on a nicely arranged universe that reflected and confirmed our ethical and social aspirations and biases.

The current crises of legitimacy and trust in expert knowledge, and the rise of populist movements, are just an incarnation of this old conflict. Scientific and technological knowledge simply do not lead to social and political change, such as response to climate change, or improvements in human character. Change is a result of choices we make as responsible individuals or societies, after considering not only knowledge and facts but also our values and goals. The anti-scientific, religious and sceptical movements are problematic, not because they question scientific facts, but because they turn legitimate concerns into conspiracy theories. The issue is not that all facts come with some form of agendas and values, but that we are witnessing a flood of agendas without any facts or even an elementary interest in the world outside of human will.

The misuse of science and technology by various regimes in the 20th century (Wolfe 2018) forces us to move beyond the enlightenment idea and technocratic beliefs that more knowledge and data guarantees progress or gives us a blueprint for action. The anti-scientific alternative, refusing

all facts and insisting on populist ideas of social actions and moral values, ignores another important enlightenment period lesson: animosity towards science feeds dictatorships. The insistence on an absolute autonomy of knowledge and the prioritisation of some absolute or sacred values both support populist excesses. The present DIY, open and citizen science movements offer a foundation for realising how this happens, and how experimenting with the various ways we bring together facts and values can help us resist populist and technocratic excesses.

Modernisation of politics and science

How to connect our pursuit of knowledge with our social and personal values? How can scientific discoveries serve societal and personal improvement? The Jacobin's search for patriotic science led to populist and anti-scientific sentiments, but what came after the Reign of Terror efficiently enslaved science to serve the political ideology of the state, and it still persists in the present problems that provoke to the populist backlash against experts.

The "modernisation of politics and science" during the Second Republic or rather Empire (under the "president" Louis-Napoléon Bonaparte 1848–1851) led to the creation of a bureaucratic apparatus that still defines how we manage science nowadays. Science simply lost its autonomy and became a servant of the colonial and imperial project:

the central feature of this modernization was conversion of subjects of a monarchy into citizens of a republic in direct contact with a state enormously augmented in power. To the scientific community, attainment of professional status was what citizenship was to all Frenchmen in the republic proper, namely the license to self-governance and dignity within the respective contexts. Revolutionary circumstances set

Attempts to resolve the tension between facts and values, epistemic and normative ideals of objectivity, transparency, autonomy, freedom and participation, must acknowledge this messy history before legitimising or even institutionalising any practices or movements. We need a middle ground from where to explore the plurality of the ways in which we bring together facts and values, atoms and human agency, and science with personal and communal values.

up a resonance between politics and science since practitioners of both were future-oriented in their outlook and scornful of the past. Among the creations of the First French Republic were institutions providing the earliest higher education in science. From them emerged rigorously trained people who constituted the founding generation in the disciplines of mathematical physics, positivistic biology, and clinical medicine. That scientists were able to achieve their ends was owing to the expertise they provided the revolutionary and imperial authorities in education, medicine, warfare, empire-building, and industrial technology. (Gillispie 2004)

We are still heirs of this modernisation of science that transformed the independent academies of science into educational and research institutes organised by the state to serve the state ("That scientists were able to achieve their ends was owing to the expertise they provided the revolutionary and imperial authorities in education, medicine, warfare, empire-building, and industrial technology"). The present calls for more applied research, that creates jobs and brings innovation to society, but also the naive embrace of emancipatory science of

any kind that will improve the “world”, only repeat these attempts to reconcile facts and values, atoms and human agency or social institutions, between the tyranny of the Jacobins and Napoleon. The insistence on national or community goals creates very little space for truly independent science that can radically question and challenge both facts and values. Just like the technocratic calls for politics to become more scientific, the forced unity of atoms and human agency, facts and values, lead to new forms of dictatorship.

DIYbio, open and citizen science’s search for independent laboratories and practices reminds us that autonomy matters; we as citizens and researchers are the heirs to a complicated history of bringing together values and facts. Atomism and science were independent and autonomous endeavours until the 18th century. They were not bound to serve state institutions – and that seems to be lost today. It was exactly this autonomy that enabled these old institutions to come up with new entities

DIY, open and citizen science as catharsis

DIY, open and collaborative practices question this status quo that is a result of the Jacobins violence and post-Napoleonic modernisation of science and society/state relations (bureaucratisation). These new movements can make science independent again and help preserve its status of ontological “disobedience” (Woolgar 2004, 2005): acting as a probe into the non-human world and reality beyond our social and personal expectations, norms and ideas. In this sense, the DIY, open and citizen science should strive to preserve, rather than resolve, the Atomist and Stoic tensions. Instead of reconciling natural, metaphysical, human and political orders, it should make them more visible for people to experience their complex relations and history.

and cosmologies which questioned the teleological and theological interpretations of the world that were part of the feudal system and later monarchies. They indirectly enabled new political and social projects to arise, because they questioned the basic cosmology behind the Christian church and the kingdom.

It is a paradox that the radical autonomy of science that changed society and politics, ultimately ended with the enslavement of new science to continue serving modern states. Is there any alternative to the anti-scientific Republic and the “scientifically” modernised post-Napoleonic regime? Should we insist on keeping science and human values separate? Where do the open and citizen science practices stand in this genealogy of bringing science closer to society? Are we in danger of becoming Jacobins if we search for socially responsible, decolonised or even artisanal science? Should we accept the status quo between science and state institutions, and only improve their mutual checks and balances?

Movements to democratise open science today are cathartic rather than transformational, revolutionary, or reformist. They are communal rather than institutionalised, which allows them to maintain a critical distance to history, the present power structures, and to experiment with new arrangements between facts and values. They are different from official science, but also from the fringe experiments of bioart or science in art (Bureaud, Malina, and Whiteley 2014; Kera 2014a) which have a more elitist connection to contemporary art. Bioart experiments and various creative attempts at science communication also democratise science and support the public participation of citizens, however not as direct engagement but rather a PR tool serving an agenda coming from the outside.

The niche group of bioartists, artists and designers of all kinds who work and collaborate in science labs or move science into the galleries, produce very provocative and inspiring works, but they also preserve the institutional status quo and divisions. They remain elitist (not sharing the tools and spaces of production) even when they try to bring science to the people.

The nascent movement of citizen scientists and DIY makers offers us an opportunity to rethink the history behind our attempts to bring science closer to society; recognise it as something personal and political that simultaneously depends on direct and material engagement. Everyone is invited to experiment and define their own community or project, which connects atoms or similar non-human entities with human interests, values, and institutions. By building open science hardware instruments, opening independent science labs, gathering and sharing data about biohacking experiments on bodies and environments, we connect science with the everyday lives, diverse interests, and hobbies of the citizens. Instead of gaining privileged access to science labs, equipment, and protocols and moving them to galleries, citizen scientists and tinkerers

Summary

DIYbio, open and citizen science movements can remain authentic only if they work as catharsis rather than some entrepreneurial revolution or communal dream. Science catharsis happens every time we perform and relive the history of science and society interactions, through various experiments and workshops, rather than when we claim new revolutions, institutions, and visions about the future. It is essential to stay open and constantly explore how to connect the pursuit of a more just and open society with the pursuit of knowledge.

or science artisans demand open access to articles, tools, and data that can turn the whole world into a lab with a social rather than only scientific agenda.

The insistence of these new movements on open-ended and collaborative research, rather than finished and well presented (art)works with strong authorship, is visible in their preference for workshops, alternative and even mobile labs, making, hacking, and open-ended DIY research (Kera 2012b, 2014b). They support the educational and communicational goals of science or the aesthetic and critical explorations of art, whilst remaining open to a variety of idiosyncratic and personal projects and ideas. They raise new questions about inclusivity, knowledge and cognitive justice that are rather neglected by most bioart projects. Instead of philosophical and post-humanist concerns, they examine specific issues with science and society interaction, including calls for decolonisation, indigenous and grassroots science. This makes the new movements also very vulnerable in terms of repeating the mistakes of Jacobins’ patriotic science or finding even more insidious ways to bureaucratised and “modernise” science.

Claiming to have some large impact on society or science (democratisation, decolonisation, etc.) is actually less important than preserving and experiencing the possibility of science becoming personal and political again for small groups and collectives. These enactments and performances of the struggle for autonomy of science outside its social, political and historic roles and constraints, are probably the most interesting and inspiring (cathartic) aspects of these new movements.

The comical forms of comparing cooking to science practices, home fermentation to synthetic

biology experiments, or some symbolic performance of power or magical thinking with instruments and data may look like a science “cargo cult,” but they are a form of catharsis and empowerment. They extend the possibility of transparency, public oversight, but also creativity and leisure, to science protocols, data, and tools. They make the personal scientific and technological, embrace the ambiguity and uncertainty around facts and values, atoms and institutions. They are what Steve Woolgar calls “ontological disobedience” (Woolgar 2005), which contrasts with the more common view of research and community interactions of Polanyi’s “community of explorers” (Polyani 2009).

Disobedience, a commitment “to be constantly unsettling, challenging, destabilizing but with no specific end in mind” (2005, p.314), is a property that Woolgar attributes to humans while Polanyi perceives it more as an ontological quality of nature which the “community of explorers” knows how to master. Polanyi is very skeptical of “moral” disobedience, which he attributes to existentialism and nihilistic philosophies, that are trying to apply

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scientific rigor to matters of human nature and society. Connecting these ontological and social meanings of disobedience seems to be the main issue in our struggle to bring moral, aesthetic and natural orders into equilibrium.

While Woolgar’s notion of “ontological disobedience” is not “ontological” enough, Polanyi’s “community of explorers” is too socially conservative and restrictive. Woolgar ascribes agency and decision making to humans in the social realm, while Polanyi would like to keep such freedom to question and experiment only in the realms of science. The DIY, open and citizen science movements extend Woolgar’s notion to nature, but also democratise Polanyi’s community of explorers by enabling everyone to bring values and facts, create his/her community of explorers, and define new forms of disobedience. We need to preserve this sphere of experimentation with science and society on a personal and communal level to better understand our past, but also provide more critical visions for the future.

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