From publics to practitioners: Invention power and open technoscience.

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Science as Culture

Abstract

There are more publics involved in science than one would imagine at first sight. In technoscientific conditions what counts as knowledge creation is not primarily the individual experimental achievement that gives coherence to scientific practice and separates science from its publics; rather, it is a form of dispersed experimentation in more than human worlds: distributed invention power. This form of labour involves intensive relationalities and transversal experimentation across different groups of people, other species and material environments. Distributed invention power is organised and regulated through the pervasive securitisation of technoscience: surveillance and control of technoscientific fields as well as financialisation of its activities and research outputs. The securitisation of science reorders the traditional split between the public sphere, the private sector and the commons. The folding of each one of these spheres into the other underlies a constant, often antagonistic, oscillation between big science and open science. What is constitutive of the diverse movements that sustain open technoscience is not that they challenge technoscience *as such* but that they try to create alternative knowledge practices inside different fields of technoscience. This distinction is of importance: it implies that a politics of publics can no longer be socially and materially transformative. What instigates transformation is the socially distributed and more than human experimentation with technoscience to create alternative forms of life.

Keywords Invention power, Experimental Labour, Open Technoscience, Ecological Transversality, Securitisation, Alter-ontologies

Bio

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Publics vs science?

Examining the relation between science and its publics, a relation often characterised by mistrust, if not antagonism, usually presupposes a separation between the two as distinct entities. But to what extent is this the case and how did we arrive to believe that such a separation is empirically justifiable and conceptually possible?

In their paper on imaginaries of publics in the UK, Welsh and Wynne (2013) investigate how the state encounters the publics of science in the post-WWII period, a period marked by the ascent of science as an institution that produces authoritative knowledge which then comes to inform and shape state policies. They claim that state perception of publics changed from initially (1950-1980) conceiving the public as a passive and scientifically illiterate recipient of advanced knowledge, to understanding the public as a threat to science and innovation-led growth (1990s), to finally moving to suppress publics that protest against specific technologies (2000s). These latter developments unfold in parallel to attempts of the state to create channels of communication and exchange between science and publics by facilitating deliberative and participatory inclusion of citizens in forming the agendas and research orientation of research, most notably captured by the public understanding of science initiatives in the 1980s and 1990s and the increased attempts to engage publics since then.

There are several examples that would support this trifold typification of the relation between publics, science and the state including the ones discussed in Welsh and Wynne's paper: anti-nuclear movements, anti-GMO mobilisations and climate change campaigns. Likewise many texts in McNeil and Haran's (2013) special issue in which Welsh and Wynne's paper also appeared. Haran (2013), for example, shows how publics that opposed the legislation on the creation of hybrid embryos in the UK in 2007-08 were framed as irrational and their position was effectively delegitimised (see also Reynolds, 2013 for a discussion of the 'GM Nation' public engagement excercise).

All these examples seem to represent the public as a potentially contentious force that science tries to contain and/or keep outside its core institutions. In particular, Welsh and Wynne bring together a wealth of sources from social movement studies in order to discuss this agonistic relation between science and publics which to a large extent is facilitated by state institutions. What characterises this relation is a *reciprocal externality* between science and publics. Yet, even if we accept for a moment that this has been the case historically, to what extent is it still the case today? Are science and publics generally separate?

The implosion of publics and technoscience

One could argue that these examples feature prominently because something very different is happening: publics and science implode into each other. The barriers between the publics and science collapse creating a space of continuous and multifarious exchanges and conflicts. Rather than one clear-cut

conflict between science and publics that Welsh and Wynne assume, there is a multiplicity of exchanges and conflicts that emerge as the separation between publics and science collapses. In these conditions the relation between science and society, knowledge and politics, materiality and culture become much more difficult to disentangle. There is no longer an obvious way to confront the purported authority of science. The loss of a clear target of critique is in ways disorienting but there are reasons for excitement too. This collapse opens different political possibilities beyond the modernist/humanist redemption story of a potential enlightened public against authoritarian science and its re-alignment with a possible democratic science.

When the barriers between science and publics collapse, science is practised in multiple ways and not only in some of its core institutions (McNeil, 2013). Also its actors multiply and the traffic between different players increases. The fusion of science and publics is contained through the securitisation of science--something to which Welsh and Wynne allude when they describe how publics are silenced today. But it is important to note here that this securitisation is not primarily a top-down process organised by the state. Rather, securitisation is diffused in and performed by science itself.

The threat is not outside science (that is the publics) but inside science itself (that is specific configurations of science *and* publics). The more science becomes open, the more securitised it becomes: (1) the instalment of physical infrastructures and complex architectures of entry requirements that regulate physical, technical and informational access; (2) the proliferation of socio-legal measures (formal and informal rights, patents, contracts, entitlements, codes, dispositions etc.) that define degrees of scientific legitimacy and power. Securitisation means that the amalgamation of science and publics is not controlled from above (by some state institutions) but on the level of the everyday.

This condition is what characterises *technoscience* (Haraway, 1997, Ihde and Selinger, 2003, Weber, 2010). The fusion of technology, science and everyday life is not just another name for science; this fusion refers to something much wider that the acknowledgment that technology actively shapes basic research and that basic research is increasingly concerned with impact on applications and the everyday. Translation and technological interoperability in technoscience is a constitutive moment of knowledge production linking directly technological innovation to basic research.

However, beyond the centrality of translation between technology and science, technoscience also means that the actors assembled in the making of knowledge are not arranged according to the traditional gap between science and publics. Every specific knowledge practice assembles around it a different social and material world--be it scientists, technologists, animals, materials, businesses, social policy makers, tools, practitioners, consumers, enthusiasts, activists, finance, community stakeholders etc. In technoscience publics are always traversing knowledge. In technoscience publics are always traversing knowledge.

But here, of course, publics are not an abstraction but always specific publics: concrete and varied groups of publics contribute to create a 'region of objectivity' that defines what counts as credible knowledge and how a specific scientific topic is discussed (Papadopoulos, 2011). In fact, the public is an empty category: when invoked as such, it creates the impression that there is an entity operating outside technoscience and that science can be developed outside of its publics. Rather, different parts of publics and technoscience merge into each other to create the uneven, often contentious spaces in which knowledge is produced.

Distributed invention power

But if this is the case, then what constitutes the specificity of scientific knowledge? Speaking of science as technoscience sounds like outright social constructivism. It isn't. Technoscience does not tell the story of the social construction of facts but a story of a different way of constructing and creating knowledge altogether. The creation of scientific facts is not shaped by how different publics contribute to their making along the way. Rather, the creation of facts is stabilised as a region of objectivity. In each specific moment this distributed creation of facts is stabilised as a region of objectivity, that is as an arrangement in which for a certain period of time technoscientific facts are considered as stable and widely accepted. That is, various players co-establish spaces where specific ways of thinking and acting are widely accepted as matters of fact for a certain period of time (Papadopoulos, 2011: 179).

How is this stabilisation achieved? Do the involved publics make 'facts' appear as facts? Or are facts the outcome of a specific scientific practice, 'the experimental achievement' (Stengers (2000)? This key event characterises for Stengers modern science, when only what has passed through thorough experimental testing, and most importantly has withstood it, becomes a scientific fact. From this perspective, science is a very specific type of practice that enables scientists to challenge their own questions and assumptions in order to achieve a level of certainty: only the questions that have withstood their objections can be considered scientific.

In other worlds, scientific knowledge is a distinct practice that doesn't come from the co-action of a multiplicity of actors (that is fragments of publics, scientists and non-human others) but from this very specific single event of the experimental achievement. But is this the case in cognitive science, climate science, biosciences, soil science, neuroscience, informatics, biomedicine, geosciences--to name a few examples? In all these scientific fields the experimental achievement is mediated by many different trajectories and actors already *before* it has taken place, even before it has been formulated. We cannot say that this is the case – unless we neglect the invisible and indeed invisibilised labours of so many different human, animal and inorganic actors that contribute to making facts (Puig de la Bellacasa, 2011).

In technoscience what counts as creation is not primarily the individual

experimental achievement that gives coherence to scientific practice (although this might be sometimes part of it); rather, it is a form of dispersed experimentation: *distributed invention power*. Science in technoscience is not done by those who object but rather by those who invent in intended and unintended collaborations. Science
in technoscience is intersubjectively 'materialized action' (Schraube, 2009). Consider the making of a chimerical mice, a transgenic lab animal, of the robot Atlas, of earth observation patterns of soil erosion, the visualisation of neural networks, climate simulations, synthetic molecules etc.

More than human technoscience

By contrast to any other form of labour power, invention power is specifically bound to the constraints set up in a concrete region of objectivity, that is the ecology where a specific type of knowledge is produced. And as such invention power is never a singular achievement but an act of connection--not any connection though, but a connection that makes a difference in a region of objectivity. In fact, invention power is hardly ever an individual act or even an act in itself but a synergy of practices that allow for a type of knowledge to emerge that alters a region of objectivity. It could be said that this synergy assembles different publics in it.

But distributed invention power is indifferent to the separation between publics and science. Not because the production of scientific knowledge is unspecific or can be done by anybody, anywhere, anytime – but rather because it cannot be done without gathering a *very specific* set of actors, resources and spaces around it that allow it to emerge; such actors that often are more than human. With John Hartigan (2015b, p. 5) we need to ask: 'If publics are decidedly human--self-reflexive readers, hailed by various nationally mediated cultural form--than how do we account for the presence of so many highlighted arrangements of multispecies life in their midst?'.
If science as experimental achievement ever existed, this achievement is dispersed in society and matter -- in a 'more than one world', in a 'more than human world', to use de la Cadena's (2010) words. Technoscience is *more than human*: the fleshly and material mixture of different fragments of publics, scientists, stakeholders with inorganic substances and other plant and animal actors. Not only are publics dispersed in technoscience and cease to be the primary actor (along with scientists) in a region of objectivity but also their significance does not stem from their capacity to act as publics; rather, these dispersed publics exist as such because of their ability to co-act with other non-human actors that populate each region of objectivity.
Rather than instances of 'nature' that withstand the thorough testing of scientists, technoscientific entities demand from us to think of knowledge production as a force of co-making. Invention power requires ecological transversality -- the transfer of substances, processes and practices across disparate material registers and human or non-human communities of life

(Papadopoulos, 2014a).

'Species thinking' (Chakrabarty, 2009, p. 213) deeply upsets any notion that invention power relies on humans. In fact human activity and relationality more broadly cannot exist outside of practices of interspecies engagement--be it interspecies care, labour or even exploitation and destruction, as for example Hartigan (2015a), Pandian (2009), Schrader (2010) or van Dooren (2014) show in their work. In analysing Darwin's experiments Hustak and Myers (2013, p. 106) conclude that '[I]t is in encounters between orchids, insects, and scientists that we find openings for an ecology of interspecies intimacies and subtle propositions. What is at stake in this involutionary approach is a theory of ecological relationality that takes seriously organisms as inventive practitioners who experiment as they craft interspecies lives and worlds.'

And it is not only the creative involvement of other species that destabilises any fixed notion of publics but also that the co-action between different species, inorganic substances and artefacts equally break and reorganise any notion of publics vis-à-vis science (Marres and Lezaun, 2011). This is something that, for example, Tim Choy's (2011) work on environmental politics in Hong Kong shows well as he describes how a diverse array of environmental actors can be thought less as constitutive of a clearly organised public sphere and more of an ecology or, even, a regional biotic community.

Experimental **labour: Ethopoiesis**

The construction of knowledge in technoscience is neither social, nor radical, nor construction *tout court*; it is a practice of making through distributed, more than human invention power which reveals a different architecture of the conditions of knowledge production. Let's talk about work. Let's talk with Leigh Star (Star, 1991, see also Clarke, 2014, Papadopoulos, 2014b, Puig de la Bellacasa, 2014) about all these labours that have been rendered absent and invisible in the experimental achievement and in the humanist tale of making and contesting scientific facts. What kind of labours are necessary in order for knowledge to be produced? What is this form of labour that is distributed invention power and who holds it?

In his illuminating study on the making of transgenic rice in experimental fields in the Philippines Chris Kortright (2013) introduces the term *experimental labour* to describe how research work is always embodied and haptic, operating in the constraints of the time and space in which the experiment takes place, involving a complex interaction with other local actors and the environment. Experimental labour is about invention and invention is always situated. In the contemporary mode of production invention power is the valorisation of social, cognitive, affective and relational activities that are embodied and situated in one's own life (originally see Moulier Boutang, 2012, p. 93, Negri, 2005, p. 268). Experimental labour is creative and inventive because it implies an involvement in the lives of other living and non-living beings. It is this 'ethopoietical practice' (Puig de la Bellacasa, 2010), the simultaneous production of ethos and ontology

that cultivates distributed invention power. Experimental labour fuses into experience subjectivity and materiality (Schraube, 2013).

There are more publics involved in technoscience than one would imagine at first sight. If one sees the work of technoscience as experimental labour then one cannot avoid seeing how many different types of relations, social groups, species, ecologies, interdependencies and ways of life participate in the making of knowledge. The opposition between science and its publics mystifies technoscience by closing it down to some few of its processes, players and outcomes. Instead we need to ask the question, how wide and intense is the technoscientific field we are investigating. The smaller it appears to be, that is the less participants and intensive exchanges it contains, the more likely it is that we use science as a proxy for something else: political authority, social power, democratic deficit, economic wealth, symbolic capital etc. But if we read technoscience as something that is done through meticulous, embodied and distributed experimentation then we start seeing how different publics and other actors with different capacities are always participating in the making of science.

Experimental *labour*: The blackmail of precarity

Following Kortright's (2013) work, thus far I have discussed the experimental aspect of experimental labour. But what about the aspect of labour? Invention power embedded in the current structures of technoscientific production is a highly segmented activity. The conditions of experimental labour are distributed unequally. Producers of knowledge are differentially positioned towards their own labour as well as the outcomes of their labour: there are different classes of researchers, scientists, experimental workers (as there are in fact different classes of lab animals, plants and materials that are valued and exploited differently). Consider the increased measurements of research activity, the making of different levels of researchers with only few of them being in secure positions, the precarisation of research work, the multiplication of different tiers of academic and independent research institutions, the access to research funding which increasingly becomes available only to few, the rise of the post-doc worker, the lab as the post-Fordist knowledge factory, the exploitation of the invention power of young researchers by senior scientists, the zero hours lecturers. All these tendencies show that technoscience's experimental labour is highly diversified and under the constant blackmail of precarisation (for different approaches and theorisations of this conflict see Edu-factory Collective, 2009, Berardi, 2010, Morini and Fumagalli, 2010, Murgia and Armano, 2012a, Murgia and Armano, 2012b, Papadopoulos et al., 2008, Muller and Kenney, forthc.).

To uphold the dichotomy between science and publics, one needs to ask: Is the contract-dependent lab researcher or the precarious academic closer to 'science' or its 'publics'? And who is the potential threat here? Is it the publics? The answer is no because there is no such thing as the publics in this configuration. Rather, there are scientific publics, that is certain segments of scientists themselves. Technoscience is not the outcome of the activity of one

single subject, the 'scientist': many different classes of experimental workers participate in it and these are in fact all different groups of publics. This creates many conflicts that could erupt anytime and, indeed, erupt in different ways between different segments of scientists.

Securitisation comes to control this situation on the ground of day to day research activity and academic work. Who has access to which type of academic positions? What is the value of our research? Who gets which type of contracts and why? Securitisation brings with it mundane technologies of control: Many researchers, scientists, academic workers live under the threat of precarisation. That's how the boundaries of technoscience are policed -- not because they exist *de facto,* but rather because the boundaries are erected depending on the specific conditions and conflicts in each specific region of objectivity. The securitisation of research work performs the selection of research agendas by permitting or deterring research activity on a specific topic in a region of objectivity. Publics are already embedded in the very heart of technoscience; they are excluded, exploited and suppressed in multiple ways.

Biofinancialisation

This complex architecture of inclusion and simultaneous exclusion is sustained through the pervasive securitisation of technoscience. I use here Kath Weston's (2013) term *biosecuritisation*--the securitisation of life-- to describe this complex architecture of control in technoscience. The term designates a double move in which science is both securitised in terms of surveillance and policing of the actors that operate in it (as discussed in previous sections) as well as securitised in terms of the financialisation of its underlying socio-material configuration. It is this latter aspect that I want to turn to now.

Financialisation is more than the reliance on fictitious financial capital; more than that, it is the reliance on a prevalent culture of valuation that attempts to reduce different forms and scales of valuation into one scale of measurement: financial valuations (Lilley and Papadopoulos, 2014). We used the term biofinancialisation to designate the insertion of this indeterminate process of valuation into everyday life, materiality, and the environment -- including the present and, most crucially, *future* appreciation of assets, goods, services, intangibles, the health and subjective capacities of individuals, the physical environment, human artefacts, other species, urban space and, also, knowledge.

What is the financial value of a novel compound? What is the financial value of an equation? What is the financial value of our academic work? What is the financial value of a scientific paper? What is the financial value of animal tissue? What is the financial value of a simulation of a neural network? What is the financial value of soil? What is the financial value of an oil spill and what of the dying birds?

There are many different ways to approach the valuation of these and similar objects and living entities (see for example Beckert and Aspers, 2011, French and

Kneale, 2012, Huguenin et al., 2006, Robertson, 2006, Beverungen et al., 2013, Karpik, 2010, Moeran and Pedersen, 2011, Stark, 2009, Zelizer, 1979). However, what is important for the purpose of this paper is that the biofinancialised regime of production relies on the appropriation of broader aspects of social and material life, everyday activities, resources of cooperation, transmaterial and interspecies relations. The biosecuritisation of technoscience reorders our understanding of who controls what in each specific field of technoscience. Welsh and Wynne locate the control (and suppression) of publics in the operations of state institutions.

But through biosecuritisation the locus of control cannot be easily located within *the* state or some prominent core scientific institutions. Biosecuritisation implicates many different actors--private and public, state owned or those belonging to the commons--at the same time and shifts the locus of control constantly according to the necessities of each specific situation in a region of objectivity. Biosecuritisation perceives as a threat every attempt to exit an arrangement that translates our activities to some form of financial value. Even the commons (practises of communing, common pool resources, peer production and common forms of sociality and relationality that are neither public nor private) that traditionally were outside the biofinancial system of value production enter gradually into it: biofinancial accumulation not only appropriates and mixes *res publicae* (public sphere) and *res privatae* (private sector), it also relies on the expropriation of *res communes*.

Methodological techno-nationalism

It is not only that private and public actors in different configurations participate in the production of knowledge but that technoscience needs to capture the creativity and potentials that exist in the commons. What is the difference between the commons and the publics here? The publics are always to some form or another linked to the state either as civil society operating in the symbolic and territorial realm of the state or as social groups which are activated by certain governmental institutions or as pressure groups that articulate their demands towards the state (or many times as threats as Welsh and Wynne discuss in their paper). That publics always map to the state does not mean that the public is identical to a specific segment of the state (let's say its population) but that the public always expresses itself and in fact exists only through channels that are set up by the state and support its governance. One could go as far as to say that publics are proactively constructed by state institutions. This does not diminish the creativity of the publics but it reveals the limits of their role. As Lezaun and Soneryd (2007) say: 'Technologies of [public] elicitation, and the cohorts of experts that control their application and interpret their results, constitute, a veritable extractive industry, one that seeks to engage publics in dialogue and generate certified "public opinion" with the ultimate goal of increasing the productivity of government'.

Even if publics might sometimes organise transnationally they only become visible, in fact they become publics, as long as they get involved in

processes of state governance (either through their engagement and participation in formal institutions or because of their exclusion and delegitimisation from them). There is no publics without state institutions even if publics are viewed as a threat by the state and are in fact often treated as a threat. The concept of public suffers from methodological nationalism which does not of course reduce its importance. It highlights though its inherent limitations.

And here is where the notion of commons contributes to understanding technoscience with a conceptualisation of certain forms of organisation that operate differently than the interlaced private-public spaces. The commons exist and can sustain themselves without the direct involvement of state institutions. That is why the commons is not publics. But that doesn't mean that the commons are not implicated and involved in technoscience and its securitisation. Although politically much more radical in its functions than the publics, the commons is not independent and autonomous of the structures of technoscientific knowledge production. Hayden (2010) has forcefully interrogated the discourse of the commons as a clear counterpart to the enclosed regimes of intellectual property and has shown how the logic of the commons is intimately entwined with enclosed private and state sectors.

The fold

In technoscience there is no clear split between science and publics, between private and public, between publics and commons and so on. These actors are all very different--occasionally they are against each other--but to one extent or another they are all involved in the making of technoscience. I argued earlier for dropping the idea that publics are outside of science and the state.

Here I add another one reason to do so: technoscience exists only as the private sector, the public sphere and the commons fold into each other. Invisible structures of common exchange and cooperation, organised public institutions and civil society actors as well as private interests and funding circulate through technoscience and reinforce each other. 'Give me a laboratory and I will raise the world.' But this captures only one aspect of technoscience. Let's capture technoscience in action: Give me a laboratory and I will raise a start-up. Give me a laboratory and I will raise a social centre. Give me venture capital and I will raise a laboratory. Give me state funding and I will raise a laboratory. Give me a social mobilisation and I will raise a laboratory. And so on.

This constant folding creates a new situation were science can no longer be considered as unified nor is it given which form of practise is defining the workings of technoscience. Increased public engagement can no longer be considered a secure path towards the democratisation of science, as for example Jenny Reardon (2012) shows in her work. Neither does the inclusion of scientific experts in regulatory procedures necessarily ensure 'regulatory pluralism, reflexivity on the science-law relationship or democratic accountability' (Bonneuil and Levidow, 2012, p. 97). Public engagement can be

seen as a mere productive activity in post-Fordist economies (Thorpe and Gregory, 2010). Kate O'Riordan (2013) for example shows how public involvement in direct-to-consumer genetic providers constructs the publics as consumers who then shape the genetic information provided.

When one actor becomes a threat capable of destabilising a region of objectivity, only in exceptional cases is the solution suppression (as implied in Welsh and Wynne, 2013). Threats to the stability of a technoscientific field are usually not suppressed; rather, they are controlled as they fold into one of the other entities and are appropriated by it. For example, when movements of the commons challenge a specific technoscientific field and are perceived as a threat then a usual response is to either expropriate the commons into the private sector or formalise and channel their creativity in some form of publics.

This continuous folding of the private, the public and the commons into each other creates a condition where designating one of these three domains as the primary force behind technoscientific innovation becomes almost impossible. Is it big science (Shapin, 2008), the commodification of science (Dumit, 2012), the neoliberal privatisation of science (Mirowski, 2011), the economisation of science (Berman, 2013), the privatisation of public institutions (Newfield, 2008) that drives technoscientific knowledge production? Or is it the intervention of the public though processes of deliberation and contention (Davies, 2006)? Or is it perhaps the practices of the commons that sustain and feed technoscientific innovation (Kelty, 2008)?

It is difficult to define a single sphere that drives technoscience. For better or worse, there is no single determination of technoscientific knowledge and there is no privileged location in which technoscience takes place. Neither is there a privileged position for controlling technoscience.

Contesting Technoscience

In these conditions it is less clear who can contest technoscience and from which perspective than it is often presented when we use the idea of the publics. There are of course some iconic mobilisations that can easily reproduce the vision that science and its publics are external to each other and are deeply oppositional such as the cases discussed by Welsh and Wynne. The anti-nuclear movement, the GM debate and climate justice mobilisations.

But to what extent do these movements contest science as such? Or in other words, do these movements target only science as such or more broadly different entities and institutions that are involved in each one of these specific fields, such as the specific industries, specific state institutions, politicians, popular opinion itself, media, local stakeholders, scientists, policy makers etc? The latter is the case. Social movements in technoscience rarely contest only science; rather, they contest the aggregate environment of a region of objectivity in which a specific technoscientific development takes place.

This distinction changes fundamentally what social movements are and how they operate in technoscience. Social movements form around a set of

political issues and material realities that entail technoscientific knowledge and only by doing this they address technoscientific knowledge per se. Moreover, they organise not only in order to contest specific knowledge per se but in order to challenge social and material injustices that pertain to their concerns. Welsh and Wynne show this very clearly and make also an important theoretical point here when they poignantly say that 'the conventional idea that unmobilised ordinary citizens as publics are different from mobilised social movement network publics is mistaken. Publics mobilised as social movements are not only interwoven and continuous with what are often called "silent majority" neutral publics, but, we contend, they are articulating the normative public concerns which are often shared silently, well beyond their own network populations themselves' (2013, p. 542).

This is important because it changes our understanding of how social movements form and operate--Chesters and Welsh (2006) have written eloquently about this, see also Papadopoulos et al. (2008): They contest power not only by organising protest but by creating the conditions for the articulation of alternative imaginaries and alternative practices that bypass instituted power and generate alternative modes of existence. Protest and resistance social movements that channel all their actions to resistance are vocal and visible.

But they are not the main force in social movements' action. What defines at the end social movement action is the capacity to set-up alternative forms of everyday existence and mundane practices that come to force power in a specific field to reorganise itself and to reengage the actors involved in new ways. Karfakis (2013) has for example discussed how the multiplicity of mobilisations of people diagnosed with Chronic Fatigue Syndrome target simultaneously popular opinion, social policy, workplace exclusion and specific technoscientific knowledge. Murphy (2012) has shown how the politicisation of technoscientific aspects of reproductive health has created a complex entanglement of women's empowerment with the broader economic, social and political logics of the past fifty years. I have discussed AIDS treatment activism as a movement that instigated major social and material transformations beyond the teleological view that it solely focussed on contesting scientific expertise (Papadopoulos, 2011).

From protest to open technoscience

Many of the different approaches to social movements in the sciences up to the 2000s were gravitating around protest and resistance, and ultimately cultivated the imaginary of a possible inclusion of the publics in science (Epstein, 2007). I Inclusion seemed to be the horizon of action: inclusion in the hermetic cathedrals of science with the aim to shape research agendas upstream and change state policies. Consider the history of protest movements: the science for the people mobilisations of the 1960s and 1970s, the radicalisation of green, ecological and health movements in the 1980s, the demands for participation in science policy as well as in defining the topics of research in the 1990s, etc. Each

movement demanded the insertion of publics into scientific institutions and political decision mechanisms.

But when science co-evolves with the actions of so many different publics, when in fact technoscience cannot exist without them, such movements have little effect. The demand for inclusion does not make sense because they are already inside! Exclusion is organised through the inclusion of actors in different positions and capacities. Simultaneously, this implosion of technoscience and publics and of inclusion and exclusion promotes a different imaginary which is less about contesting technoscience and more about the alternative making of science.

Instead directing demands for change to science, the practice of making science has created an alternative vision of technoscience. Technoscience can be imagined as open. *Open science* is a contested terrain not a given reality or a definite programme. Depending on the specific subfield and topic the quest for openness addresses different issues and different levels on which technoscience is operating: (1) open research agendas; (2) open standards; (3) open hardware; (4) open data repositories; (5) open access to research outputs. Not all of these take place necessarily and simultaneously in every subfield but technoscience is challenged from inside by combinations of these alternative practices.

Big enclosed technoscience and open science often co-exist in certain fields or even more they feed each other, often making impossible to see how a technoscientific field can continue developing without all these different levels of organisation. Of course, this is far from a peaceful co-existence; it is a matter of appropriation and conflict. Big science and proprietary science constantly expropriate and privatise or enclose open science. Simultaneously, open science exists by reclaiming knowledge and technologies that are developed in the realm of enclosed science. Although implicitly reproducing the false dichotomy between publics and science Adrian Mackenzie (2013) in his work on open biology offers a glimpse into this ambivalent movement between 'publics' that object and invent on the one hand, and 'publics' that are just validating and confirming big Bio on the other. Alessandro Delfanti (2011) offers a more complex view of this process in which the folding of private enterprises, publics and the commons into each other underlies the constant, often antagonistic, oscillation between big enclosed science and open science (see also Hope, 2008).

But one could object here: is this enough to contest and challenge technoscience in its present form? Is open technoscience strong enough to bypass the pervasiveness of technoscience? Traditional protest movements – such as those described in Welsh and Wynne's paper and many of the papers included in McNeil and Haran's (2013) special issue – seem to conceive technoscience as an already formed, unified and given terrain. Open science reverses this approach. Social movements are successful to the extent that they change the conditions of knowledge production *by engaging with* knowledge production in a specific subfield of technoscience. However, as long as these

movements remain only protest and resistance movements their capacity to instigate social and material transformations is limited. Only when social movements produce alternative knowledge with, within and occasionally against specific developments in technoscience can effectively challenge the constituted order of a technoscientific region of objectivity and become constituent forces of technoscientific change (Papadopoulos, 2011).

Give me a kitchen and I will raise a world. From open technoscience to alter- ontologies

How far can social movements for open technoscience carry us? The limit of open technoscience is that the more successful it becomes the less political it will be. We know this already from the open software movement. The designations 'open' and 'free' software account for a small difference but of crucial importance. Free and open software are not very different in terms of how they are made and their intrinsic qualities; but free software is made explicitly as an attempt to promote the value of non-proprietary software, that is to promote justice by challenging copyright, while open software is promoting the software itself as an infrastructural tool for facilitating open information access (Stallman, 2013, Coleman and Golub, 2008).

We already know today that this difference, although so crucial for the development of open software, has been almost lost. The reason is that open and free software outpaced itself in terms of the innovation it produced and is now in the process of being continuously folded into proprietary software and vice versa. In this sense there is no longer open source software as fully separate from proprietary software since both feed into each other in order to exist; and, there is no free software as distinct from open and proprietary software because it is simply contributing to the making of the same infrastructures of codes despite the political differences and values that motivate it. As Kelty (2013, p. 3) puts it, 'There is no free software. And the problem it solved is yet with us.'

But one has to ask here: Why do we expect social movements to solve social problems or at least to contribute to their solutions? Academic research on social movements seem to be stubbornly functionalist. But it is time to overcome this teleological understanding of social movements as always fixed on a certain task or having a certain target. Social movements are good if they seek specific solutions otherwise they are subconsciously perceived as too unruly, unclassifiable, interstitial, hybrid, dangerous. Functionalism in the understanding of social movements ends up reproducing the logic of the state that treats them ultimately as a threat as long as they are not incorporated into it. But if social movements are more about creating worlds beyond the one world of the state and its publics, then the question of *how far* can open technoscience carry or include us becomes less important.

Movements of open technoscience create new spaces for alternative social and ecological action and for material experimentation. From kitchen science to DIY biology, the maker movement, the alternative experimentation

with medical substances, lay engineering projects, production of alternative forms of energy, projects of ecological modernization from below, self-managed systems against environmental hazards, alternative forms of agriculture and soil renewal, radical patient-based campaigns, permaculture regeneration, punk science, health movements, indigenous eco-cosmologies, clandestine chemistry, the hackers culture, ecological justice initiatives, cross-species collaborations, bio-art, self-organised projects of scientific literacy--all examples of reclaiming and reinventing technoscience from within (for an analysis of some of these projects see the innovative work of Ghelfi, forthc.). Give me a hackerspace and I will raise a laboratory. Give me a community space and I will raise a laboratory. Given me a garage laboratory and I will raise *a* world. Given me a laboratory and I will raise *a* world. Give me a kitchen and I will raise *a* world.

What is constitutive of these movements, practices and initiatives is not that they encounter and target technoscience *as such* but that they change the conditions of knowledge production inside different fields of technoscience. This distinction is of importance: it implies that a politics of publics challenging technoscience as such can no longer be socially and materially transformative. What initiates transformation is the socially distributed and more than human experimentation with technoscience to create alter-ontologies, i.e. alternative knowledge and new forms of life.

What is at stake here is not technoscience itself but life in its ontological constitution. And these social movements target exactly this: the alternative creation of ontologies, the forking of life into alternative forms of existence--alter-ontologies. They change technoscience not by (primarily) targeting technoscience itself but by attempting to change life entangled with technoscience. Can technoscience ever become fully open? Can these movements ever liberate technoscience? Possibly not but this is not the point. What matters is that in this process technoscience itself becomes a field of social and interspecies experimentation. The more intensive this process is, the more publics become experimenters, commoners, practitioners of technoscience and of the alternative worlds they craft.

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