TECNOSCIENZA

Italian Journal of Science & Technology Studies

ISSN 2038-3460

Special Issue:
Tecnoscienza 10th Anniversary

Since 2010 Tecnoscienza *has invited different artists to contribute with one of their works to 'cover' a journal issue. We thank them all once more for their kindness and willingness to donate their works.*

2/10 – *Autonomous Trap 001*, by James Bridle

1/10 – *ASCII Shell Forkbomb*, by Jaromil

2/9 – *NoArk*, by The Tissue Culture & Art Project (Oron Catts & Ionat Zurr) in collaboration with Marcus Canning

1/9 – *Touchy*, by Eric Siu

2/8 – *Ouroboros*, by Alvaro Cassinelli

1/8 – *Freedom Flies*, by Chris Csikszentmihályi

1&2/7 – *Velocipedia*, by Gianluca Gimini

6/2 – *Dispatchwork*, by Jan Vormann

6/1 – *Connessioni*, by Fabrice De Nola

5/2 – *Telstar (Wisdom) 200 (Dark bog oak, various sustainable exotic wood veneers)* © by Paul Fryer

5/1 – *The Table of Alliance*, by Daniela Papadia

4/2 – *No stars*, by Alia Scalvini

4/1 – *Smile of a Stem Cell: A Dialogue between Science and Society*, by ESTOOLS

3/2 – *Public Smog (2004-ongoing)*, by Amy Balkin et al.

3/1 – *Ospedale a mare*, by Andrea Napolitano

2/2 – *I Am Whatever You Want Me To Be*, by Daniela Kostova

2/1 – *The Beggar Robot*, by Sašo Sedlaček

1/2 – *God Bless DianaI*, by Heman Chong

1/1 – *Der Jasager,* by Zaven Paré

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Tecnoscienza è una rivista scientifica che indaga i rapporti tra scienza, tecnologia e società. La rivista è semestrale, open access e peer-reviewed; è gestita da un Comitato Editoriale, con la supervisione di un Comitato Scientifico.

Tecnoscienza is promoted by **STS Italia** (www.stsitalia.org)
The Italian Society for the Study of Science and Technology
Tecnoscienza c/o STS Italia, Via Carducci, 32 – 20123, Milano – Italy
www.tecnoscienza.net – redazione@tecnoscienza.net – ISSN 2038-346

TECNOSCIENZA

Italian Journal of Science & Technology Studies

Vol. 11, Nr. 1, June 2020

Anniversary Issue
Tecnoscienza 10th Anniversary

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"Do It First, Do It Yourself, and Keep on Doing It": Ten Years of *Tecnoscienza*

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Abstract: The paper introduces the ten years anniversary issue of Tecnoscienza. A short history of the journal is presented, together with some reflections about its evolution along the years. Sketching the texts that compose the anniversay issue, we identify some past, present and future themes in STS.

Keywords: Tecnoscienza; anniversary; do-it-yourself; academic publishing; STS.

Submitted: September 1, 2020 – **Accepted:** September 20, 2020

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Commonly, at around 10 years old, children start to change drastically: they begin to build strong relationships with peers, from whom they also experience greater pressure; they become more independent from their family and start to recognise more clearly the point of view of others; their attention span increases, while at the same time they need to cope with greater school commitments; as puberty approaches, they also become more aware of their own bodies. While not properly a child (but possibly our "*non-human child*"), at the end of its tenth year of life *Tecnoscienza* begins to deal with issues very similar to those listed above, facing increasing pressures, putting its own identity under discussion and coping with higher responsibilities.

Tecnoscienza was born in 2010 (but its conception goes back to at least 2008) as an open access journal, in an academic scenario where this model of self-organised open access publishing represented the newest and in some sense the most radical alternative to traditional scientific publishing. However, over the years, this scenario has changed rapidly. Ten years ago open access publishing platforms were, at least in social

and human sciences, still an embryonic phenomenon – also considered as an emerging technology surrounded by both technical and social controversies. Today, not only are open access journals a well-established reality in academia, but the same notion of "open access" has been actualised in several different ways.

When the first issue of *Tecnoscienza* came out, open access was mainly discussed as a political tool able to rebalance the huge concentration of power within the academic publishing sector. Today, open access is no longer one distinctive model, alternative to established corporate publishing, but it includes very different, and to some degree conflicting models, including the last frontier of that same corporate publishing that open access appeared to bring into discussion at the beginning. For example, it is quite common today (for instance within EU projects) to encourage open access in its so called "gold" declination, which means that the authors pay a fee to make their own work freely accessible for everyone, without the need for the readers to pay a subscription. Although a valuable initiative in terms of knowledge circulation, this model does not offer a real alternative to existing monopolies in the publishing sector, with the associated risks of weakening the quality of academic publications (as in some situations authors pay to receive a publishing "service") and also carrying the further responsibility of stimulating the growth of the much depreciable phenomenon of predatory publishing.

In contrast, at the beginning of its journey, *Tecnoscienza* adopted a different and more radical kind of open access model, defined as "platinum" or "diamond" open access, in which neither authors nor readers are required to pay to make scientific work freely available, thanks to a self-supported publishing organisation. This was made possible by a collective effort put in place by the Italian STS community and supported by STS Italia, the Italian Society for Science and Technology Studies. In 2009-2010, the group of founders of the journal adopted this quite uncommon – at that time – way of publishing with the idea that an alternative organising of the way a journal is funded economically and managed operationally was fundamental to allow different voices, identities and perspective to emerge. At the same time, as STS scholars, we enthusiastically embraced new technical tools available (especially the Open Journal Systems open access software, released originally by the Public Knowledge Project in 2001) with the genuine belief that new technologies need to be appropriated with emancipatory political aims in order to display fully progressive outcomes.

At the beginning, these choices undoubtedly favoured *Tecnoscienza*, allowing the journal to grow in an environment that was increasingly "welcoming" to such alternative views on academic publishing. However, while the changes occurring in the academic publishing landscape in the last decade helped the development of *Tecnoscienza*, along the years they brought new pressures, raised by several interconnected phenomena. Just to name a few: the increased competition in the open access sector; the

increasingly demanding work required to maintain a high quality publication; the multiplication of open access STS-inspired international journals; the proliferation of scientific databases (each with its criteria and indicators to meet); and the increased pressure for publishing in high-ranked journals.

The flourishing of other self-organised and open access publishing experiences within the STS community has allowed *Tecnoscienza* to find 'peers' with whom to compare and build common experiences. At the same time, however, the presence of an increasing number of open access journals has also been a source of 'pressure' on *Tecnoscienza*, which has had to find ways to characterise its identity in a more marked way in the face of a very different and more densely populated landscape than the one in which it was born. Moreover, having been cited and considered on several occasions as a possible 'model' to be inspired by has made us focus not only on the identity of *Tecnoscienza* that was being built, but also on the expectations nurtured towards it.

In order to sharpen the journal's identity and to make it relevant to the already-existing and evolving STS international community, we opted to draw transversal lines across the existing categories and boundaries, for instance giving space to reflect on the evolving geography of STS at the global level. Since the STS landscape arose in specific countries (i.e. the UK, the Netherlands, the USA, and Nordic countries), it has been characterised by the growth of newer, increasingly international and globally interconnected networks, journals, and research. Today, the presence of STS scholars has expanded in many different countries around the world. In this scenario, one of the aims of *Tecnoscienza* has been to redefine the geography of the global STS community by giving resonance to the importance of the local embeddedness of STS perspectives. Thus, not only is *Tecnoscienza* an attempt to draw attention to a relatively new, 'indigenous' Italian STS community; it also more generally supports a revaluation of the role of smaller national communities and alternative perspectives in the STS domain.

Staying true to the original idea of working without the support of a traditional publisher – thus maintaining full autonomy over our work and offering a true platinum/diamond open access formula – we continue to manage everything by ourselves and attend to all aspects of the publishing process, from the governance and decision-making about editorial choices, to the management of the peer-review process, copyediting, maintenance of the web platform, and promotion. This is of course hard work, often with little visibility, and not rewarded in academic terms, but nevertheless crucial for the journal's independence and autonomy which, we believe, are the pivotal features to advance and to develop a critical and reflexive discourse on academic publishing and knowledge making.

As is well known in STS, knowledge production is not a neutral activity, but on the contrary a work that actively contributes in producing the realities it claims to just report. Knowledge production is performative,

and research practices and methods enact a specific reality at the same time they describe it. From this standpoint, looking at scientific publishing in a "critical way" implies a reflexive attitude about our own scientific practices, of which publishing is a crucial one. Setting up and running a journal, thus, is not just a way to share ideas; it is a performative action that can alter the scientific context we inhabit and the kind of knowledge we produce and circulate.

A celebratory issue

As a 'celebration' of its first ten years, this issue of *Tecnoscienza* follows a different model to the usual one. Playing with words (and time), at the beginning of 2020 we invited several members of our Scientific Committee to contribute with short texts reflecting on the state of the art of STS and its future challenges, possibly within the next ten minutes, days, months or years. Then the SARS-COV-2 (commonly known as "Coronavirus" or "Covid-19") appeared and all of a sudden a dramatic reconfiguration of our daily private and public practices (including work, of course!) took place. Priorities took on a different shape and we all had to be smart enough to find ways to manage exactly at the same time our analogue and digital life, as well as our private and public spaces.

Thus, notwithstanding all the problems we and our contributors have had to face in the last months, we are happy to present to our readers a collection of celebratory contributions from several of the friends and supporters of this publishing adventure. These texts are a meaningful set of reflections on the journal's history, on the state of the field of STS in Italy and internationally, with a focus on present issues but also on future challenges and, of course, on the contemporary issues related to the pandemic that emerged precisely during the writing of the texts.

The set of articles is opened by a sort of birthday gift Lucy Suchman has kindly donated to the journal. Thinking through volumes 1 (2010) and 10 (2019), she sketches five generative lines of future STS inquiry: translations; ordering; senses; feminism; and 'more than human'. More importantly, the text by Suchman is a call to expand "our capacity to acknowledge radical difference, including the specificities of our own locations and associated onto-epistemological conditions, and the histories, politics, economies and discourses that hold those differences in place" (Suchman 2020, 20). The politics of language in academia and scientific publishing in particular, with the dominance of English as lingua franca, she remarks, "are integral, in sum, to thinking about our field's pasts and transforming its futures" (ibid, 16). And a less hegemonic future could look for "new possibilities for researchers not only to think and work but also to write in first languages" (ibid, 16). In fact, as recently pointed out also by Law and Mol (2020, 265), the point is not just about "the effects *of* english on whatever it risks eroding (…) [but] the possible value *for*

english of importing some of the intellectual resources embedded in other tongues. (…) What kinds of lessons might 'english' usefully learn?"

To stay with Suchman, it could learn that "too often the worlds of reference remain implicit, comprising the taken for granted settings and networks in which we ourselves are located. Who do our words reference, when, where, and under what circumstances?" (Suchman 2020, 20). This discussion and the text by Suchman explicitly interpellate *Tecnoscienza*, which at the beginning published articles in Italian and in English, but shifted to English only in 2016. It is not the case to recall the endless conversations we had at that time in our board, nor to try to quickly solve a complex issue which opens up many questions: how to balance the evaluation of local idioms with the need to reach potentially global readers? How to contribute to the scientific debate by questioning or refusing the linguistic standards of scientific debates? How to give voice to a plurality of languages without marking new boundaries between them?

Whereas Suchman articulates her discourse by taking the 10 year trajectory of *Tecnoscienza* as a reference point, the following two contributions by Massimiano Bucchi and Mariachiara Tallachini focus on the coexistence of various 'modes' of science and on the dialogue among institutions, scientists, and citizens as a crucial theme for the future of STS. Taking the present pandemic condition as "the greatest exercise in public scientific education that there's ever been" (Shapin, in Bucchi 2020, 23), Bucchi questions whether it is still plausible (and promising for STS research) to conceptualise science and scientific knowledge as the results of chronological transitions of organisational practices of research (from academic to post-academic science, from Science 1.0 to Science 2.0). Maybe, he argues, it is time to "recognise the *coexistence* of different modes of science – as narratives, rhetorics and images that continuously overlap and intersect, with the same actors practicing and preaching different modes in different situations" (ibid., 24). In the same vein, Tallachini starts from the present situation to point to another issue STS have variously underlined, namely the processes of coproduction of scientific knowledge and policy making. Incidentally, differently from the past she argues, "the very same citizens, previously depicted as undisciplined recipients of compulsory measures, have turned into essential actors in dealing with the pandemic (…)" (Tallacchini 2020, 30). In this scenario, the idea of coproduction could be "a powerful democratic instrument to open up science policy to public discussion".

The texts by Giuliano Pancaldi and Paolo Volontè shift the attention to the past of STS in order to trace some future lines of direction. Giuliano Pancaldi (2020) does so by concentrating on the history of STS in Italy, highlighting the ways in which the field has gained visibility in the Italian context, but also pointing out obstacles and problems that still must be overcome. First of all, the traditionally rigid disciplinary partitions of Italian academia, which contrasts (and constrains) the vocational interdisciplinarity of STS. In fact, as Paolo Volontè notes in observing "the future

twenty years of twenty years ago" (2020, 44), the public engagement of science and technology has been quickly expanding, but the same cannot be said about the presence of STS in the knowledge of scientists, engineers and designers. Focusing on some recent trends of European technical universities towards integrating critical and reflexive skills into the core of their educational programmes, Volontè underlines the opportunity for STS to become protagonists of a process which could have profound effects on the education of technologists and engineers, and thus on the present and future world.

Alessandro Mongili and Federico Neresini adopt metaphorical thinking as a conceptual strategy to widen the analytical architecture of STS and face the future challenges and ambiguities of what can no longer be conceived as a one-world world. Mongili (2020) uses two images in this regard, that of a 'lateral' approach and that of an 'unsewn' world. Only by *lateralising* our research can we challenge the Western-centred STS canons, amplify multiplicity, and conceptualise the world in local and global terms at once. Neresini (2020) proposes the metaphor of the 'swerve', or, better, of a 'swerving methodology' as a tool for reflexively questioning STS objects of study and epistemologies, together with their 'exclusiveness'. Also, the swerve implies a lateral move, thanks to which we can make more evident the intrinsic *processuality* of objects and research questions and avoid self-referentiality.

As closure of the section devoted to "anniversary reflections", the text by Geoffrey Bowker (2020) offers a swerve itself, exploring apps for menstrual tracking, the affiliative power of technologies and the reconfiguration of expert and lay knowledge. It may sound out of place, but sounding out of place is at the core of past, present, and future STS.

The issue is closed by a reflection by Assunta Viteritti, current President of STS Italia, on what STS can say about the pandemic we are in and what kind of scientific models we need to question our time. Because anniversaries, in order not to be simply ritualistic, also have to take into account ongoing situations. Finally, as always, the issue is closed by book reviews of not-only Anglo-American books.

A motto and an attitude

The quotation chosen for the title of this anniversary introduction ("Do it first, do it yourself, and keep on doing it") is not an innocent one, being the motto of the gangster Tony 'Scarface' Camonte. Not that we subscribe to a gangster imaginary or attitude, but beside being a gangster, the peculiarity of Tony Camonte resides in continuing to take action himself. While other bosses get comfortable and set the limits of their ambition as their career proceeds, Camonte stays actively involved in the front line, willing for more and not taking for granted what he already has. We believe a do-it-yourself attitude is necessary not to forget that things

could have always been done differently and that we cannot simply wait for things to happen. Without the do-it-yourself attitude *Tecnoscienza* would simply not exist; so yes, we will keep on doing it.

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Alcune riflessioni sul 10° anniversario di Tecnoscienza

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Abstract: How can STS move towards a greater pluriversality? How can we question the taken for granted of STS scholarship and geopolitics, so as to engage across radically different worlds? Thinking through a decade of *Tecnoscienza* and bridging the articles published in the 2010 and the 2019 volumes, the contribution reflects upon possible lines of future STS inquiry.

Keywords: STS; pluriversality; feminism; more than human relations; Tecnoscienza.

Submitted: May 30, 2020 – **Accepted:** 30 June, 2020

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1. Introduction

How can STS (an STS multiple) be part of wider transitions from universal knowledge projects to projects in articulating pluriversality?[1] The answer to this question cannot, obviously, be a prescription for what 'we' all should be doing. Rather, answering needs to be part of an ongoing, collective conversation in which we locate ourselves as speakers/writers, not once and for all but always in relation to the discussion at hand. Our discussion here engages with the 10th anniversary of the journal *Tecnoscienza*, established initially as a forum that invites contributions from STS scholars for whom Italian (once the imperial voice of Renaissance Europe) is their native tongue, or those who have undertaken the work of gaining fluency in that beautiful language. This itself is a step towards greater pluriversality, asking different readers to make the effort of becoming multilingual or risk missing out.

While the dominance of English as the lingua franca of academic publishing continues, there are at the same time shifts in centres of gravity

within STS that challenge monolingual futures for the field. The flourishing of *Tecnoscienza* is indicative of an expanding range of STS scholarship and associated journals, which support regional networks of research and publishing in (*inter alia*) Latin America (*Tapuya*, published in English but inviting supplemental translations in Spanish and Portuguese) and East Asia *(EASTS)*, as well as across Europe (*Science and Technology Studies*) and Scandinavia (*STS Encounters*, published in Danish and other Nordic languages as well as English). In a less hegemonic future, these networks could open new possibilities for researchers not only to think and work but also to write in first languages, leaving those of us who are monolingual English speakers feeling (at last!) increasingly on the outside. At the same time, this transition is not an easy one, as is evident in the fact that, while the majority of the journal's contributing authors continue to be located in Italy, *Tecnoscienza* shifted to English only submissions in 2016. The politics of language are integral, in sum, to thinking about our field's pasts and transforming its futures.

Where else might we begin in taking *Tecnoscienza's* 10th anniversary as an occasion to think about STS? How about the cover of Vol. 1, No. 1, a human/machine designed by Zaven Paré? The human, as is so often the case, is figured as/by a face (in this case without a mouth), suspended on what is evidently the machinic body that supports and animates it. The editors' description of the art installation of which this device is part is eloquent, conveying the poignant effect of multiple of these identical phantasmatic subject/objects, inchoately murmuring, generating sounds that, while originating from human bodies, diffract through these machines and the gallery space to engender an affective return to the bodies that the installation incorporates as its audience.

Ten years later, the cover of Vol, 10, No. 2 presents a self-driving car, bedeviled by a salt circle; "By reproducing a "No Entry" road marking, the circle confuses the car's vision system into believing it is surrounded by no entry points, and entraps it" (Redazione Tecnoscienza 2019). A work of installation artist James Bridle, "Autonomous Trap 001 (2017)" joins the human/machine as another fetish object of automated autonomy, this time centering automobility. Bridle himself embodies a transdisciplinarity indicative of the future of STS, as an artist/scholar capable of configuring the hardware and software of this "research vehicle." The research being conducted by Bridle is a simple suggestion for a non-violent act of sabotage, a countertechnology to the investments of Google, Tesla and other contenders for the displacement of driving labours, and a move towards demystification that demonstrates the fragility of the car's sensory coupling with its surrounding environment.

As a device for navigating the rich range of topics evident in work published over *Tecnoscienza's* first decade, I'll stay with the somewhat arbitrary strategy of thinking through Volumes 1 (2010) and 10 (2019), about generative lines of future STS inquiry.[2]

2. STS of Translations

Following translation – as the work of making commensurable, with its inescapable losses and frequent betrayals – is a founding/ongoing STS project. Within the material-semiotic framing of STS research, translation refers to processes by which entities, beings, knowledges and practices from one location are re-rendered in order to be intelligible and practicable within another. The inaugural issues includes stories of raw milk dispensers (Piccioni 2010), the stabilisation of furniture (Parolin 2010), the "retranslation" of images in experimental psychology (Gianelli and Montanari 2010), and the "recombinant typicalities" of breadmaking with "reconfigured 'natural' yeast" (Mongili 2010). In Volume 10, the case of the "translational imperative" to move findings from animal models to humans (Lowe et al. 2019, 6) considers the question of who suffers, or is sacrificed, on behalf of whom as an integral moral/ethical thread, for both biomedical practitioners and STS scholars. Reminding us that care is a longstanding topic for STS (cf. Lynch 1988), the current moment brings new questions and normative prescriptions regarding multispecies translation, and adds further layers of nuance to critical STS accounts regarding "material flows and conceptual transformations" from bench work to clinical treatment, laboratory to market (Lowe et al. 2019, 11). Recognising that the traffic of natureculture flows in multiple directions, extending and deepening our field's tracings of the politics of translation begins to open up possibilities for "doing difference" differently (Verran 2013), in support of more radical transformations in the geopolitics of knowledge making.

3. STS of Ordering

Perhaps more than any other field of social research, STS has attended to the material practices through which social ordering is enacted. In Vol 1, Coletta (2010) directs us to the performative agencies of street names, taking the mundane artefact of city signage as a guide to recovering the administrative lifeworlds that assign material-semiotic orderings to the urban landscape. Ventura (2010) examines relations of urban lighting and road surfaces through the case of Palermo's Piazza Politeama, showing daily cycles of transition in the piazza's symbolic and practical character affected by naturalcultural changes in illumination. Ten years later, as I write these reflections in the moment of the pandemic of Covid 19, we find ourselves subject to extraordinary reconfigurations of social space aimed at managing and disciplining mobility/contact. These new orders of mobility governance intersect with ongoing, and intensifying, techno-political regimes of population management through border control. Animated by discourses of in/security, b(ordering) at once promotes fear

from invading 'aliens' (as human and viral actors/actants are deliberately conflated), and promises to conquer the threat through fortification and containment (Andersson 2020). Technopolitical regimes at the border engaged in what Pelizza (2019) has characterised as "processing alterity" are enabled through the expansion of computational infrastructures; these systems reanimate longstanding imaginaries of omniscient/omnipotent control based on translational technologies of sensing and datafication.

4. Sensing STS

From Volume 1, STS is a resource for critical data analytics as both method and object of research, troubling dominant tropes of research into computationally-enabled sociality, e.g. "online community" (Pelizza 2010), in favour of attention to the noncoherence and ephemera that escape the computational system's normalising designs. By Volume 10, relations of datafication and knowledge-making take STS into multiple domains. Zampino (2019) follows the case of self-tracking as a mode of ontological choreography, not only in the clinic but in everyday life cycles. Bodily agencies are complicated in a matrix of expert knowledge and behavioural management on one hand, incorporation of new possibilities for self-knowledge of the body on the other. The politics of knowledge making are critical here, specifically questions of who configures relevant measurement devices in the service of whom, further complicated by the ways in which a device's design is at once normatively prescribed and never determining of its use and significance (see also Roberts et al 2019). Measuring devices do not render their signs independent of the body that "learns 'to be affected'", to be moved by those signals (Zampino 2019, 33, citing Latour 2004). The direction of movement, as Yli-Kauhaluoma (2019) reports, may be less about changes aimed at health and well being than about new routines developed in the service of the smooth operation of sensing devices themselves.

5. Feminist STS

In Volume 1 Castiello's (2010) review of *Meeting the Universe Halfway* (Barad 2007) anticipates my own reflections on relations between Barad's writings and ANT (Suchman 2011 which, my apologies, should have cited Castiello!). Castiello observes:

> Questi due movimenti – verso il reale e verso una nozione di realtà non rappresentativa bensì performativa e in divenire – costituiscono, probabilmente, la cifra di una convergenza di interessi, seppur con le debite differenze, tra il dibattito inerente ai STS e le teorie femministe (2010, 115).

> [These two movements – towards the real and towards a notion of reality which is not representative but rather performative and in a process of becoming – constitute, probably, the sign of a convergence of interests, albeit with due difference, in the debate between STS and feminist theories].

Delineating lines around and between things is, as we know, a practice of making difference. It follows that responsible knowing requires attentiveness to the reiterative, material-discursive practices through which object boundaries are drawn, and to the constitutive relations – and exclusions – that boundary making enacts. This includes, of course, the figures of STS and feminist theories themselves, each becoming, however contentiously, in relation to the other.

A decade later Sciannamblo (2019, 80) returns to the question of what we might mean by STS as an "ethico-onto-epistemic practice," adopting an admittedly unwieldy conjunction introduced by Barad to signal the inseparability of ethics, knowing and becoming. Sciannamblo prefaces her empirical discussion of instances of writing research with a thoughtful and extensively referenced précis of debate regarding how STS is implicated in its own theoretical/empirical arguments regarding the performativity of knowledge claims. This is a discussion that has at its best combined clarifying critique (rather than critique in the service of territorial claims or one-upmanship) with transformative reconceptualisations of relations between research methods and their objects, the material and the discursive, knowledge and world making.

6. More than human STS

By Volume 10 the multiple realities of climate change compel attention from STS researchers, not only to associated technosciences but increasingly also to wider publics and multispecies relations. Inspired by Callon (1998), DelSesto (2019) takes people-plant interactions as a site from which to examine what he identifies as the logic of constraints that frame the socio-spatial architectures of the Anthropocene, and the overflows that open that logic to alternative paths towards transitions to sustainability. As he traces the disconnection of social life from nature, DelSesto centers "the ongoing design of people-plant interactions as a practice that can work from the inside-out to unfold new political capacities" (2019, 101). The prison garden, for example, enacts a kind of counter socio-spatial logic, wherein "a certain kind of energy … exists – of uncertainty, openness, and possibility" (ivi, 108). Without over-representing the agency of such spaces within wider political economies of mass incarceration, DelSesto argues that their local effects are powerful, and are echoed in diverse configurations from urban gardens in reclaimed 'vacant' lots, to therapeutic gardens inside institutions like hospitals or long-

term care facilities.

Giardullo et al. (2019) take the movement for a global energy transition from finite fossil-based to renewable zero-carbon systems as critical for sustainable human/more than human relations. Read in a moment of pandemic, the toxicity of globalisation as a political economic project, involving the opening of commercially-based flows accompanied by renewed commitment to the containment of (mostly forced human migration), is as an index of the wider transition of which remaking energy sources is a key element. Crossing boundaries in order to connect the dots leads this discussion into a plethora of multi-scalar (both temporally and spatially) and interrelated themes.

7. Coda

A crucial question for us as STS-informed scholars/activists is just what worlds are presupposed, assumed, reiterated in our reading, writing, and practice? Who do our words reference, when, where, and under what circumstances? Too often the worlds of reference remain implicit, comprising the taken for granted settings and networks in which we ourselves are located. For many of us writing from Anglo/Euro/US worlds, unmarked figures (of the human, the consumer, the actor, the citizen) stand in for the specificity of those we actually have in mind. We need to expand our capacity to acknowledge radical difference, including the specificities of our own locations and associated onto-epistemological conditions, and the histories, politics, economies and discourses that hold those differences in place. At its best, careful scholarship in STS helps with that work, as it draws from and builds upon the accumulating archive of writings/insights that comprise the field, elaborating or reconsidering our collective ideas as they are reiterated and mobilised anew in a next story, analysis, and argument.

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[1] Mignolo (2018, x) characterises the pluriversal as working counter to the power differentials introduced by colonialism and its companion modernity, with their associated investments in the unity of Western technoscientific knowledge systems.

[2] My apologies to all of the bountiful scholarship left out of this brief survey, for which I refer readers to the archives of *Tecnoscienza*!

STS Challenges. The Next Ten Minutes and The Coexistence of Modes of Science

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Abstract: The Covid-19 pandemic is not only a profound health, economic and social crisis but also a dense summary of key STS concepts. The current pandemic invites us to recognise the co-existence of different modes of science, offering an opportunity to contribute to a better understanding of contemporary science in society dynamics and their changes.

Keywords: STS; Covid-19; modes of science; coexistence; decisional processes.

Submitted: May 30, 2020 – **Accepted:** June 30, 2020

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In ten minutes from now, a scientific expert will say something about the Covid-19 pandemic that will trigger comments and critiques from other scientific experts, further questions and discussions in the media.

Controversies; insights into the changing social role of scientists and the public image of science; shifting relationships between expertise and policymaking. The current pandemic is not only a profound health, economic and social crisis but also a dense summary of key STS concepts. As Steven Shapin put it in our recent conversation, "we are now living through the greatest exercise in public scientific education that there's ever been"[1].

Public debates reveal implicit assumptions about the perceived role and nature of science.

However, there have been several discussions regarding disagreement and diversity of advice provided by experts and the impact this could have on policy decisions and public opinions. These discussions often oscillate between two extremes: those who think that science (and scientists) should speak with "just one voice", offering to political decision and to public opinion reliable and uncontroversial knowledge; those who invite to recognise the inherent uncertainty, provisional character and articulation of scientific debate and research processes, allowing no shortcuts even in times of emergency.

In STS, we are familiar with the different "modes" of science (mode-1 and mode-2, academic and post-academic science, Science 1.0 and 2.0), often described as chronological transitions of organisational practices of research and its social uses (Gibbons et al. 1994; Nowotny et al. 2001; Ziman 2000; Bucchi 2015).

To an STS-eye, the current debates on the role of science in the pandemic might be easily interpreted as the misalignment between "mode-2" concrete expectations (e.g. short-term orientation towards practical goals; pressure to deliver solutions; scientists as expert advisors) and "mode-1" traditional social image of science (e.g. long term, curiosity driven effort and discussion; independence; scientists as intellectuals having the right to express their own individual vision, even when potentially contradicting their colleagues).

It is easy to imagine STS lifting its finger and admonishing science: "You are working and being funded as mode-2 science but still pretending to have all the prerogatives and freedom of mode-1 science". And vice versa, lecturing society: "You are expecting quick results and convenient fixes typical of mode-2 science but are still reasoning and imagining science along the lines of mode-1".

But would this really help? Or is the current crisis a situation that invites us instead to recognise the *coexistence* of different modes of science - as narratives, rhetorics and images that continuously overlap and intersect, with the same actors practicing and preaching different modes in different situations?

This overlapping is neither unprecedented nor unfamiliar to those studying science and even to scientists themselves. In his book *Science and Government* (1960), CP Snow tells the story of how leading physicists contributed to the UK military effort during the World War II. One of them, Nobel laureate Patrick Blackett, credited for having made possible defeating the powerful Nazis U-Boots, introduced the concept of "operational research". His lesson to politicians and the military was "that you cannot run wars on gusts of emotion. You have to think scientifically about your own operations" (ivi, 25). Blackett had a lesson also for his fellow scientists willing to engage as experts advising decision makers: "The giver must convince himself that if he were responsible for action, he would himself act so" (ibid.). When scientists accept to enter into the dynamics of this operational modality of knowledge, they implic-

itly accept to try and give simple responses to complex questions, to compress the long times of research; not to suppress uncertainty altogether but making it manageable by those who have the ultimate responsibility of political decisions.

This role of science in decisional processes, can, of course, enter into tension with an image of research as independent. In this sense, for instance, the 92 different scenarios offered by experts to the Italian government in view of the so-called "phase 2" of the pandemic represent a very detailed technical overview but quite difficult to be used in decisions.

Tension and ambiguity between different modes of science can also emerge dramatically, as it happened in the case of L'Aquila earthquake (2009). The reading of that judicial case from the international scientific community was fast and superficial, even comparing it to the Galileo trial. Without entering into the complex juridical details, it is clear that expressing an evaluation in a scientific paper is not the same thing – from the point of view of responsibility – compared to expressing it when a scientist acts in the capacity of expert delegated by politics to manage an emergency situation.[2]

The "right to error" is typical of independent science: taking unusual or intellectually risky paths has sometimes allowed making unexpected or revolutionary discoveries. On the other hand, a scientist who accepts engaging into operational relationships with politics must evaluate the potential consequences of her/his indications. Not all scientists, however recognised for their studies and academic publications, have like Blackett the necessary qualities to play this difficult role. And unfortunately, not always politics succeeds in carefully selecting among the different advices provided by experts: UK Prime Minister Winston Churchill finally managed to get rid of Blackett and continued to trust physicist Frederick Lindemann, who insisted on concentrating all military efforts on bombing German cities. Data later showed that his estimation of the impact of those attacks was completely wrong, ten times higher than real effects.

Seventy years later, the ambivalence and interplay of different visions and modes of science is much stronger and visible. Rather than an ambiguity to be finally resolved, we could consider it as resource for bringing into light such different visions, highlighting their implications and consequences for research, politics, and society.

In ten minutes from now, STS scholars will have once again an opportunity to contribute to a better understanding not just of the present pandemic, but more broadly, of contemporary science in society dynamics and their changes.

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[1] Original interview, 14 april 2020. A short excerpt has been published in Corriere Innovazione, 24 april 2020.

[2] A recent reappraisal of the issue by Brandmayr here: https://hscif.org/author/fb446cam-ac-uk/

Establishing a Legitimate Knowledge-based Dialogue among Institutions, Scientists, and Citizens during the Covid-19: Some Lessons from Coproduction

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Abstract: Within a STS approach to science policy, the concept of coproduction suggests that scientific explanations and normative evaluations are deeply entangled. Science-based decisions surrounding the use of surgical masks and the measures for contact tracing in the context of Covid-19 show that coproduction can be a powerful democratic instrument to open up science policy to public discussion by highlighting how its statements are negotiated and elaborated.

Keywords: science policy; coproduction; Covid-19; surgical masks; App IMMUNI

Submitted: May 30, 2020 – **Accepted:** June 30, 2020

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The relations between science, policy, and law represent a major field of analysis in Science & Technology Studies and have the potential to contributing to an improved quality of governance in democratic societies. Indeed, as has been recognized, science and normativity are the two pillars through which democratic societies make sense of themselves, major sources for authority (Silbey 2008), and the main creators of orders and rules (Jasanoff 2012).

Within this field, the concept of coproduction, as developed by Sheila Jasanoff (2004), has proved as a useful tool to look at the interfaces be-

tween science and regulatory processes in all institutional branches, from the legislative (Jasanoff 2005) to the judicial (Jasanoff 1995), and the administrative level (Jasanoff 1990). The notion of coproduction suggests that facts and values, scientific descriptions and normative evaluations, formally separated as the two different logical worlds of "is-ought" (a quasi-definitional formula of modern thought), cannot be set apart when they interact in the real world of science and society. The actual life of science, policy, and law involves a more complex combination of descriptions and prescriptions. Focusing on how the boundaries between facts and values are reciprocally generated, coproduction aims at deconstructing and disentangling them, by looking inside the black boxes of regulatory science. For these reasons, besides being an analytical tool, coproduction can be a powerful democratic instrument to open up science policy to public discussion by highlighting how its statements are negotiated and elaborated.

The current crisis related to COVID-19 has allowed these complex relations to emerge and to become apparent to citizens in all democratic societies through the dialogues, the open and hidden controversies, negotiations, and decisions among politicians and decision-makers, their scientific advisers and the wider scientific communities. The public discovery of the true life of science-based decisions, still often imagined and depicted through the myth of "science speaks truth to power" (Wildafsky 1979), is a relevant opportunity for intentional institutional unveiling and disclosure of the coproduction of science and normativity. This approach would allow, even under less extreme and tragic conditions, to make all parties – namely decision-makers, scientists, and citizens – more aware of the intrinsic dynamics of knowledge and power in negotiating and establishing norms and courses of actions in more scientifically reliable and politically responsible manners. In other words, it would improve the legitimacy of democratic life.

With an unprecedented clarity, the 2020 emergency has given visibility to several phenomena that are both STS well-explored topics and interesting cases for a coproductionist analysis: from the role and construction of experts and expertise to the relations between heads of government and their chief-scientists, to the political choice of single or multiple advice and advisers, to the styles of communication and the management of citizens' rights to receive and ask for information, to the revision of facts in order to reframe decisions and responsibilities.

I would like to focus on two relevant topics that have been central in the COVID-19 crisis and are deemed to become a durable presence in the relations between science and policy in democratic contexts – here by looking at them mostly through the lenses of the Italian situation. One topic concerns how institutions have proved largely unable to reliably and responsibly provide arguments in making normative decision in the face of scientific uncertainty. The other relates to the new epistemic roles for citizens and to the emergence of a broader meaning for citizen science.

As to the institutional communication of how uncertain knowledge has been used in policy decisions, the COVID-19 pandemic has revealed that, when faced with uncertain scientific knowledge, decision-makers have often failed to provide a robust explanation of their reasons for adopting a specific scientific hypothesis. Indeed, policy-makers do not seem equipped, not only scientifically but also politically, to distinguish between actual disagreements among experts in the same field and the heterogeneous assumptions and perspectives characterizing different disciplines (e.g. virology and epidemiology). Moreover, hiding behind presumed objective and certain knowledge is easier than taking responsibility for endorsing an uncertain scientific scenario – perhaps together with a plan to cope with the limits and rate of errors of the vision adopted.

The case for surgical masks, namely their necessity or irrelevance to prevent infection, has been paradigmatic of this apparent awkwardness as well as of coproduction as a tool to clarify and legitimize decisions. At the beginning of the emergency, most policy officers, politicians, and scientific advisers (starting at World Health Organization [WHO] level) failed to openly admit the scarcity of masks as a reason to prioritize their use by the health personnel, while advising citizens to act carefully in the absence of these protective devices. Instead they chose to hide the reality behind the "scientific fact" that masks were useless for healthy people. Only later, when masks became widely available, suddenly their use turned out to be almost mandatory – again with reference to a single scientific paper showing that a six feet distance could not be safe enough (Bourouiba 2020). WHO changed its guidance from "no evidence that wearing a mask by healthy persons (...) can prevent them from infection" (April 4, 2020) (WHO 2020a) to "(m)asks can be used (...) for protection of healthy persons" (June 5, 2020) (WHO 2020b). [1] This single event was literally "unmasking" how the "cherry picking" of scientific data could be tactically managed to back-up difficult policy decisions, instead of operating in transparency and building reciprocal trust between institutions and citizens (Culver 2020; Alvaro 2020).

An institutional culture of dialogue with citizens in science policy, where scientific evidence and proposed norms are presented and discussed by highlighting all the assumptions, correlations, and implications, and where facts and values are opened up in their reciprocal, coproduced establishing credibility and legitimacy, cannot be improvised. This culture has to be daily interwoven in the institutional fabric of relations with citizens in order to generate confidence on both sides. Moreover, this culture requires an updated epistemological vision, where post-normal science – namely when facts are uncertain, values in dispute, stakes high, and decisions urgent (Funtowicz and Ravetz 1993) – becomes the normal condition for all societal choices, and where scientific uncertainty is unfolded to explain how and why normative decisions are made (Toews 2020; Tallacchini 2020).

The second topic for reflection relates to how, in the context of the

pandemic, the circulation of knowledge among institutions, scientists, and citizens has revealed new critical roles for citizens in using scientific knowledge, and perhaps has broadened the meaning of citizen science. These roles and this emerging meaning for citizen science can be better understood and implemented in the light of co-production.

Often and repeatedly, in the past decades, Italian citizens have been represented as scientifically ignorant and irrational, and averse to science and technological innovation. The same accusation has accompanied public acceptance of biotechnology and genetic engineering, electromagnetic fields, and more recently vaccines. In this latest case, the Italian government has adopted a compulsory approach to vaccination (Law 119/2017), also backed-up by a decision of the Constitutional Court (5/2018) portraying scientific certainty and objectivity as the rationale for legally binding measures – even though, according to a "Nature" editorial (2018), this approach seemed more typical of countries with poor democratic traditions, "mostly the post-Soviet Union States".

Indeed, Article 32 of the Italian Constitution encompasses two different visions of the right to health, defined as an individual fundamental right, but also compatible with mandatory treatment authorized by the law when public health is at stake. However, if traditional methods and measures in public health have been developed, especially in the field of infectious diseases, in connection with legal acceptance of compulsory measures and strong limitations of fundamental rights, in the past decade disease control and surveillance have been increasingly made more participatory and primarily based on citizens' individual and collective responsibility (Epstein 1998; Gainotti et al. 2008). Lacking an institutional culture and training for dialogue with citizens, the Italian government did not even try to discuss and build a collaborative vision of the right to health, framed around participation, solidarity, and reciprocity, neither in the vaccine domain nor in other public health domains (from environmental health to screening programs) because adoption of this path involves admitting and coming to terms with scientific uncertainty (Tallacchini 2019, 2020).

What the crisis has shown is that the very same citizens, previously depicted as undisciplined recipients of compulsory measures, have turned into essential actors in dealing with the pandemic (Ministero della Salute 2020a). Indeed, citizens' accurate understanding and implementation of scientific knowledge in their daily behaviour, and more broadly their voluntary compliance with government recommendations about self-certification and self-isolation have been at the core of the containment strategies.

If harmonizing individual and collective health is a key to a health system in line with the principles of a democratic and under the rule of law society, this approach is also coherent with an epistemologically advanced vision about how conditions of scientific uncertainty need to be opened up, shared, and discussed in order to make social decisions more robust

(Stirling and Scoones 2009; Tallacchini 2019).

The scientific information and science-based practices that citizens have acquired, have become acquainted with, and have been implementing since the pandemic has started – e.g. the safety protocols that individuals have to set up and apply in all kinds of private or professional activities (from properly sanitizing personal food items to safely running a commercial activity)– not only require a reciprocally trusted relation with the institutions offering the necessary knowledge, but are also going to affect society as a whole. This phenomenon can be described as a fairly new meaning for citizen science, where institutions have to widely rely on lay people's ability to properly manage knowledge and practices with crucial impact on keeping social life safe. Indeed, if this phenomenon is not entirely new, its dimensions and impact certainly are. From this perspective, Toews et al. (2020) have highlighted that:

> the whole world becomes an extended peer community, as the appropriate behaviour and attitudes of individuals and masses become crucial for a successful response to the virus. This extended peer community is the opposite of a technocratic, number and model-based decision strategy.

Among these new epistemic roles for citizens, where citizens' science-based behaviour and trust are becoming increasingly important, the (often governmental) implementation of tracing digital technologies to predict and control the spread of the virus reveals interesting features (Barsallo Lynch and Zabierek 2020). These forms of so-called participatory surveillance for public health purposes are portrayed as a move towards more democratized practices as they function on a voluntary basis and directly engage the observed subjects. However, making tracking voluntary does not justify its overall legitimacy, as participation *per se* is not significant if the powers involved and all the procedures are not disclosed, clarified, and balanced (Biggeri and Tallacchini 2018). In the Italian case of IMMUNI, the app that "uses technology to alert the users who have had a risky exposure – even if they are asymptomatic", [2] a lot of attention has been paid to the anonymization of data and its deletion after two weeks as a way to gain citizen's trust. Privacy and data protection, however, have been overemphasized as the single concerns in the overall process, even though a lot of uncertainty and undisclosed knowledge surrounds all the administrative mechanisms and potential gaps and inefficiencies involved: first of all, the risk for citizens to find themselves lockdown after an alert without the certainty of being timely tested and unlocked after the quarantine. The document released by the Italian Ministry of Health (Ministero della Salute 2020b) in late May on contact tracing does not mention the issue and limits its provisions to the moment when the user who is SARS-CoV-2 positive is invited by health personnel to download the app and to transfer his data to the Ministry for Health. The app has been pub-

licly released without having taken care of all its practical implications.

Quite interestingly, the problem has been raised, instead, by a WHO brief, in June 2020, that has introduced new criteria "for releasing COVID-19 patients from isolation" (WHO 2020c). WHO was previously recommending two negative RT-PCR tests at least 24 hours apart, but "in light of limited laboratory supplies, equipment, and personnel in areas with intense transmission" WHO reframed its requirements asking "that patients' symptoms have been resolved for at least three days before release from isolation, with a minimum time in isolation of 13 days since symptom onset" (WHO 2020c, 3). To date the Italian government has not adopted a position about implementing the new criteria, which increase dramatically the individual responsibility in managing knowledge as the decision about having recovered from the disease is left to citizens.

Again, the governmental perspective that limits concerns to data protection is an example of the institutional reductionist vision of technoscience – not perceived as a complex process embedded in social and bureaucratic practices – and of the lack of a well-designed plan for citizens while asking them to go blind into implementing the governmental app. Using coproduction to clarify the intersections between knowledge and decision-making may contribute to a better epistemology and an improved confidence in the relations among institutions and citizens.

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What Can We Learn from the History of STS in Italy? A Few Hints for the Future

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Abstract: By recalling his own career as an historian of science and technology, the author sketches the history of Science and Technology Studies in Italy from their early steps in the 1970s and 1980s. He highlights the ways in which the field has gained visibility and substance in the Italian context, but also pointing out the constraints and hurdles that still must be overcome to consolidate it. In particular, the author underlines how the traditionally rigid disciplinary partitions of Italian academia and the nationally centralized system of Italian universities have hindered, and still hinder, the institutionalization and the potential impact of STS south of the Alps.

Keywords: STS; History of Science; Italy; Interdisciplinary studies; academia.

Submitted: May 6, 2020 – **Accepted:** May 30, 2020

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As an historian of science and technology with an interest in STS dating back to the early 1970s, I want to contribute to this anniversary issue of *Tecnoscienza* with some reflections combining a long-term perspective on the field and a few hints on how to sustain its further development in the future. The reflections and the hints, hopefully, will benefit from a less-than-cursory experience in the joint venture of historians of science and STS scholars in different countries over the past fifty years.

A former engineering student with a passion for the history and philosophy of science, in 1970 I ended up with a philosophy of science "laurea" degree, based on a dissertation on a history of science topic with some significant social implications, that I addressed from a moderate socialist standpoint. There were no substantive academic opportunities for historians of science in Italian universities in those days. Unhappy with the kind

of logical positivism prevailing among Italian philosophers of science, I was attracted by what I regarded as the promising, recent developments in the history of science as practiced in the United Kingdom and USA. Such developments displayed a growing attention for the social history of science and for what were then called "science studies". In 1971 a new journal by that name – renamed *Social Studies of Science* a few years later – was launched in London. The two editors were from two different, recently established research units pursuing the kind of topics I found fascinating. Roy MacLeod was based at the time at the University of Sussex, where the Science Policy Research Unit (SPRU) had been established in 1966. David Edge was at the University of Edinburgh, where the Science Studies Unit had been created in 1964, thanks to a grant from the Wolfson Foundation. A few years earlier Edward Shills, an American sociologist with an interest in science policy who participated on both sides of the Atlantic in what was later called the cultural Cold War, had established the journal *Minerva. A Review of Science, Learning and Policy* (1962).

In the early 1970s another, significant playground of the cultural Cold War was launched that proved important for the early history of STS. It was supported by UNESCO and cultivated by historians and sociologists of science interested in a dialogue across the Iron Curtain. The 13th International Congress of the History of Science, meeting in Moscow under the auspices of UNESCO in 1971, saw the formation of an International Council for Science Policy Studies whose members represented institutions ranging from Paris, Harvard and MIT to Moscow and India, as well as scholars from western and eastern Europe and Latin America. There were no Italians on the Council. One lasting product of the initiative was a fascinating, massive volume published by SAGE in 1977 under the title *Science, Technology and Society. A Cross-Disciplinary Perspective*. Edited by Ina Spiegel-Rösing and Derek de Solla Price, the book is regarded as the first of the several STS "handbooks" we are now familiar with (Spiegel-Rösing and de Solla Price 1977).

Back in 1971, another seminal book in the field had been published by Jerome R. Ravetz, then at Leeds University: *Scientific Knowledge and its Social Problems* (Ravetz 1971). In the meantime at University College, London, and other British universities, the Wellcome Trust – a research-charity established by an American-born British pharmaceutical entrepreneur – supported the introduction of research units and teaching positions devoted to the social history of medicine and human health. University College already had a Department of History and Philosophy of Science and in 1994 it became today's Department of Science and Technology Studies.

Nothing comparable was happening south of the Alps in those same years. Within the slow-moving, centralized, ministry-approved, Italian hierarchy of academic disciplines, it was not until 1979 that there were unambiguous signs of the history of science being recognized as a new field. In the national academic context, the social history of science often met

with skepticism bordering on hostility.

However, thanks to frequent travel and a 1979 scholarship from the British Academy-Wolfson Foundation that I spent in London, in 1980 I was asked by Roy MacLeod to write a "country report" for *Social Studies of Science* focusing on "The history and social studies of science in Italy" (Pancaldi 1980). The burden for the author on such an occasion was to try to explain to foreign colleagues why – despite the often vibrant, occasionally fierce Italian public debates on "science and society", often involving *internalist* versus *externalist* historians and natural scientists, many inspired by a Marxist agenda – no new research units, journals or other significant publishing initiatives devoted to the social studies of science were being launched.

It took a few years, and some flank movements on my side, to convince senior Italian academics that there might be room at our state-run universities for the kind of social history of science that I was practicing. Having secured a tenured position at home, I was able to expand the international networking that appeared to me the main way to develop the convergence of the history of science and social studies of science, that I found so stimulating in the works of a growing number of British and American colleagues, and help circulate it in the peninsula.

In 1986, a Fulbright scholarship allowing me to spend a semester as a visiting scholar in the Office for History of Science and Technology at the University of California, Berkeley, offered additional yarn from which to weave experiments at networking and institutional change. The Office had been created in 1973 with the aim, among others, of maintaining close ties between historians of science and the powerful natural sciences community for which Berkeley was known worldwide. John Heilbron, trained as a physicist and head of the Office, had worked as Thomas Kuhn's assistant. Heilbron was later critical of Kuhn's work and influence, but in those years he edited a journal, *Historical Studies in the Physical Sciences*, that at its launch in 1969 was intended by founder Russell McCormmach to pursue "the synthesis of the intellectual and social history of science that must come" (McCormmach 1969, viii). Taking the helm of the journal in 1980, Heilbron himself had declared: "McCormmach's resolve to bridge internal and external history has entered the ethos of the profession…" (Heilbron 1980, ii).

In Berkeley in 1986, in dialogue with John Heilbron, the idea developed of establishing an International Summer School in History of Science along the lines of similar schools popular among physicists. Beginning in 1988, the Summer School met in Bologna, Uppsala, and Berkeley in rotation, with Paris to be added later. Of the scholars in charge of the school, two were born before WWII (Heilbron, Berkeley, and Tore Frängsmyr, Uppsala), and two after the war (Pancaldi, Bologna, and Dominique Pestre, Paris). The four represented, as it were, two different generations of scholars, with the latter feeling much closer to the social studies of science and STS that were putting down roots in many English-language universities.

The students admitted to the school – doctoral students and post-docs – reflected the agenda and moods of a somewhat divided but thriving field of study. The school's ten one- or two-week-long sessions held between 1988 and 2006 attracted more than three hundred students from eighteen countries. Those attending the 2004 School in Bologna will long remember the passionate discussions that followed Dominique Pestre's lecture on "Thirty years of science studies" (Pestre 2004) and Jan Golinski's on "Making natural knowledge" (Golinski 1998).

For the young Italian scholars in attendance, the school brought networking opportunities and the welcome breath of fresh air that lively international meetings carry with them. But of course, more was needed for the field to catch on and begin growing roots within the Italian university system. Only the creation of research units and teaching programs specifically devoted to the new field could offer hopes of establishing it in a lasting way. The example provided in those years by universities abroad was clear. In 1988, the MIT Faculty approved their new STS doctoral program. Still active today, the program partners with historians and anthropologists to train researchers in the "historical, cultural, social, political and economic dimensions of science, technology and medicine across the globe."[1] The 2002 establishment of the Harvard program on "Science, Technology & Society" sent a similar message. Other such programs currently active in the USA include the Berkeley Ph.D. in Science and Technology Studies, and similar programs at Cornell, Wisconsin-Madison, Michigan, and Virginia Tech.

In Italian universities, Ph.D. programs in any discipline were first introduced as late as the mid-1980s, when I was just being appointed as professor of the History of science at the University of Bologna, without the requirement of a Ph.D. Convinced that doctoral studies were indeed a crucial experience and cherishing the prospect of writing my next book in English, I took the step – unusual for a professor – of becoming a doctoral student again. I earned my Ph.D. (*DPhil*, as they call it) from the University of Oxford under Robert Fox, who practiced a history of science that I found congenial as it combined close attention to scientific content and a deep awareness of institutional and social contexts.

My efforts at networking and institutional bricolage continued. In 1991, I took advantage of the euphoria generated in Bologna by the recent festivities celebrating 900 years since the foundation of the university to launch an International Centre for the History of Universities and Science. Still in operation, the Centre allowed the kind of regular hosting of foreign visiting scholars that the Summer School could not provide. It also made it somewhat easier to attract local, national, and European funds to support young researchers interested in exploring new avenues of research. It took many years, however, to convince colleagues at the University of Bologna that the most urgent step needed to catch up with what was happening abroad was to launch a doctoral program adopting some of the features characterizing the STS programs prospering elsewhere. A full academic

year spent at MIT and the Harvard Department of History of Science thanks to a Dibner Fellowship in 2002-2003 confirmed my convictions. Back in Bologna, a small step in the hoped-for direction occurred in 2005 when cultural anthropologists agreed to host an annual course of lectures on the Anthropology of Science and Technology (in 2009 the name was changed to Social Studies of Science). The course became quite popular among students from both the humanities and the natural sciences.

I pursued a connected line of intervention as a member of the national and local committees selecting candidates for new academic positions in Italian universities. This consisted in attracting back to Italy several Italian colleagues who had completed their studies abroad in areas akin to the social history of science and STS. As part of the same strategy, I also encouraged several of my students to continue their doctoral studies abroad.

In 2007, finally, a new Ph.D. program was launched at the University of Bologna, hosted by the department I was attached to: the Philosophy Department. The title adopted – Science, Technology, and Humanities – reflected the program's aspiration of combining the humanities, deeply rooted in the local tradition, with the natural sciences and technology. In its early days faculty members supporting the program came from physics, mathematics, the biomedical sciences, engineering, and economics as well as philosophy and the humanities. The program also benefited from cooperation agreements with scholars from the Universities of Exeter and Konstanz. The new Ph.D. program attracted a fair number of students from several countries each year. As time went by, however, the combined pressure exerted by both local and ministerial diffidence towards the interdisciplinary character of the program – atypical vis-à-vis the deep divide separating the humanities and social sciences from the natural sciences and technology within the institutional setting of Italian universities – prevailed. Such pressure eventually led the denomination of the program and the composition of its faculty to be changed. Currently, "Philosophy and Science Studies" is only one of the three curricula available to students, and the program no longer maintains close ties with faculty from outside the humanities and social sciences.

Around the year 2000, a new source of potential support for projects pursuing the kind of interdisciplinary agenda sketched above became available from the European Union through its cultural programs. My own experience with one such program, "Culture 2000", was satisfactory on several accounts. It made it possible to organize conferences and publications on "nature, culture and identities" through a joint initiative by scholars in the social and natural sciences belonging to the universities of Heidelberg, Louvain-la-Neuve, Montpellier and Salamanca, as well as Bologna.

Another major, potential source of support for the kind of interdisciplinary research agenda I am talking about materialized with the creation in 2007 of the European Research Council. With the declared goal of sustaining research in all fields of science and scholarship, and having adopted a system of panels and disciplinary sectors for the selection process more

frugal and flexible than the one in force in Italian universities, the ERC had the potential to facilitate comparatively new interdisciplinary fields such as STS make their way south of the Alps. In recent years, undoubtedly, the competition among Italian universities in their effort to attract ERC recipients and funds has allowed some scholars with substantial experience in STS abroad to return and secure tenured positions in Italy. It is probably too early, however, to say whether the inflow will have an impact on the traditionally rigid disciplinary partitions of Italian academia.

Conclusions

So, what can we learn from the history of STS in Italy? Are there any hints to be drawn as to how best to sustain its further development in the future?

In the Italian context, more than elsewhere, young academic fields need a pouch if they are to conquer spaces in universities and research institutions. In the early steps discussed above, in the 1970s and 1980s, the 'kangaroo' offering STS a lift was the history of science which, in turn, was taking on a degree of autonomy from the philosophy of science and the history of philosophy, fields that at the time benefitted from their earlier establishment in Italian universities. In more recent years, if we judge from surveys such as the one outlined by Attila Bruni as President of STS Italia in 2012, the kangaroo supporting the penetration of STS in Italy has been, above all, sociology (Bruni 2012).

Useful and indeed necessary as they are, lifts such as these also bear certain costs. During the earlier period, Italian scholars interested in STS had to either publish abroad or adjust to the topics, style and jargon prevailing in the kangaroo disciplines prevailing in Italy. In the more recent season of Italian STS, something similar is happening with sociology.

The situation described entails additional costs. Several of the early STS research centers and doctoral programs established in English-language universities were, and often still are, the fruit of joint initiatives by scholars from the humanities, social sciences, natural sciences, engineering, and medicine. Those centers and programs continue to benefit from a comparative ease of movement among the different fields made available to doctoral students and faculty members when they build their careers in those universities. That does not apply to Italian STS in the same measure. A significant portion of the literature produced by scholars active in English-language STS centers and programs is conceived keeping in mind the comparatively broad audiences constituted by scholars and readers from a range of different disciplinary backgrounds. A similar goal is achieved in those countries through the policies pursued by the main university presses. When transforming a Ph.D. dissertation into a book meant for those presses, scholars are expected to adopt arguments and a language appropriate for broader audiences. The growing number of articles that

English-language STS scholars publish in magazines and websites meant for a general public is producing a similar result. Once again, such conditions do not apply to the same degree within Italian academe or among Italian publishers.

On a deeper level, the power accumulated by the kangaroo disciplines through the nationally centralized, rigid hierarchy of disciplinary arrangements in force in Italian universities has the effect of discouraging younger generations of scholars from adopting the more innovative, ambitious goals typical of comparatively new fields, like STS. When it comes to launching or supporting new STS initiatives, the all too limited autonomy that individual state universities are willing to claim from the ministry in Rome and from the national evaluation agency represents an additional and powerful constraint. Together with the permanently inadequate, public and private resources devoted to scientific research, this is yet another circumstance pointing to the fact that – as I have argued elsewhere (Pancaldi 2020) – the centralized, imagined national scientific community that Italian elites have built since unification has backfired.

Are not topics such as these urgently deserving to be studied by Italian STS scholars?

While waiting for the national problems to be addressed, we can find some relief in a trend that involves us as members of the broader, international STS community. A recent survey of the articles published in *Nature* over the past fifty years found that "scientific work is ever more becoming a mixture of disciplines", and "the scientific endeavor increasingly integrates across boundaries," including the social sciences and humanities (Gates et al. 2019, 34). Indeed, this trend appears to be confirmed by the attention that journals such as *Science* have paid recently to the work of scholars such as Bruno Latour.

There was some emphasis in the title – "The Whole World is Becoming Science Studies" – adopted for Latour's 2018 interview published in *ESTS* (Mazanderani and Latour 2018). The ecological crisis and debates on the Anthropocene were mentioned at the time to support the message. Writing today, we would of course add the Covid-19 pandemic to that list, and the message would appear less emphatic than it did two years ago. For us here, however, the question remains: how should we best equip Italian STS to face the multiple challenges that defy the disciplinary and institutional niches on which our universities and we ourselves have relied for so long?

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The "Past Future". Twenty Years of STS and Technical Universities

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Abstract: If the public engagement of science and technology has been quickly expanding in the past few decades, the same cannot be said about the presence of STS expertise in the knowledge of scientists, engineers and designers. This article focuses on the opportunity given to STS by the recent trend of European technical universities towards integrating critical and reflexive skills into their educational core.

Keywords: engineering algorithm; engineers; technical universities; interdisciplinarity; demarcation.

Submitted: June 15, 2020 – **Accepted:** June 30, 2020

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The time elapsed since *Tecnoscienza* was established, has generated great transformations in the field of STS, but even more so in the area of emerging technologies. Such changes, which concern everyday-life dimensions such as communication, mobility, health, security, etc., are profoundly modifying the lives of ordinary people and, subsequently, also the meaning and methods of engineering and design. Increasingly, albeit often unwittingly, it is technologists and designers who take responsibility for determining people's future lives. So to speak, they are becoming today's (unrecognized) "politicians". I am convinced that any discussion of the near or distant future of STS should not ignore such changes. Yet, instead of looking ahead, I will look to the past.

Looking back to see forward may seem a strange and contradictory strategy. However, this is what I intend to do with the aim of anticipating the future of STS. The challenge of predicting the future is almost inexorably destined to fail for those who do not possess the right skills, which I do not. Hence, I prefer to shift perspective and look at the past future

twenty years in what could be called a "future perfect" mode. That is to say, I will observe the future twenty years of twenty years ago. I believe this perspective can give us some insight into where the STS are going today.

Why go back twenty years? At the end of the last century, STS was an established and rapidly expanding disciplinary field. All major journals and international associations in the field already existed, many STS research centres had flourished in British and North American universities, disciplinary literature was widely developed and began to produce manuals and handbooks[1]. This stabilization and expansion of the field had proceeded through the most common strategies and policies that usually govern the development of disciplinary fields of Western science, such as institutionalization, boundary work to establish demarcations between contiguous disciplinary fields (Gieryn 1983), definition of a specific capital (Bourdieu 2001), construction of epistemic authority (Gieryn 1999), co-production of identities, institutions, discourses and representations (Jasanoff 2004).

In this state of effervescence and stabilization, the new field of study was confronted with neighbouring disciplinary fields, that is, first, philosophy, which was the quintessential target attacked by the sociology of scientific knowledge (SSK, see Bloor 1976), then sociology, or "sociology of the social", the main target attacked by the Actor-Network Theory (ANT, see Latour 2005). The interest for a confrontation with scientists and engineers was weaker. The so-called "science wars" originated from scientists' reactions to the constructivist approach dominating STS, rather than from a systematic engagement of STS in a discussion with STEM disciplines.

Hence, the expectations of STS for the next twenty years were quite well defined at the turn of the century. It was time to abandon the narrow academic endeavour and the anxiety of disciplinary demarcation against neighbouring disciplines – i.e., those "meta-scientific" studies that cast a critical and reflective eye over the world of science and technology, such as philosophy and sociology – and to turn, instead, to a wider interaction with the possible final stakeholders of STS expertise, such as scientists, engineers, policy-makers and decision-makers. Time was ripe to transform STS into a body of knowledge assisting the democratization of science and the governance of technological development, putting a brake on the technocratic power of experts. The editors of the third edition of the *Handbook of Science and Technology Studies* were well aware of this. Indeed, in the introduction to the *Handbook* they actually considered this change accomplished (Hackett et al. 2008, 1-2).

However, it was not. During those very years, the hectic development of digital technologies was disclosing a world governed even in its most trivial daily activities by a hypertrophic technology that was increasingly autonomous from human control. Emerging technologies proved to be pervasive in people's ordinary life, and their alleged devastating conse-

quences were no longer limited to extraordinary situations (as it had been the case, for example, with nuclear energy). In such a changing context, the most forward-looking scholars saw in "meta" disciplines a fundamental tool to secure a more appropriate development of technologies, which otherwise risked escaping human control. The focus of STS and other "meta" disciplines on the "human, all too human" side of science and technology could arguably help humanize technological progress.

Kenneth Keniston, the founder of the STS programme at MIT, persuasively expressed this idea by describing what he used to call a "crisis of the engineering algorithm" (Keniston 1996). For him, the engineers' algorithm was a set of basic principles governing engineering regardless of the technical problem it tackles. It is based on an assumption that closely resembles the Popperian principle of demarcation. Precisely, the problems that human beings have to face both individually and collectively can be divided into two separate realms, namely problems that can be solved in principle, and everything else. The first realm includes technical problems, which require physical or mathematical knowledge and the development of adequate technologies to be solved. The second realm includes, among other things, social problems, value issues and philosophical or religious matters. Very briefly, the engineering algorithm states that, in order to effectively address the first type of problems, technologists must be completely disinterested in the second type of problems. Engineers develop technologies, and they do it all the better the more they succeed in isolating technical problems from social and cultural variables. Someone else will be concerned with evaluating the social impact and ethical implications.

Keniston's idea at the turn of the century was that the engineering algorithm was experiencing a crisis for several reasons that made the idea of demarcation less credible. The public image of the engineer had suffered, as s/he was no longer considered the untouchable hero of social progress. In addition, the public image of technological innovation had suffered as well: once defined simply as a road to a better life, it was now seen as a major cause of environmental degradation. The emerging technologies were increasingly complex, and the solo engineer designing a single product had been replaced by the interacting, coordinated team of engineering specialists working on a complex design of a component of a complex socio-technical system: "society", once something out there, had entered the workplace. The consideration of trade-offs between incommensurable factors – such as efficiency and safety, costs and reliability of technological devices – was moving towards the centre of engineering. Finally, what used to be dealt with as externalities, such as environmental impact, had increasingly become an integral part of engineering design.

To sum up, the crisis of the engineering algorithm had broken the naive separation of the two realms. It was progressively exposing technological innovation to the awareness that it was no longer possible to avoid meta-technological problems simply by either disregarding them or by

delegating them to others, i.e., philosophers, sociologists and politicians who would intervene downstream of technological development. The king was naked, and the task for the next twenty years was, at that time, to equip engineers with a new sensitivity to problems that are unsolvable but also unavoidable. The goal was helping them to develop technologies that are less "naïve" from an ethical and social point of view.

This was Keniston's prediction in 1996. I dwelt on the next twenty years in a "future perfect" mode because I believe that the prediction has not been fulfilled as yet, at least not completely. If the public engagement of science and technology (both *of* technoscience and *with* technoscience) has been quickly expanding especially in Anglo-Saxon and North European countries, the same cannot be said with regard to the presence of STS expertise in the knowledge of engineers and designers. What seems to be a logical consequence of the crisis of the engineering algorithm is struggling to materialize in the practice of universities and research and development centres, and much remains to be done.

To be sure, a trend is clearly visible, at least in Europe. According to research we carried out at the META study unit of the Politecnico di Milano (unpublished), a policy of openness towards "meta" disciplines is ongoing in many European technical universities, particularly those best positioned in international rankings. This policy consists in integrating critical and reflexive skills into the educational core of technology and engineering Departments and Schools. The instances are highly diversified, since some primarily focus on teaching, and others on research; some leverage the creation of interdisciplinary groups (such as at RWTH Aachen), while others that of single-discipline institutes (e.g., STS as at TU München and Ethics at TU Delft); some aim to implement an extensive introduction of humanities courses for all engineering students, while others to the structuring of specialized courses for students who are particularly sensitive to the topic. In general, groups of STS scholars that are active in European technical universities are gradually moving from niche and marginal clusters to the core sets, thus becoming a fundamental part of the universities' teaching and research programmes.

The reasons for this process, namely the legitimating arguments put forward in official documents, refer to both the technologists' adequate education to enable them to govern emerging technologies and the university's social responsibility. For example, the "Mission Statement" published on the ETH Zürich website states that the commitment to consider humanities and social sciences integral parts of the technical university's educational profile derives from "the need for a new approach to knowledge and technology", which aims at equipping the new engineers "to tackle the enormous challenges facing mankind" (https://bit.ly/3fWtZEI). TU München, on the other hand, insists on our responsibility towards the future, which involves technologists in the forefront to the extent that technological progress has become one of the main factors determining people's life in economically advanced coun-

tries: "Our aim is to equip our students with the capacity to accompany social change with a sense of responsibility. [...] Society should know what we are working on in science and technology for our future, and how we are preparing young people for tomorrow's challenges" ("Our mission statement: We invest in talents. Recognition is our return", https: / /bit.ly/30IqcVa). Similarly, TU Delft claims to connect technological research systematically to societal challenges, "and will make this more visible to the outside world, by stimulating multi-disciplinary, and cross-faculty research that aims at responsible, societal innovation" ("Strategic Framework 2018-2024", https://bit.ly/3eOuuiN). Reference to the European cultural tradition, implicitly opposed to that of other technological giants (such as China and the United States), is found in the statements of the Département Humanités et Sciences Sociales at the École Polytechnique in Paris, which emphasize that the humanities and social sciences "provide a unique and enriching experience for students, putting their scientific knowledge into perspective with courses in history and in political and social structures. In the tradition of the age of Enlightenment, the goal of the HSS department is to train critical minds that are curious and open to the issues of the current world" ("Département Humanités et Sciences Sociales", https://bit.ly/2Brzxbu).

However, while this trend is indeed ongoing, visible and publicly claimed by European technical universities, most engineers continue to train on the engineering algorithm, and change is slow. The fact that, to date, STS have not been particularly active in seeking confrontation with engineering disciplines has contributed to the situation. A new deal is needed in the years to come, that is to say STS should develop a new attitude towards technology, no longer focused just on the critical observation of the way in which it develops but also interested in creating cross-fertilization situations with technologists themselves, as they are the main actors of technological development. Since ethnography has historically been the method preferred by STS scholars, the opportunity offered by collaborative situations with engineers will not escape the eye – that is, the chance to work side by side, experiencing, as it were, "technology-in-action".

Technical universities offer a favourable setting to this end. Our field of study, which by nature is a non-discipline born of the convergence of multiple disciplinary interests, and which has gradually acquired the ability to fertilize traditional sociology with its own methods and its own specific way of looking at reality, should now seek to apply those skills to engineers and technologists, as well as to scientists. STS could fulfil the task of training them in the ability to take a step back from the very object of technological research and to observe it with the detachment of critical thinking and with the breadth of horizon produced by reflexivity. Indeed, this could make the design work more complex and less efficient, but at the same time more sustainable in its results, which would be a substantial achievement. Cultural traditions, such as ANT and SCOT, could pro-

vide very valuable tools in this direction.

However, the precondition is for STS to emancipate themselves from the constraints dictated by the stabilization process I have described above, and to open up to a greater and more authentic interdisciplinary relationship with other social sciences and humanities. Philosophy of technology has been ground-breaking in this regard, as several philosophers have made considerable efforts, in recent decades, to open up to the realm of empirical data and, in particular, to STS methods and body of knowledge. Starting from the post-phenomenology of Don Ihde (1993; see Ihde and Selinger 2003), scholars such as Peter-Paul Verbeek (2011) have dialogued extensively with ANT and STS. Especially in the Netherlands, philosophers of technology have embraced the principles of Value Sensitive Design (Friedman, Kahn and Borning 2006), which aims at integrating technical investigations about designs and their operational principles with empirical investigations concerning contexts and experiences of people involved in technological environments and conceptual investigations intended to clarify the values at stake and to discuss the trade-offs between values (see Van de Poel and Royakkers 2011, 188-189). Similarly, STS should rediscover their original interdisciplinary vocation and overcome traditional disciplinary boundaries. They could thus become protagonists of a process that is currently changing the education of technologists and engineers and will, therefore, end up profoundly influencing the world we live in.

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[1] Although the 1995 *Handbook of Science and Technology Studies* (Jasanoff et al. 1995) is numbered as a second edition, it is actually the first edition explicitly named with "Science and Technology Studies", as the previous one was titled *Handbook of Science, Technology, and Society* (Spiegel-Rösing and de Solla Price 1977). For a study of the history of STS Handbooks see Ienna (2018).

Future Hybrids in an Unsewn World

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Abstract: The contribution aims to outline the next steps of STS studies in order to challenge contingencies and changes in an unstable World. The crisis of *One-World World*'s approach and the appearance of multiplicity in different forms opened up the possibility to a more engaged STS. In this regard, a more *lateral* approach and a constant attention to unstabilized phenomena has to be promoted.

Keywords: multiplicity; pandemic; convergence; information infrastructures; infrastructuring.

Submitted: May 30, 2020 – **Accepted:** June 30, 2020

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1. Next 10 minutes: The public and Science and Technology Studies

The results of Science and Technology Studies (STS) have been disseminated across many countries, academic institutions, and publics. Some theoretical frameworks, such as Actor–Network Theory, were produced by the first wave of STS, causing a paradigm shift in many fields of research. Consequently, a second generation of STS scholars is now browsing and referring to a repository of an already old wave of original theories, points of view, and paradigmatic shifts. Among the vast number of investigable topics, the crisis of finance capitalism, recent climate change controversies, and the Covid-19 (SARS-CoV-2) pandemic provide some terrific opportunities to implement current STS scholars' research.

During the 1980s, when STS surged, technoscience, as well as academic and epistemological concerns changed dramatically. The multiplication and compartmentalization of knowledge follow two parallel courses with-

out producing an equivalent theoretical effort. We are still applying theoretical frameworks elaborated many years ago to new phenomena. Technoscience is "overwhelmingly old" (Edgerton 1999) and its ecology has dramatically changed since 2008 and financial global crisis. Nevertheless, the presence of STS studies and approaches has been important in the public debate.

In Italy, it is still quite rare to find an analysis of technoscientific or sociotechnical phenomena from an STS perspective in public debates. Italian STS scholars are generally well informed about the theoretical debate at the international level. However, the severe lack of important texts in Italian has left young students and the educated public unaware of STS approaches and uninformed about, and often disconnected from, this international debate. Without reaching a wider public, the fate of our studies will be parochial.

2. Next 10 days: Pandemic and contingencies

The present time is marked by the Covid-19 pandemic. A global sense of tragic fate is replacing inclinations toward purposeful action that previously dominated the hegemonic Western mentality. Our future no longer seems to depend on our plans—obviously, it never did. Indeed, this global contingency has spoiled any plan. As Latour (2020) highlighted, the economy has been suspended, public bodies (states as well as local governing bodies, such as cities, regions, and federated local entities) have a renewed prominent role, ecology and environmental measures have become essential, and welfare and public debt have been adopted as business as usual by institutions that were previously strictly oriented toward budget control and expense monitoring. In this inverted world, technoscience is playing a crucial role both as an object of politics and as a political tool of government, not considering the huge dimension assumed by scientific controversies. The pandemic has also highlighted the length of collectives composed of hybrid elements we were used to consider and propose in academic debates.

The pandemic has also acted as a contingency changing the previous courses of action or becoming embedded in a renewed business as usual. A contingency is an unexpected accident, disaster, or breakdown that gives way to an interpretive activity, not necessarily controversial, directed at the features of phenomena previously interpreted in another way (Pellegrino 2014). In the present case, which phenomena are these? Apart from those shown in Latour's (2020) various interventions, it appears that the role of STS in public debate must be vindicated. Distance and prudence must be abandoned, and a public stance must be adopted. Some of the most relevant examples are Paul Edwards' (2010) book on meteorology and climate change, *A Vast Machine*, and John Law's (2015) critical paper, "What's wrong with a one-world world?". Although many other contributions have

been made, these particular works opened up the possibility of an engaged STS. The authors of both works developed a critical stance toward societal and technoscientific regimes of stabilization without abandoning the traditional ANT distrust for indignation as a narrative register (Latour 1993). Indignation cannot exist without some trust in a balanced form of society, whereas a critical stance can be developed from an interest in equality or from ethical or ecological interests, or it can come from other sources and positions. Many arguments concerning the core interests of STS have emerged from this huge contingency and from the struggle among interests to manage them as a breakdown of old practices and of old hierarchies, or as an embedded business as usual. All of them are waiting to be reabsorbed in old courses of action or to serve as their stumbling stones.

3. Next 10 months: An unsewn world

Technologies and human activities are so intimately connected today that many people take this overlap for granted. Monitoring an entire population with tracking apps during a pandemic does not mean an overall *reductio ad unum* as in a dystopian nightmare. It is a complex phenomenon within which some layered activities produce distinct effects that cannot be reduced to a single causal aspect.

Three kinds of interwoven human, technoscientific, and material activities seem relevant today in order to produce a continuous effort for "sewing" and connecting different elements: (a) convergence among different elements around a device, which are projected, designed, or used; (b) infrastructured works and infrastructuring; and (c) contexts or ecologies comprising any element that can be in-between devices or technological systems, which interacts and changes them.

The idea of convergence is quite fruitful for describing processes involving a multitude of actors and entities with a common course of action but without necessary agreement or a common structure.

It may or may not contain ordering practices and involve elements or local sets without necessarily reducing them to a common structure.

Convergence is an often-ephemeral phenomenon combining socio-technical elements, such as social actors, design, money, materiality, knowledge, skill, case, situations, infrastructures, standards, forms of classification, data, duration, organizations, norms and conventions, etc. This texture of different elements recurs increasingly as socio-technical networks extend their reach to any aspect of life. Especially in Northern and Western countries, they are included in a project or are labelled as a project, but they tend not to have a denomination, especially in the world's peripheries (Mongili 2015, 162-170). They increasingly saturate some environments, but they are more often distributed as one of the "wires" of socio-material life, among others. For example, an aircraft is deeply saturated with many technological systems, which are often correlated to make

the device work. The presence of humans is rare, and their tasks are secondary when compared to those of the device. By contrast, the classroom contains many humans, social, and material elements in-between the technological ones (heating, electricity, interactive whiteboards, Wi-Fi, etc.).

Convergence does not correspond to a stabilized device or techno-system, rather than neither to their purpose or failure. It is a process and a common course of action that brings different elements closer together. Convergence often lacks clear boundaries and a clear fate: it can drive a stabilized novel assemblage through strong classification work and standardization, or it can include new elements in a new device. It can be an ephemeral phenomenon producing networking. This is why it is important to distinguish convergence from interoperability and stability. Certainly, convergence can drive the interoperability of different devices in a more complex system, a certain stabilization of a device in its shape and use, and a stable network intertwined with the device. However, this outcome is far from being assured. From a sociological point of view, it is a valuable concept because it focuses on the texture of socio-material processes. Extensive research on social, material, and technical convergence is constantly emerging, and it always has a heterogeneous character in terms of the ascription and belonging of its elements. Similar to interaction, convergence produces many things, including social and abstract objects (Blumer 1969), without considering their influence in diverse personal performances and positions. Also similar to mobility, in contrast to sedentarism (Urry 2007), convergence is a condition that is much more diffused than stabilized phenomena. Further, convergence and other socio-technical processes produce different ontologies of the same devices in their set of existence, following different interpretations, uses, and handling (Star 1999; Star et al. 2004).

The surge of information artifacts and systems, which converge with human activities in producing common work, has taken on a large-scale dimension following digitalization. Numerous activities, such as communication, writing, gaming, scientific research, digital applications for chatting, social networking, and the Internet and the main digital platforms, are no longer thinkable as only-human or only-social activities. They exist because they converge with information artifacts in some intertwined hybrid sets, defined as *information infrastructures*. In other words, some information artifact works with other entities to make the activities flow. These are all embedded in other social, material, and technical frames, and this modularity of humans, infrastructures, and devices is the very basis of a socio-technical texture that can extend across different places, times, spaces, and chrono-topic narratives. Their diffusion does not require the different users to share a common interpretation of the infrastructure or a common use in different chrono-topes. Information infrastructures have the main purpose of enabling work to be done. They demand maintenance, repair, adaptation, and torqueing by technicians or users, defined as *infrastructuring*, especially if they do not work and do not allow the various activities to

flow; otherwise, they are transparent and taken for granted by users or naturalized (Edwards et al. 2007, Mongili and Pellegrino 2014; Monteiro et al. 2013; Star 1999; Star and Ruhleder 1996).

These constant activities of infrastructuring, compared to simple convergence, create a thicker texture in contemporary societies, composed of specific technical subcultures that connect people dispersed through space and time but that also enable many devices and technological systems to be naturalized in many situated sets. This socio-technical texture has been visible during the Covid-19 pandemic. In fact, people must learn to use information infrastructures to ensure that work and social life flow, but at the same time, devices and information artifacts must be taken for granted in ordinary activities. A range of solutions can resolve this double tension, and we can observe humans' complete adaptation and complete adjustment of devices at both ends of the spectrum. Yet these poles represent the rarest cases. Usually, in the lives of humans and devices, we observe many arrangements and a transformation of human performance as well as a continuous challenge to the stability of technologies, in their shape and uses, not to mention the unitary interpretation of their essence, which is very rare because consensus is not needed (Star and Ruhleder 1996).

We must not forget that technology represents a context for a huge number of human activities but also that any device or system occupies a place or time in human activities or in other technological or material environments. Considering the spaces between socio-technical networks or delimited collectives, everything in-between remains relevant not only as a silent context but as a set of elements that interact with the socio-technical networks. They modify some of their behaviors, knowledge, and roles, but they also they modify some of the socio-technical elements in their use, handling, care, or torqueing. An ecological understanding of technology can sharpen the focus on processes and consequences, uses and articulation, with respect to other conceptualizations that privilege conditions or factors indicated as causes, such as design, purposeful action, projects, and so on (Star 1995).

A more ecological understanding of the human–technology whole, to conceptualize both the singularity and universality of modern technological conditions, can help STS promote its crucial role. All this effort directed to connect and "sew" different elements do not solve the multiplicity and the diversity, but it is, in some sort, a witness of the constant need to solve problems and to face the adversities of an "unsewn" World.

4. Next 10 years: New hybrids

Multiplicity is not a simple plurality of forms but is intertwined with hierarchies and power relations. STS scholars working in the Global South cannot afford a symmetry of ignorance with the Global North without running the risk of appearing out of fashion. European and North American

topics are our topics; they have been endowed with a universalistic character before to our subaltern eyes. Our phenomena are reduced to mere fieldwork aimed at implementing these theories; they are theoretically arid and only local (Chakrabarty 1992). If we *lateralize* our research toward sociotechnical processes and local participants' practices and forms of conceptualization, letting them speak (Morita 2014, 311), we can challenge the Western-centered STS canons but also amplify multiplicity.

Multiplicity and connection represent the new dichotomy that seems to prevail in the contemporary world(s). The fluidity of technical as well as human performance, belonging, and identity and the local occurrences of different ontologies (de Laet and Mol 2000) is inseparable from their connection. Being connected in long collectives does not mean uniformity, nor does it mean that their interpretation must be drawn from the design side or using its master's narrative. This point of view does not problematize diversity and inequality, discard plurality, and it is seen itself as the center. On the eve of the end of Western centrality, we must start from the participants' practices and conceptions to conceptualize the world in both local and universal terms and to develop a more balanced interpretation (Morita and Mohácsi 2013; Star 1999).

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'The Swerve': A Modest Hint for Appreciating Tradition and Escaping Self-referentiality

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Abstract: The essay suggests 'the swerve' as an analytical metaphor useful for researchers and theorists engaged in building the future of STS studies. What is suggested is to shape one's own "swerving methodology", presented as a "reflective practice" adopted in the comparison with objects, with research questions and STS epistemologies.

Keywords: STS epistemology; methodology; displacement; interdisciplinary; community.

Submitted: May 30, 2020 – Accepted: June 30, 2020

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1. Ten minutes. Ten minutes should give us more than enough time to play a round of 'the swerve'. However, before we play, we must understand the goal of the game, which is to avoid being unintentionally misguided by our STS assumptions… or prejudices, if we are speaking bluntly. The first rule for playing the swerve is to spend just ten minutes putting some distance between us and our research object as well as our research question. In other words, the swerve involves briefly suspending our next research activity so we can reflect on the almost certain reality that we are investigating an object and a research question to which someone has already dedicated her/his attention and time, in the more or less remote past. The move I suggest calling 'the swerve' sounds like a displacement, able to relocate our viewpoint to a position other than that which we usually assume. Actually, the concept of 'displacement' has already been discussed within the STS community, but it was introduced primarily to indicate one effect of becoming aware that technoscientific objects can be regarded from a vantage point other than the one usually

taken outside the STS perspective. By examining technoscientific objects from a new perspective, STS can illustrate how a technoscientific object, which is apparently the same for many heterogeneous actors, actually takes on as many meanings as there are actors having to do with it.

The swerve suggests considering objects and ideas in a new way, as they can be perceived differently from how they are usually interpreted by the current STS perspective or by the STS perspective as a whole. However, the swerve encompasses more than just this, as it will become clearer as this article develops. Nevertheless, this partial definition is all we need for now to begin our argument.

2. STS is now a consolidated academic field, with its own rules, theories, concepts and institutions: journals, conferences, doctoral programmes, undergraduate courses, handbooks, scientific societies, grants and prizes. This is not wrong, of course; in fact, the opposite is true, as the STS consolidation was necessary for their survival and development, especially within national contexts where they are still weak, as is the case in Italy. Indeed, we cannot maintain our research approach in a permanent state of original effervescence; we cannot continue to be revolutionary forever, unless we want to disappear into the oblivion of a perhaps exciting but inconclusive season.

Yet, at the same time, we should adopt every possible strategy and embrace all epistemological and methodological tricks to avoid becoming self-referential, able only to speak among ourselves. Moreover, we should not transform the original desire to change the way of looking at technoscience into the dictatorship of a taken-for-granted STS approach. We cannot advance by continuing to consume every new research object simply by applying, mechanically and rigidly, a bag of sensitising concepts and interpretative models and theories, or by assuming that our point of view is the best by definition.

We are now obliged to cope with this irreducible opposition: on one hand, we must not repeatedly restart at point A, as if STS had never existed; on the other hand, we should not take for granted the STS perspective nor its theories, notions or methodologies.

Each new research object has its own specificity but, for the most part, poses the same questions as those implied by other similar objects in the past. Let us think, for example, about neurosciences or synthetic biology – two emerging technoscientific objects that are presently attracting STS attention: should we completely disregard existing knowledge about biotechnologies or nuclear power? Are big data or machine learning so peculiar that we can forget all we learned about analogic scientific archives or about AI at the end of the last century? Can we look at the new phenomena through research questions radically dissimilar from those of the past? Is it enough to change our jargon – for example, using 'engagement' instead of 'participation' – when technoscientific controversies are analysed to arrive at new research problems?

To recognise that our research object is defined by questions much like those posed about other objects studied in the past means both that we must be aware that STS is a well-established research field and that what is now under inquiry has a history resulting from an evolutionary process. The swerve, then, can produce two effects: first, it can invite us to exploit the theoretical and empirical heritage accumulated by STS along its development; second, it can enrich our research with the historical depth that makes it even more interesting and full of theoretical implications, so that we are pushed to go beyond a mere descriptive level.

However, the swerve should also produce a third effect, namely, keeping us from becoming self-referential by taking for granted our point of view, together with its epistemological and methodological armamentarium. Creating distance between our research and ourselves – even if only by a measure of minutes – could, indeed, enable us to displace our perspective and illustrate that our viewpoint is neither obvious nor necessarily open to the standpoint of other subjects with whom it could be very relevant to interact. It is worth noting that dodging the bullet of self-referentiality is not only a problem in our relationships with people who appear distant from the STS perspective, such as the so-called 'hard' scientists or laypeople; we are also experimenting to an increasing extent with the difficulty of interacting properly within the field of social sciences. In some respects, in fact, it has become easier for a sociologist to engage with an anthropologist or a political scientist with whom an STS approach is shared rather than with another sociologist who is far removed from STS. This problem is exacerbated by the fact that, on the surface, the two sociologists share the same vocabulary; however, if the first talks about 'network', the second can easily recognise the word but understand it from a completely different line of thinking and, hence, attach an alternate meaning.

3. For the swerve to be effectively implemented, it should be positioned not only at the beginning of our research but also during its fulfilment, so as to ensure that we experience multiple benefits of its employment. What matters is that, just like each sudden shift made to avoid colliding with an obstacle, the process of implementing the swerve must be swift and abrupt; only in this way can the resulting cognitive jolt be strong enough to make us understand what we were risking: unconscious permanence inside STS commonplaces.

Of course, unlike what might happen if we were driving a car or walking on a sidewalk when confronted with an approaching obstacle and did not take quick action to keep from meeting it head on, without a hasty implementation of the swerve, the impact would not be so violent; however, the consequences could be equally powerful: a quiet self-referentiality, not even perceived because it is derived from an attitude considered 'natural'.

Honestly, I have no idea how to make such a move with a sudden

force. Maybe we could randomly disseminate alerts in our digital calendar or rely on our capability to occasionally recall the need to swerve… I am not sure – we can all invent our own swerve methodology.

Regardless of the approach, an effectively incorporated swerve should produce highly remunerative results: spending only ten minutes should suggest that maybe it would be better to invest at least ten hours to deepen the hints and the questions raised as a consequence of this initial move. Ultimately, what can be gained will be more evident in the next ten months, even more in the next ten years: reducing the risk of being trapped in an STS taken-for-granted flatness.

Another relevant aspect that the swerve can bring to light is that deviating from a path implies having a trajectory. In other words, it is possible to practice a swerve only after a research question has been developed and a research object identified, so that our research can be oriented having a direction. This will allow us to realise that the redirection introduced by the swerve is something radically different from the changes of direction derived from a casual wandering around what sounds vaguely technoscientific. At the same time, it should be clear that having a research trajectory has nothing to do with 'trajectorism', as it has been depicted recently by Appadurai (2013, 223):

> A deeper epistemological and ontological habit, which always assumes that there is a cumulative journey from here to there, or more exactly from now to then. […] Trajectorism is the idea that time's arrow inevitably has a telos […]. Modern social science inherits this telos and turns it into a method for the study of humanity.

A research trajectory is no more than the sense of direction drafted by our question. Such a trajectory makes it possible to swerve but also to return to the path outlined for our journey after becoming cognizant that the trajectory could be another one and that the path we are following has already been trodden by others.

4. The swerve, thus, is a lateral move in relation to our research direction, thanks to which we can gain an alternative position that makes more evident the intrinsic *processuality* of objects and research questions. They have a history that entrenches them in a specific context, even if it makes them also fluid or, even better, shows that the stability of the first and the relevance of the second emanate from the fact that we are deeply and unwittingly plunged in the present, directly connected to the flow of events, to the *hic et nunc* of everyday life. Once we access this alternative viewpoint on our own research, we must measure the depth of its thickness and, therefore, the need to deepen its analysis by drilling into the layers that time has gradually deposited on it.

5. Finally, the swerve is a plea for interdisciplinarity as well. In fact, it

can help us to assume and cultivate an interdisciplinary attitude, providing the opportunity both to look at an object from a different perspective and to consider the STS approach as one among many. Feeding this kind of awareness is a useful premise on which to base transdisciplinary research, i.e. to fulfil the hybridisation among heterogeneous viewpoints and, hence, to acquire a new one, detached from what we tend to consider obvious.

In other words, the swerve can help us remain in the early wake of the STS tradition, which has always been genuinely interdisciplinary and sometime transdisciplinary too, while at the same time avoiding self-referentiality.

'The swerve' – ten minutes that could be well spent today, looking at the next ten years.

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Immunity and Community: Being Stuck and Getting Moving

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Abstract: The text contributes to the special issue celebrating the 10th anniversary of the journal *Tecnoscienza* by presenting a reflection departing from viruses, biology and relationships.

Keywords: virus; Covid; biology; relationship; feedback.

Submitted: May 30, 2020 – **Accepted:** June 30, 2020

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> *It may also be given to us to invent metaphors that do not belong, or that do not yet belong, to accepted patterns* (Borges, 1967/8).

I had a good friend years ago who died, painfully and slowly, of Hodgkin's lymphoma. There was a metaphor ready to hand for his experience – "he showed bravery in a long battle against cancer"; "he was another victim in the war on cancer" and so forth. This is what Borges called a "pattern metaphor" – one that could generate myriad variations but which freighted a singular vision. David, though, had another relationship with his cancer – he wanted to live with it, to share his body with it, to learn how it was part of him; not some foreign invader out to storm his barricades. I thought this was so wise, but it has taken me a number of years to begin to understand it. I've been thinking of David a fair amount in the context of the war against Covid-19 (get your battle kit her: https://www.beyondmybattle.org/covid19!) – this silent and 'evil' disease which is attacking whole families.

Let's start with the fact that if viruses 'want' anything, it's that we

should all just get along. Just in terms of self-interest, a virus has no interest in wiping out its host – any more I guess than people do in wiping out their ecosystem… It just looks like it sometimes. Successful viruses, such as herpes – which infect more than half the US population – find niche nerve ganglia and largely lie dormant. Lynn Margulis' widely accepted theory of mitochondria (which provide oxygen/energy within cells) is that they are endosymbionts – 'invaders' which did such a good job that were incorporated into our (in the sense of we eukaryotes') genetic code.

It's easy to think of the world in terms of me in here and the rest of the world out there – the first line of defense for the self being the skin. This is an historical construction – in Western Europe, the skin got to close us off from the rest of the world in the early nineteenth century (Reinarz and Siena, 2007) – earlier it was a porous membrane which took in effluvia and exhaled waste. Great pragmatist philosopher Arthur Bentley (1941) was surely right when he wrote that: "Human skin is the one authentic criterion of the university which philosophers recognize when they appraise knowledge under their professional rubric, epistemology", going on to say that: "if philosophers cease thus crudely to employ it, all their issues of epistemology will vanish, and the very type of attack they make on cognition will be discredited".

Which brings me to something I've been reading for no good reason. A friend and I were talking about insides and outsides of folks[1] and we got into the immune system – leading to this piece in the Stanford Encylopedia of Philosophy (Swiatczak and Tauber, 2020). What got me as once was the idea of the immune system as another sense – not something which is setting up boundaries, but something which – as with our other senses – is exploring the world. My taste buds don't just exclude Mars bars – they work out what to include, and how; similarly, all my other senses. The immune system would be a monumental failure if it merely tried to keep stuff out: over 90% of the cells in our – and I stress our – bodies are microfauna and microflora. The digestive system can be seen as the 'outside within': what do we choose to 'incorporate' and what keeps sliding down and out.

The general point for me here about stuckness and knowledge is that we look at the world wrongly from the beginning if we break it up into separate entities. The theory of evolution is just wrong if it only accounts for the origin of species. What is much more interesting is the development of relationships – as in Michel Serres' discussion of the parasite form as central. In a related context, Martin Buber argued that the relationship – to thou or that – was always prior. We murder to dissect… at any level… within or without the organism. There are reasons why many biologists say the species concept is unreal: there is no singular slicing apart of a set of entities. We interpenetrate. There are also reasons why many cleave to the species concept. It's an available and easy background while we do what

[1] A discussion of chiasm and flesh in late Merleau Ponty.

we want to do. Like the nation state for historians: it's nice to have a defined border to scope your history (especially if it's in one language for the historians/speciality for natural scientists) but really doesn't do much to weave stories of how change happens.

This stuckness is a mirror image of the Enlightenment. Above all else, Enlightenment scholars classified – they organized the world and developed stories about each of its parts. Chapeau! As ever, within the movement were the seeds of it's change – Claude Bernard with his theory of homeostasis reimagining relations; Beniger's *Control Revolution* privileging relationship (feedback). Or, much more interestingly, Theilhard de Chardin's noosphere and more recent Gaian imaginings. We've gotten stuck along the highly successful strategy of dissection; time to move on.

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An STS Perspective on Pandemic

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Abstract: What can STS say about the pandemic? What kind of scientific models do we need to question our time? In this reflection I envision three issues which seem to me of particular importance: (1) the 'social' as a result of sociomaterial associations; 2) science as an open-air laboratory; 3) the new forms of alliances between science and politics. I conclude focusing on the theme of interdisciplinarity, the major challenge that the pandemic poses to science.

Keywords: pandemic; associations; sociomateriality; interdisciplinarity; politics.

Submitted: May 30, 2020 – **Accepted:** June 30, 2020

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What can STS say about the pandemic? What kind of scientific models do we need to question our time?

My impression is that the pandemic we are witnessing points to three major issues: 1) the 'social' as a result of sociomaterial associations; 2) science as an open-air laboratory; 3) the new forms of alliances between science and politics.

I will now try to sketch them in some details.

1. Sociomaterial associations: or, the allies in the virus' journey

We are part of fragile, multilayer ecosystems. They are stratified archaeologies that come together in a shaky, non-inclusive, non-linear, non-stable way.

STS provided a shift away from any essentialist tendency, highlighting how every scientific idea, every technical artifact, every social fact, every event of the living are the product of entangled networks of relations in which human and non-human interact. To see closely the associations between human and material we can look at two of the social spheres most involved in the pandemic: education and healthcare.

Some images from China (figure 1)[2] – the first country that translated the rules of physical distancing within the material spaces of classrooms – show how protective and safety objects have been added to the traditional 'frontal' organization of classroom space (the 'one to many' learning model). The dividers separate students from each other, suggesting a relationality inspired by control, vigilance, surveillance, but also by safety, protection, and prevention. Dividers, benches, bulkheads, and protective devices (gloves and masks) worn by young girls and boys reconfigure the school space in terms of protection, inscribing morality and values, as well as new environmental and relational constraints.

Figure 1. School space post-covid in China

Looking at the medical field, the second image[3] shows a micro-environment of bio-protection in which different elements (gloves, bed, plastic-coated walls) are assembled so to allow healthcare workers to operate safely, protecting the patient at the same time.

Figure 2. Micro-environment of bio-protection

The image shows associations, entanglements and inscriptions between norms, ethics and knowledges that enact emergency and routine practices in bio-medical settings.

The other photo (figure 3) shows new risks and missing alliances. Technical objects, such as protective masks and gloves, placed into the chains of daily practices, do not find other connections after their use, but are placed in other types of connections and associations that feed the already serious environmental issues. These objects activate relational effects that can be described in other words: environmental risk, pollution, non-disposal, danger.

Figure 3. Mask and plastic gloves (photo taken by the author).

In this case, similar objects – arranged in different ways and seen in their relational effects – show new alliances or rather deficit of alliances and risks: similar objects and opposite effects.

According to Latour[4], the virus is only one node within a network. The virus highlights the interconnection between two crises, the health and environmental one, showing that the classic definition of society as something made exclusively of human entities no longer makes sense. The so-called 'society' depends on associations between many and heterogeneous actors, most of which do not have human form. This applies to microbes (Latour, 1993) but also to the Internet, the law, the welfare State, as well as to the climate change.

Viruses, animals, markets, men, women, sick people, elders, children, States, money, airplanes, cells, air, antibodies, politicians, hospitals, masks, swabs, gowns, food, drugs, vaccines, scientists (virologists, anesthetists, infectious disease specialists, veterinarians, pharmacologists, pneumatologists, epidemiologists, economists, sociologists, statisticians), nurses, doctors, protocols, decrees, rules, apps, data, big data, databases, standards, procedures, numbers, corpses, breaths, lungs. With all these elements we have built a new familiarity over the last ten months. They might seem arbitrary, yet we have learned to grasp them as part of an inextricable and vulnerable sociomaterial network on a global scale, in search of stable connections. Only if we look at how these elements associate with each other can we capture the multiplicity of associations in which we are immersed.

As Donna Haraway argued[5], just by understanding the chains of associations as *natureculture* – as elements that are not separated from each other – we can shift away from the centrality of the human being. The emphasis on these associations can be caught in the journey of the virus that triggered the pandemic. We have heard that it would be a product of evolution and certainly not a "artificial construction" in the laboratory. But what is actually "natural" if we are dealing with an event that has been facilitated, activated, amplified by actions that involve the human animal as well? In what sense can the natural be separated from the human in this story? What is there of non-human in this "natural" that would belong to the virus only?

Through the narration of the many scientists, science journalists, experts who have intervened in the public media space on a global level we have learned that there was not a single trigger event, or a cause, or a singular culprit. Rather, a chain of events occurred that have become both causes and effects.

Like many viruses, the SARS-COV-2 (commonly known as "Coronavirus") travelled around the world and among living species (humans, animals) and other material elements. David Quammen's book *Spillover* (2012) offers various examples of such a process. *Spillover* brings attention to all the times that humans have violated spaces, appropriated

resources, invaded ecosystems and brought events such as forced deforestation, urbanization and global warming that caused the release of viruses from animals – whose ecosystems have been violated – to other species and humans.

The first case we encounter concerns the measles of horses that broke out in September 1994 in a suburb of the north of Brisbane, Australia, called Hendra (the name that will take the virus). Hendra is a quiet old town, full of racetracks, horse lovers, wooden houses converted into stables, newsstands that sold sheets specialized in horse betting and coffee. But what triggered the virus? In his reconstruction, the author follows the associations between humans, nature and animals:

> After our first conversation, at a café in Hendra, Peter Reid drove me several miles southeast, across the Brisbane River, to the site where Drama Series took sick. It was in an area called Cannon Hill, formerly pastoral land surrounded by city, now a booming suburb just off the M1 motorway. Tract houses on prim lanes had been built over the original paddock. Not much of the old landscape remained. But toward the end of one street was a circle, called Calliope Circuit, in the middle of which stood a single mature tree, a Moreton Bay fig, beneath which the mare would have found shelter from eastern Australia's fierce subtropical sun. "That's it," Reid said. "That's the bloody tree." That's where the bats gathered, he meant. (ivi, 14)

The "bloody tree" was left alone where once there was "pastoral land surrounded by city" in which many other trees probably grew. Now it was the only one under which horses could shelter from the heat, and the only one for bats to take refuge.

We have found similar traces in the narration performed by several scientists in recent months. The international virologist Ilaria Capua (2020) spoke of the Coronavirus as a product of our world, of a violated forest, of a market where animals belonging to different ecosystems are locked alive in captivity in the same cages. Imprisoned by humans, the bat and the pangolin exchange viral agents, so that the latter could have become the involuntary "intermediate host" of the new Coronavirus, the bridge for the leap of species of the virus from bat to man. Pangolins seem to lack defense systems against viral infections but they tolerate them, thus becoming reservoirs of microbes while protecting themselves from their effects.

The beginning of the virus journey suddenly produced new associations: planes, trips, airports, ships, sick people, hospitals, dead people, quarantine. Time and space have entered into a powerful short-circuit: the SARS-COV-2 walked with our fast feet and planes, and moved immediately on a global scale from East to West (at first it was called "the virus of the rich", the virus in a suit and tie). The virus associated very well with the main feature of the contemporary and its mobile lives (Elliott and

Urry 2013): a mobility that made it travel, using humans as a vehicle – first to the Western routes and then to the rest of the world[6].

2. A global open-air laboratory

Scientific research invites us to follow new processes in order to produce a sort of domestication of the virus. Both in the public and professional (health) spheres, new technical objects come into play with their attempts to contain, manage or mediate the action of the virus, while contributing to redefining the concept of public health and individual well-being. Masks, soap, disinfectants, gowns, gloves, buffers, bulkheads and tools to promote physical distancing, and then reagents, respirators, serums, and so on have entered the scene incorporating, in different ways, imperatives for individual and collective behavior. We learn to live with these objects in order to live with the virus.

Scientists in recent months have found themselves under enormous exposure in the social space. Politicians and public opinion struggle to understand the uncertainty with which scientists are confronted in their work. Politicians and citizens want "ready-made" science and resist looking at the unstable, in-action construction of scientific knowledge. Yet, scientific research in the laboratory lives on uncertainties, doubts, approximations, data to analyze and interpretations of phenomena that scientists try to tame. No science is ready-made in the laboratory. Science is always in its making, more or less stabilized. In this phase, science in all of its components is indeed in a process of construction, in progress. The construction of science is an uncertain process in search of evidence to build forms of stability that are never permanent: the instability of scientific knowledge is one of its foundations.

Science laboratories all over the world are entering the public arena and – as in the Pouilly-Le-Fort farm, where Pasteur publicly prepared his experiments – are looking for practical solutions capable of taming the virus. Scientific practice seeks means, compares hypotheses and sets experiments to find recurrent trends and build more stable knowledge. In the occasion of the SARS-COV-2, one more element has marked the communication and representation of the virus: the metaphors that are escorting its journey. As suggested by Susan Sontag (2001), metaphorical images are a powerful social construction to relate to adverse events such as diseases and contagions. The most common and immediate one that has spread was that of war, of combat, of confrontation in a ring: a metaphor that invoked the virus as an enemy to fight. Then, slowly – and thanks to the language of some scientists – we moved from the war metaphor to that of living together with the virus. This less martial vision was introduced when we began to familiarize ourselves with the circulation of the virus.
A third image used is that of the adaptation to the host:

> Of course, more scientific evidence of a mutation is needed but it can be said that as the virus tends to adapt to the host. A new virus is always very aggressive in the early stages, then it learns to live with the host. This is an opportunistic attitude which allows it to survive[7].

Coexistence, dance, adaptation: this is the new perimeter of relations to dwell with. Verbal and material domestication practices embedded within sociomaterial networks of containment make our relationships with the virus more visible, less dangerous and more liveable. The American materialist philosopher Timothy Morton (2013) has coined the concept of *hyperobject* for interpreting entities of large spatial and temporal dimensions that produce effects on the local and global level: the pandemic looks like this.

3. Science and politics

In these times, the apparently unbridgeable gap that has often separated science and politics (at least at the public level) seems to disappear. We are witnessing three processes: science and politics talk to each other and share common tables publicly; many scientific knowledges are put into action in a polyphony of expert voices that enter the public space; pathogenic agents and material objects become central actors of political attention.

Contrary to what Robert Merton said, the immunity of science is deeply questioned: politics and science join their forces and hybridize their spaces, while research laboratories move their field of action and communication in the public arena. Hospitals, research centers, experts, scientists, politicians, patients are in a common arena and look for common embankments, they imagine solutions and forecast scenarios. Science and politics sit side by side in ministerial teams, on television talk shows, in regional political arenas, and we see a profound redefinition of the role of scientific and political activity. Scientists find themselves acting as public actors and policy agents for the sole fact that they speak publicly about measures, numbers, comparisons, data. Technical objects of daily use (masks, gowns, gloves, reagents) become central in everyone's life, and new sociomaterial alliances are established for building stable networks capable of facing the emergency.

Politics asks for ready-made, reassuring, univocal answers, but science and scientists, all over the world, bring partial, in the making, not reassuring, and unstable results. Experts speak in public about ongoing experiments, present slides of infected cells in television programs, show trends and provide partial interpretations and analyses of the current (and future) situation.

Politics asks science for answers and science presents itself with open questions. In this tension, politics and science appear more vulnerable, and in need of a new relationship, as for the task forces of experts and scientists created in various Countries testify. Many alliances (and task forces) are acting internationally, nationally, and regionally. They bring together scientists and experts from different technical and political fields, an unprecedented and important collaboration. Science and scientists (virologists, epidemiologists, clinicians, and so on), have been "gathered" for an event that affects all latitudes. The composition of the task forces – often shamelessly populated mainly or only by men – highlights the separation of expert knowledge between natural and social life. This separation uncovers the difficulty in framing the entanglement of the effects brought by the virus and which say: the natural sphere cannot be separated from the social one!

Another relevant associative process is the one impressed on the relationship between research laboratories and clinics. Research must now be translated into drugs, therapies, vaccine studies, and clinical trials of all kinds have already started throughout the world. This is an accelerating movement that has already been in place for decades: after the Human Genome Project, translational research has aimed to speed up the discovery of new treatments and diagnostic tools to transfer scientific knowledge from bench to bedside (Cambrosio et. al. 2006; Neresini and Viteritti 2014). Serological tests, new drugs and vaccines go in this direction. The question that arises is how to build common platforms between scientists from different countries and disciplinary fields to favor the analysis of large and complex databases, as well as how to ensure the interoperability between large data systems.

For the moment being, the alliances-in-the-making between science and politics translate in new public and private practices: diagnostic practices such as swabs and serological tests, practices of physical distancing assisted by the use of protective objects; the safe arrangement of public spaces (commercial, institutional and mundane); practices of tracking (via apps and information systems) and of personal hygiene (such as wash your hands often). Each of these practices, outline necessary as problematic alliances and associations between humans and non-humans, as well as between politics and science.

4. Final thoughts

Although it is not a novelty for STS, scientists from various fields have recently pointed to the centrality of interdisciplinary research as the only horizon for understanding the complexity of the living in all its natural-social-cultural-material-technological forms[8]. STS as a plural and non-anthropocentric scientific field, in dialogue with other bodies of

knowledges and experiences (such as technoscientific feminism), can then contribute in describing connections that would be invisible to a monocular knowledge perspective. With the pandemic we have witnessed the impact of the butterfly effect, and, as researchers, we are required to develop more skills in reading effects that are not given, not linear and not sequential. We are learning practically the consequences of taking seriously the idea that we are immersed in a reality where, as humans, we are not protagonists and architects, but the result of processes of intra-action (Barad 2007).

As individuals, we strongly contribute to troubling local and global ecosystems by creating harmful chains that favor the triggering of "viral" phenomena, which quickly move across time and space. As Donna Haraway (2016) suggests, we must equip ourselves theoretically, culturally, and materially to live an infected planet, seeking non-anthropocentric adaptations and alternative visions centred on the coexistence of humans and non-humans.

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[1] An extended and more academically attuned version of this contribution was recently published in "Sociologia Italiana", 2020/16, pp. 237-255.

[2] Photos circulated in April 2020, made by photojournalist Sam Yeh.

[3] The figure shows the image of a frame exported from a video available here: https://www.adnkronos.com/salute/2020/05/27/nuovo-coronavirus-sta-diventando-piu-buono-risposta-che-divide-medici-scienziati_mUy2usyMuJWarqznQbEL4H.html.

[4] Le Monde, March 25, 2020 https://www.lemonde.fr/signataires/bruno-latour/.

[5] Video-interview "How to survive on an infected planet". Turin Book Festival "SALTO Extra" on May 15, 2020 https://www.youtube.com/watch?v=-CaRdmalZHok

[6] Ilaria Capua talked about one of the first viruses that passed from animals to man with the birth of breeding and agriculture: measles. It still lives with us causing contagion and death. In 2015 alone, the World Health Organization estimated 134,200 deaths caused by measles, which in its debut "walked with the feet of humans" and took a long time to spread (as did HIV and other viruses).

[7] Massimo Clemente, Virologist at the San Raffaele Hospital in Milan, expressed this opinion in a interview.

[8] Two examples of scholars who underline the urgency of an interdisciplinary approach. The first one is scientist Ilaria Capua, who, in her texts and in the public discussions during the quarantine, invites sciences (from physics to information technology) to join forces and knowledges to look at the complexity of the health of the living beings and the planet. The second example is represented by Deborah Lupton, who has been involved for years in studies on digitization processes that also affect public health. On March 29th, 2020 she launched a working group entitled Social Research for a Covid and Post-Covid World: An Initial Agenda, which contains topics that can only be addressed through the integration of different disciplines.

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Ruha Benjamin
Race After Technology: Abolitionist Tools for the New Jim Code. Cambridge, Polity, 2019, pp. 172

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Race after Technology is aligned with a growing body of work on critical data studies that seek to unpack forms of social injustice embedded in algorithms and data practices. To that purpose, the book "integrates the tools of science and technology studies (STS) and critical race studies" (p. 34) within the framework of *race critical code studies.* At the core of this framework is the STS-inspired metaphor of the "black box". In the book, this metaphor helps situate algorithms and data practices as kinds of sociotechnical systems with well-known external effects and opaque internal functions. Interestingly, the book does not focus opening the "black box" of algorithms and data practices, understood as in providing an account of their internal mechanisms. Instead, the focus seems to be on unpacking the external effects, and their relationships, which are not only well-known and visible but also oftentimes discriminating and socially unjust.

Methodologically, the focus on unpacking external effects and their relationships is approached by drawing upon "thin description as a method for reading surfaces" (p. 45). As described in the introduction, "thinness" is considered an approach to knowledge production that allows for analytic flexibility by tracing links between surfaces. This approach emphasizes exposing relationships rather than deepening in their underlying phenomena. Indeed, the book is an incredibly rich source of examples that illustrate how systemic forms of racism, sexism, and classism produce and are reproduced in technologies. However, this richness can be at times overwhelming. The focus on illustrating connections rather than on elaborating comparisons helps construct a large mesh of examples. In this way, this approach succeeds in conveying the interwoven complexity of the concerns at stake; however, it can be easy to get lost in all the ramifications and relationships.

As the examples of systemic forms of racism, sexism, and classism unfold, the book makes a solid case for the need to hold public accountability of automated data products. These products being job placement processes, refugee placement algorithms, or loan risk predictions. These contemporary examples are often referred to as the "New Jim Code", meaning forms of systemic bias embedded into technologies that monitor and measure people differently based on race, class, or gender. This neologism is inspired by the Jim Crow Laws, which created legal separations by race in 26 states of the United States of America from 1881 to 1964. Even

though these laws were formally abolished more than 50 years ago, the book shows how their legacy is still very present. In the book, these laws serve as lenses that help reveal how technologies produce, reproduce, and amplify separations in ways that sometimes are invisible and normalised. Similar to the inspiration for the "New Jim Code", most of the examples, terms, policies, and historical events in the book are situated in the United States of America. Indeed, while reading this book together with some of my colleagues at the Confronting Data Co-Lab of the University of Copenhagen, many of the questions we posed ourselves were related to which theories, laws, or empirical evidences would set the ground for a *race critical code studies* from a European perspective.

Interestingly, an example of the European movement of the Luddites helps illustrate what for me it is the main argument of the book. The Luddites were a group of English textile workers who revolted against manufacturers who used machines in nineteenth-century England. Nowadays, the term is still used to describe those who oppose technology. However, the actual meaning of their protest was not the technology in itself but the "social cost" of developing these technologies. Similarly, this book denounces the societal costs of automated data products by exposing relationships, opening up ways to engage with data technologies, and inciting to imagine more socially just alternatives. In my interpretation, this approach is aligned with an anti-essentialist perspective on Luddism (Woolgar 1997). From this perspective, the new technical artefacts that originated the opposition by the Luddites did not have fixed attributes; instead, the artefacts became part of an existing network of actants with a distribution of power. The key question for the workers (Luddites and non- Luddites), entrepreneurs, and other actors involved was "whether and what effect and for whom could the new machinery be enrolled as allies?" (Woolgar 1997, 54). Similarly, the key questions posed in this book tackle matters of power, how new (digital) technologies can preserve or challenge the status quo, and who is represented in imagining new (digital) futures.

Zooming into the actual structure of the book, the first four chapters discuss how technologies help produce social inequality, starting with the most obvious ways of engineered inequality to more subtle forms of systemic bias such as technological benevolence. The last chapter takes a slightly different angle, as it focuses on design practices and imagining futures. Explicit illustrations of the systemic biases embedded into technologies are described in Chapter 1. These examples range from the first even Beauty AI contest to a myriad of types of social credits. A particularly interesting insight is that these technologies are usually described in terms of innovation and forward-thinking, which impact the way they are represented publicly. More concretely, current innovation narratives tend to package AI-based systems in a mystical aura that makes their decisions magically more neutral, fair, and objective than their human counterparts.

The ways in which algorithms are, and become, represented in society have an impact on which qualities and attributes become normalized and accepted; as when social media claim to know what is most important to the public through algorithmically generated "trends" (Gillespie 2012). Therefore, the "politics of representation" (Gillespie 2012, 19) become especially relevant as algorithms are increasingly considered neutral, fair, and objective in estimating, assessing, and predicting societal matters. Relatedly, the book contains many reminders that algorithms are not better than the people that create them; indeed, they can potentially be more harmful because of their scope, recursive nature, and limited accountability. A related aspect to the innovation narrative is intentionality, meaning that these systems are created with the intention of creating better worlds. However, harmful decisions can be morally covered by a rhetoric based on good intentions. Some of the recent work in critical data studies is aligned with this line of thinking and proposes that moving toward more desirable futures entails revising the current focus on individual accountabilities by, e.g., considering ways to enact public reason (Binns 2018).

Moving towards more subtle ways of discriminations, Chapter 2 focuses on instances of unfair and unjust systems that pass off as a "minor problem" (p. 77). These issues usually remain unnoticed and sometimes become visible in technologies in use. The examples in this chapter illustrate how glitches in the system are not exceptions to faulty technologies but peepholes that allow looking into the assumptions and stereotypes that are seamlessly integrated in the development and production of algorithms and data practices. One of the examples is Google Street maps reading aloud Malcolm "ten" Boulevard instead of Malcolm "X" Boulevard. This supposed "glitch" in the text-to-speech system illustrates some of the design assumptions that eventually dispossess the street name from its original legacy. From a design perspective, these "glitches" are very interesting since they can be instrumental in making concerns about discrimination visible and therefore open opportunities to imagine different futures. Indeed, making things visible is a common argument for social justice and democracy; however, is visibility always desirable?

Chapter 3 unfolds the complexity of exposing race in and through technology, and how there are cases in which visibility can be a "trap". Visibility is discussed in many different forms, from literal examples of photo cameras designed to expose "whiteness" to concerns about how visibility is enacted to predict in which geographical areas crime is more likely to happen. Many of the examples illustrate ways in which combining visibility and predictive algorithms can be especially harmful and discriminatory. Algorithmic-based predictions rely on data to make their estimations. Thus, depending on the circumstances and consequences, it might be convenient to be visible while in other cases invisibility can be an asset. The extent to which people can decide whether to be visible or remain hidden relates to issues of power and perpetuation of existing dis-

criminatory systems. This points to the importance of explicitly standing up against the "datafication of injustice" meaning that "the hunt for more and more data is a barrier to acting on what we already know" (p. 116). The rigidity associated with data processes hinders possibilities of including different points of view and representations. In this regard, Seaver (2017) has proposed tactics to enact algorithms ethnographically, which help approach them as rich sociotechnical systems rather than constrained and procedural formulas. Relatedly, there are more and more initiatives that try to imagine different worlds in which data can help produce desirable futures; however, some of them can be quite problematic.

Examples of technologies that try to "fix" the system are described in Chapter 4. These include attempts to fixing diversity, race, and health, with interesting practical examples and reflections on how some technological narratives around diversity monetize differences. Something particularly interesting is how this chapter draws a line from the Jim Crow Laws, which sought to identify people's race to discriminate effectively, to the New Jim Code, which seeks to provide technical fixes to effectively meet everyone's needs on the bases of supposedly stable group identities. The line from the Jim Crow Laws to the New Jim Code is paved with tech design imagination. Well-intended technologies can be harmful and insidious, especially if presented as agents toward better futures. Therefore, as argued in the last chapter, it is important for tech design to be aware of how race and technology shape each other. Here the book refers to many different design-related notions and terms, such as design thinking, empathy, and design justice. It feels like the starting point of another book, rather than a closure. Also, some of the arguments seem to remain at the shiny surface of what sometimes is understood as design. However, there are other substantial forms of design that might be well-aligned with many of the issues raised in the book: for example, in the context of gender, tech, and design several projects and initiatives (such as fempower.tech and femtech.dk) are trying to move away from deficit approaches to issues of gender in computing. These projects seek to challenge stereotypes and assumptions that led to the systematic and structural mechanisms that make computing an exclusive field and discipline.

In summary, *Race after Technology* is an excellent read on why it is important to decode systemic bias embedded into technologies from a *race critical code studies* perspective. The book makes a timely contribution to a growing corpus of work on critical data studies, and it might be interesting to read it in conjunction with other contemporary books (e.g. D'Ignazio and Klein 2020; Eubanks 2018). Integrating the tools of STS into *race critical code studies*, this book makes a compelling case for how race is not only a social construction, but it also constructs realities where race and technology shape one another. Many of the arguments are probably very familiar to researchers in STS; however, the examples can be

instrumental in opening up important discussions among actors such as researchers, developers, designers, students, or policymakers. Indeed, the author's clear and down to earth writing style makes this book very engaging for anyone interested in how algorithms and data practices embed forms of social injustice and how these can be considered when imagining better futures.

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Stefano Crabu

Dalla molecola al paziente. La biomedicina nella società contemporanea [From the Molecule to the Patient. Biomedicine in Contemporary Society], Bologna, Il Mulino, 2017, pp. 179

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"From bench to bedside" is the motto of the emerging translational research in current biomedicine. In the biomedical literature, translational research is promoted as a strategic and efficient way to implement the novel discoveries of biological science in clinical practices, and to incorporate clinical observations back to laboratory science. In Science and Technology Studies (STS) and in social studies of biomedicine, translational research is addressed as a space of problematization instead, which invests important transformations in the articulation of clinical and experimental practices as well as discourses and epistemologies, the generation of novel biological entities and, finally, the making of subjectivities.

In *Dalla molecola al paziente*, Stefano Crabu introduces the Italian reader to the STS discussion on what is often called *precision* or *personalized* medicine. While in the biomedical literature "precision" and "personalized" neutrally refer to the application of genomic knowledge for the development of targeted, patient-specific therapies, in STS these terms are instead problematized. Crabu contributes to this effort of problematization, through an original ethnographical analysis in two strategic sites of translational medicine: an institute specialized in clinical research on cancer and a laboratory working in the emerging field of nanomedicine. Crabu shows how these sites are problematic spaces where the institutional boundaries of care and knowledge production are blurred. He thus explores the complex epistemological and pragmatic realignments of clinical and research practices that characterize translational medicine.

In the first chapter, Crabu sets the analytical framework by discussing the main theoretical approaches in the sociology of medicine, health, and illness and in the social studies of contemporary biomedicine. Here Crabu combines the STS understanding of laboratory practices with some central notions in the social studies of biomedicine, and in particular with the theory of *biomedicalization* developed by Adele Clarke and colleagues (2010). This move allows to grasp the complex transformations occurring in contemporary biomedicine, including what Clarke and colleagues called the "technoscientization" of biomedical knowledge production and clinical practice. Technoscientization is what enables the insertion of STS analysis of laboratory practices into the social studies of biomedicine, through another important analytical notion largely used in this literature, namely the concept of *biomedical platforms* developed by Keating and Cambrosio (2003). Covering semantically "natural and artificial entities, material artifacts and their blueprints, technical and political, material and symbolic referents", biomedical platforms are "way[s] of arranging things in both a material and a discursive sense… the basis for the organization of activities" (Keating and Cambrosio 2003, 345-6). The concept of biomedical platforms has been introduced to account for the growing importance of biology in current medicine and the clinics, as biology has become "the ultimate description and account of disease origins and mechanisms" (Keating and Cambrosio 2003, 354). It is therefore particularly apt to understand the institutional, pragmatic, and epistemological transformations characterizing the current biomedicine, especially in fields like translational research. In fact, the analytical framework developed by Crabu in this research is strongly indebted with the notion of biomedical platforms and in general to the work of Keating and Cambrosio on the intersection of the new genetics with cancer research and clinical treatment.

A third relevant concept largely adopted by Crabu, is that of *molecularization* (Rose 2007), namely the re-inscription of the biological into the mechanisms and dynamics of the molecular entities of the human ge-

nome. Molecularization, moreover, accounts also for the pervasive use of information technologies in contemporary biomedicine, as well as for the articulation of the molecular in informational terms, that enables the deployment of genomics and post-genomics knowledge in addressing health, illness, and therapies targeted on the patient's genetic specificities. Molecularization, finally, has important implications in the re-making of bodies as *biomedical objects* and of patients as *experimental subjects*. Referring to *biomedicalization*, *biomedical platforms*, and *molecularization*, Crabu investigates what translational medicine implies in terms of the emerging novel articulations and intersections of clinical and experimental practices. The theoretical reflection on these articulations is empirically grounded on the analysis of the practices situated in specific sites of treatment and research, where biomedicine is in the making.

The second chapter is thus devoted to an ethnographical analysis in an Italian medical institute specialized in cancer care and research. Here, by studying what he calls a "translational biomedical platform" (p. 74) in the making, Crabu explores the interconnection of care, clinical research, and experimental development. This valuable analysis is articulated along two interconnected axes. The first axis concerns the re-arrangement of care and clinical research practices in a translational framework. This means that the traditional routines in patients' treatments are reshaped according to the protocols for the research on molecular biomarkers. The second axis refers to the transformations investing patients and their bodies. By combining the reflection on molecularization and on *clinical labor* (Waldby and Cooper 2014), Crabu shows how patients' bodies are reconstituted into a flow of mobile biological samples, parameters, and bioinformation, that can be treated *in vitro*, *in vivo*, and *in silico*. The body is fragmented and rewritten through a complex technoscientific apparatus of molecular quantification. In this way, the individual patient is converted into an experimental subject enrolled in the process of bio-knowledge production.

The adjustments of laboratory knowledge to clinical activities and the related re-arrangements of the everyday procedures of care and patients monitoring, according to the requirements of scientific research, are encapsulated in the original notion of *technomimicry.* This notion is the main theoretical contribution of Crabu to social studies of biomedicine. Crabu distinguishes between *clinical technomimicry* and *experimental technomimicry*. The first one captures the "cognitive, material, and technological resources" operationalized in the situated everyday practices that make "scientific research epistemologically consistent with clinical action" (p. 69). The second refers to the ways "the clinic locally re-adjusts its routines and practices" to the norms and methodologies of the scientific laboratory (p. 74). According to Crabu, *technomimicry* is what makes the biomedical platform of translational medicine working, by providing the medical experts with the operative logic for producing clin-

ical data and samples that can be used in the laboratory setting. *Technomimicry*, in its clinical and experimental acceptation, is the analytical device that enables to grasp how translational biomedical platforms are concretely and locally enacted and how the practices of care interpenetrate technoscientific research and innovation.

In the third chapter, Crabu explores the field of nanomedicine, that is the combination of nanotechnologies with the biotechnological design of new entities aimed at improving drug delivery and developing novel molecules to treat cancer. Here, the analytical framework is enriched with the contribution of the so-called *sociology of technoscientific expectations* (Brown and Michael 2003). Largely used in the analysis of emerging and future-oriented technoscientific innovations, this approach is suitable for investigating how discursive spaces of future promises and technoscientific imaginaries are enacted to shape and orient the course of action of research and innovation. The sociology of technoscientific expectations allows Crabu to deploy the notions of biomedical platforms and *technomimicry* for an analysis of future-oriented biomedical technologies. In this way, Crabu investigates the articulation of practices, discourses, and biological and technological objects in the everyday activities of a laboratory working on prospective biotechnological applications.

In the final chapter Crabu goes back to STS and social studies of biomedicine to theoretically discuss the implications of translational biomedical platforms. The ethnographical analysis undertaken in the previous chapters enables the identification of four trajectories that are reshaping the contemporary biomedical landscape: 1) the making of a hybrid space of increasing interaction between the laboratory and the clinical setting and the related technological and organizational arrangements enabling the coordination among different disciplinary fields; 2) the manipulation of the biological and the life itself; 3) the redefinition of the role of the patient as a central actor in nowadays biomedical practices; 4) the transformation of the roles, expertise, and identities of medical, research, and health professionals involved in contemporary biomedicine. The implications of these four trajectories are discusses along two axes.

The first one, centered on Crabu's notion of *technomimicry*, focuses on the articulation and the assemblage of knowledge, practices, and technological objects. Translational medicine is thus not represented as merely a strategy for improving the application of genomic and post-genomic knowledge and techniques to the clinic, as in the biomedical literature. Rather, translational medicine is studied as a new style of practice where the boundaries between the clinical and the experimental are blurred and reconfigured. *Technomimicry,* in both its clinical and experimental acceptation, is the core notion that enables the identification of this novel, emergent style of practice, where clinical routines are shaped to produce scientific data (through the lenses of molecularization), and laboratory procedures are adapted for the generation of knowledge and technologies

usable in the clinic.

The second axis is related to the implications of molecularization for the role of patients. Here lies a huge contrast between how the patient-centered approach of translational medicine is depicted in the dominant narrative of the biomedical literature and how the patient is subjectified in current, concrete biomedical practices. By drawing on the notions of molecularization, clinical labor, and experimental subjectification (Rose 2007; Waldby and Cooper 2014), Crabu shows how the claims of a personalized, patient-centered medicine are instead translated into the reduction of the patient to her/his biological and genetic specificities, materially represented by the bio-information extracted from her/his samples and her/his informatized medical records. Crabu stresses how the patient is, in other words, transformed into a flow of samples and bioinformation, metabolites and biomarkers, bits and data analyzed and manipulated by complex technoscientific apparatuses of calculation and intervention. The translational biomedical platform transforms the living body into elements that are manipulated, mobilized and translated into information according to experimental, patient-oriented practices. In this way, a striking paradox in the dominant rhetoric of translational medicine is addressed: through molecularization, the patient-centered approach turns into the re-inscription of bodies in terms of biological entities and bioinformation. Patients are only represented in discourses, experimental practices, and clinical procedures but not as actors-in-the-flesh. The literature in social studies of biomedicine has largely worked on the implications of molecularization for the re-shaping of the self, individuality, personhood and the subjectification of those who are enrolled as experimental subjects in contemporary biomedicine. A stronger engagement with this literature, and a closer analysis of how patients are experiencing their re-inscription as "separable, mobile, exchangeable and reincorporable body parts" (Rabinow 1999, 95) would have enriched the valuable problematization of translational medicine made by Stefano Crabu. Similarly, the notion of *technomimicry* is useful to capture the mutual and continuous realignment of clinical and laboratory practices in translational medicine, but a discussion about the existing lines of conflict between purely clinical settings and novel translational practices would have further improved the problematization of this emerging biomedical platform.

This book is indeed a precious contribution, well integrated in the existing literature in STS and social studies of biomedicine, and it introduces the Italian readers to the scholarly problematization of the situated discursive, symbolic, and material practices characterizing the contemporary emergent biomedical fields.

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Silvia Gherardi

How to Conduct a Practice-based Study: Problems and Methods. 2nd Edition, Cheltenham, Edward Elgar, 2019, pp. 295

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As a renowned scholar within organization studies, Silvia Gherardi needs little introduction. Spanning topics such as work, organizational learning, sociomaterial practices, and more recently, affectivity, Gherardi's work is generally known for its ability to introduce and reinforce insightful new perspectives in a timely manner. Most prominently, Gherardi's work has been influential in establishing practice-based thinking around the same time that the notion of a 'turn to practice' gained traction. It is thus fitting that the latest edition of her book *How to conduct a practice-based study* manages to reflect much of the range of her and her colleagues research with specific attention to practice.

In so far as the book covers research, it more importantly covers the process of doing research. The book is not a standard book on methods but one that engages with giving some idea of how phenomena can be conceptualized in a practice-based manner and in presenting stories of how practice-based studies are possible. Consequently, the book is not a summary of research findings or a step-by-step guide on how research is done. While possibly confusing at first for those who might want an easy read on what they should be doing in research, the narrative approach

makes for an excellent run-through of the actual challenges of doing practice-based research.

Given the scholarship of Gherardi, the book can be assumed to be primarily intended for audiences in organization studies. However, it is fair to state that the book is relevant to other audiences. Not only is this notable in the inspirations Gherardi draws from, e.g. microsociology, Science and Technology Studies (STS) and feminist theory, but also the themes covered in the book. Next, I give a short summary of each chapter to clarify the main themes of the book.

In Chapter 1, the book posits a general position of practices as interesting units of study and a means to re-conceptualize traditional understandings of the social. This position is based upon Gherardi's reading of microsociology, i.e. ethnomethodology, symbolic interactionism, and phenomenology, i.e. Schütz and Merleau-Ponty. Drawing on these insights the book lifts the embodied character of practical knowledge, an important staple of Gherardi's theory of practice. Moreover, it positions such knowledge as essentially collective and situated. Practice is not individual doing but collective knowledgeable doing that happens somewhere.

The chapters that follow generally expand upon Gherardi's introductory definition of practices and how they can be studied. In Chapter 2, the topic of knowledgeable doing is fleshed out by illustrating its collective nature in workspaces. In Chapter 3, the embodied aspect of practical knowing put forth and illustrated in terms of how aspects of the body, as well as the gendered body, matter in practices. Chapter 4 presents how an interest in practices also can extend beyond the confines of classical sociology. Most notably, Gherardi draws upon insights from science and technology studies and post-humanist feminist theory in suggesting the performativity and agency of materiality.

In Chapter 5, Gherardi discusses the issue of normativity in practices and how rules are instantiated and used as resources for practical doing. Chapter 6 follows this by discussing the discursive nature of practices and its study, channeled in a methodology to grasp language-in-use and communicative practices. Chapter 7 then expands upon why practitioners engage in practices, and the concerns and issues that drive them. To accomplish this, Gherardi connects to wider theoretical discussions on topics ranging from aesthetics, ethics, and affectivity.

As she posits, a study of practice can more justly be defined as always engaging with aesthetic sensibility, ethical dimensions, and the affectivity that suffuses practical doing. Here Gherardi makes her interest clear in bridging the study of practice into domains that could both be seen as enriching it while also being theoretically compatible. With the emphasis on doing research, the book goes beyond others (e.g. Andreas Reckwitz), who made similar conceptual points to discuss more concrete examples of an expanded study of practice. In Chapter 8, Gherardi connects the

notion of studying practices with the issue of studying multiple practices, i.e. nets or complexes of practices. Drawing upon her previous work, Gherardi defines a line of inquiry involved in understanding the relationality of practices in what she refers to as the *texture of practice*. Moreover, she expands upon her earlier definitions of this by connecting with an interest in the assemblages of the sociomaterial world, or as she prefers to regard it: the *agencement* involved in the texture of practice.

The final two chapters stand out from the rest in having different ambitions. Chapter 9 presents some more hands-on advice in terms of techniques in the study of practice. Topics such as doing interviews and ethnographic research are given particular attention. Finally, Chapter 10 lays the foundation for Gherardi's more recent theorizing as a means to tie together the various themes of her research mentioned in the book. Here, at the center, lies an explicit idea of a post-humanist understanding of practice, and more so, a post-humanist practice theory. This chapter goes beyond Chapter 4 in discussing the conceptual implications of such theory, while simultaneously making room for all themes covered in the book.

Readers of new materialism will most likely feel a sense of familiarity when approaching the theoretical synthesis of Gherardi. Even though Gherardi draws from social phenomenology and classical microsociology, her doing so is largely accomplished in order for it to be compatible with posthumanist reasoning. This is not particularly surprising for those who have kept tabs on the development of practice-based thinking. Departing from its classical theoretical form in the works of Bourdieu and Giddens, practice scholars have been open towards critiques of humanist thinking in efforts to treat materiality. Given the rise of new technologies, ongoing climate change, and – more recently – pandemics, making an explicit posthumanist point can be seen as warranted for practice scholars to better assess these new challenges methodologically.

In her final chapter, Gherardi states that she is aware that her work draws from multiple traditions that differ in terms of assumptions, lines of inquiry and methods. Nonetheless, she bridges these differences to suggest important commonalities to be gained by framing these perspectives under the umbrella of practice-based studies. The most important among these – given the context of the book – is that practitioners' practices and researchers' practices are to be conceptualized as interlinked. Rather than the pursuit of the study of the 'Other' through some form of distanced, rationalistic inquiry, practice-based scholarship realizes that researchers are not withdrawing from the world when engaging in scholarship but very much engaged with their bodies, affects, non-humans, pursued ends, ethics, and so on.

Having summarized the chapters and the book's central message, a fitting question to ask is whether the new edition of book has anything new to offer for those who have read the first edition. The major differences can be posed as follows: some chapters have been re-structured to

more poignantly present particular themes of practice-based research. In addition, the description of practice theory has been reframed and Gherardi makes a more distinct effort in presenting her own theorizing. These changes are welcome as they make the book and its contents stand out more distinctly and simultaneously be more accessible.

Some things in the book can, however, be critiqued. I must first signal that my impression of the book is colored by my own background in organization studies. I originally read both editions of the book with an explicit interest in practice theories in particular and their implications for organizational scholarship. From this perspective, the book can be posed as providing an introduction to practice thinking, fit for those who might wonder what practice approaches are good for and what they mean for research practice. The ties to organizational scholarship are, however, not particularly prominent. There is no grand effort in mounting a major offense on mainstream organizational theory here from a practice-based perspective. This is not a detriment of the book as such, and perhaps suggests that it is more appealing for a broad readership.

Leaving organization studies aside, the book can also be judged on the basis of its appeal for scholars of practice. For those expecting a book with a focus on practice theory– this book is not immediately for you. In contrast to another popular textbook on practice studies (Nicolini 2012), Gherardi makes no major effort to account for a genealogy of practice theory nor does she make any major effort in defining the family of intellectual inspirations connected to practice theory. While some assessment of the tradition of practice research is present, it mostly is directed towards a short excursion into classic microsociology and the sociology of science. A reader of classical practice theory, e.g. Bourdieu and Giddens, would perhaps also not immediately feel at home with some of the connections drawn. Here, I object to the emphasis on Alfred Schütz phenomenology as a guiding inspiration for practice theory on the basis that it underplays the legacy of Heidegger's philosophy in the theorizing of Bourdieu and Giddens, and more recently: Theodore Schatzki. This objection, however, rests upon a specific understanding of the genealogy of practice thinking; one among others that are not brought forth here.

While one could argue that making a deep dive into theoretical elaboration is not necessary there are a couple of important implications. First, and as stated above, this book does not fully analyze core assumptions of the various theoretical approaches discussed. Secondly, due to the book's nature of being oriented towards the craft of research, the book is less evidently related to later, prominent developments in practice theory (e.g. Schatzki 2019; Shove et al. 2012). When they are mentioned, they are only discussed in superficial manner. While not necessarily a problematic issue, there are parts of Gherardi's text that can be seen as polemic in nature. Indirectly, the book is found in a discussion with alternative accounts of practice that are never properly presented in the book. This

implies that the uninitiated readers are left in the dark concerning the full implications of Gherardi's methodological reasoning. Third, the book also does not deal with some of the critique leveraged against practice theory (Turner 1994). It can, at times, appear to be a text dedicated less to argue in favor for its assumptions and more in line with helping scholars who are already on-board in their research.

These aspects are not necessarily major flaws, and for some readers these are possibly irrelevant concerns. I would go as far as to say that the lack of theoretical emphasis makes this book particularly helpful for scholars of practice. Unlike much discussions on practice theory, Gherardi launches directly into discussions of epistemology – practice as epistemology in her terminology – and in discussions of actually doing research. As much thinking in regards to practice theory has been marshaled in conceptualizations rather than actual empirical elaborations, Gherardi's emphasis is sorely needed.

To conclude, this book is of value for all those interested in pursuing practice-based scholarship empirically. More so, one could claim that the book provides an interesting read for all interested in anecdotes that cover the processes of doing qualitative research. Given its style and the themes covered, the book can be seen as relevant across the social sciences including thus STS.

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Daniela Rosner
Critical Fabulations. Reworking the Methods and Margins of Design, Cambridge, MA, MIT Press, 2018, pp. 216

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The first time I have approached the book *Critical Fabulations. Reworking the Methods and Margins of Design* by Daniela Rosner was during the EASST Conference held in Lancaster in 2018. At the time, Rosner was in Lancaster acting as one of the discussants in the open panel "Situating designs", and presenting her freshly published book. I remember that Rosner's insights into the rich and complex relationship between design and STS have been quite encouraging for me, a postdoctoral researcher in Participatory Design back then, with a PhD in STS and a background in Media Studies. I was grappling with the particular condition of navigating neighboring, yet different, research fields, striving to find my place somewhere between them. In that circumstance, I found Rosner's thoughtful considerations about how STS and design are connected rather promising insofar as she identified the contribution that each of them could offer to the other (Boeva 2018). More than anything, after listening to Rosner's intervention, I have started the process of dismissing that idiosyncratic picture of design made up of sticky notes, portfolios, posters, websites etc. (that is, what I was the least familiar with), and pinpointing the actual, although challenging, entanglements between STS and design. This commitment was definitely confirmed and reiterated by reading the book, which advances the theoretical argument of 'critical fabulations' understood as ways of storytelling that rework how things we design come into being, therefore opening new paths for design by awakening alternative stories.

The book is divided into five chapters, crossed by a narrative thread that starts with theoretical and impersonal chapters (1 and 2) and runs towards practical and personal examples of critical fabulations (chapters 3, 4, 5). The distinction between 'personal' and 'impersonal' narrative is not a trivial one, as it reflects both the theoretical pivots underpinning Rosner's book and work as well as the narrative tone deployed in the book. The book's structure, indeed, moves from a historical critique tracing central influences on design today and search for "correctives" (identified in feminist programs of technoscience) to interventionist possibilities. Such content structure is also experimented in form and voice, with Chapter 1 presenting a historical account, Chapter 2 a biographical narrative, Chapter 3 an autobiographical note, while Chapters 4 and 5 portray Rosner herself as deeply embedded into critical fabulations. Accordingly, she adopts a more embodied and experiential writing voice along the way, a narrative choice that reflects her professional and personal transi-

tion from a dominant design paradigm towards a more implicated, open-ended, collaborative practices of technoscience. As a matter of fact, Chapter 1 reconstructs the intellectual pillars that, according to Rosner, have dominated design thinking: individualism, universalism, objectivism, and solutionism. Each of them is situated, so as the doctrine of *individualism* is associated with John Dewey's American Pragmatism, while *universalism* is linked with Cold War cybernetics, *objectivism* is related to the cognitive model developed by economist Herbert Simon, and *solutionism* is coupled with the increasing tendency toward problem solving the design discipline took up at the outset of the 1960s. According to Rosner, these intellectual foundations of the dominant design paradigm advance an understanding of design as a disembodied activity comprising universal subjects, thus neglecting or underrecognizing certain bodies and voices.

An alternative way of understanding design is drawn from feminist programs of technoscience, which are examined in Chapter 2 through the biographical notes of two major figures in the field: Lucy Suchman and Donna Haraway. Rosner engages with Suchman's and Haraway's work and lives though biographical notes collected from various public interviews and from conversations she personally had with them. The outcome is an interesting double portray that emphasizes connections by highlighting the different paths walked by the two scholars, namely ethnomethodology and symbolic interactionism in the case of Suchman, and Heidegger's phenomenology, Whitehead's writings and cybernetic theory in the case of Haraway. Such heterogeneous formations developed later into two more coherent research frames: whereas Suchman attended to the position of the user by developing the concept of 'situated action', Haraway focused on the position of the analyst by elaborating the concept of 'situated knowledges'.

These intellectual sensitivities are put at play in the subsequent chapters, in which Rosner narrates her personal encounters with critical fabulations. Chapter 3 provides an account of her fieldwork with knitters and crafters in the Bay Area, an experience that made her grapple with issues of invisible labor and the view of users as a united category of practices. In this respect, *Spyn* – the new knitting technology Rosner developed – served more as a tool whereby to open the intimate relationships at stake than the right solution to achieve a supposed universal state. This experience allows Rosner to develop a deep reflection on the role of design practice and designers, leading to the elaboration of four orienting tactics characterizing critical fabulations: alliances, recuperations, interferences, extensions. Rooted in the theoretical commitments of feminist technoscience, these techniques work as guiding orientations for critical fabulations, in order for investigators to reimagine established design techniques and to recuperate invisible stories behind contemporary technoculture's extractive systems of power. More specifically, *alliances* refer

to the set of relations designers can foster through their practice, enabling ways whereby to cultivate collective action and to inquire in concert with those standing in the design setting. An example of this tactic is mentioned in relation to contemporary design projects aimed at enabling alliances between gig workers as in the case of *Turkopticon*, a digital platform developed to allow Amazon Mechanical Turk workers to search and add reviews of employers, thus prompting both workers and employers to be known and accountable to one another. *Recuperations* point to attempts to revive stories entangled with the design settings, but neglected by prevailing design narratives. This tactic pushes investigators to ask questions such as: Whose invisible work underpins your own? How might inform your inquiry? What histories of practice have been suppressed or elided? Whose legacies are being left out or dismissed? Similarly, the tactic of interferences works to disturb a narrative that is privileged within a prevailing design culture, showing that it might work otherwise, and how. In the case of *extensions*, designers work to uncover and value an abandoned or ignored design situation within a prevailing design culture.

The last chapter of the book brings us into the critical fabulations through an account of design projects in which Rosner was involved. These projects have been devoted to challenging the established ideas of craftwork as a plan to be given form by design (*Arc* project), embracing legacies of repair (*Broken Probes* project), recuperating the textile work of Little Old Ladies – the female workers who wove the software into the core memory for the *Apollo* Missions – to trouble the current mainstream understandings of design and engineering innovation (*Making Core Memory* project).

Critical Fabulations is a brilliant piece of intellectual and empirical work, which falls into an interesting lineage of scholarship focused on developing a conception of design as an activity inherently cultural, social and political (Balsamo 2011; Manzini 2015; Escobar 2018), aiming at creative and ethical transformation. What I think makes Rosner's book particularly interesting for the STS audience is the effort to portray a critical and engaged practice of design building on works that are central in the STS scholarship, such as Suchman and Haraway's intellectual legacies. Such an effort is palpable in the recurrent emphasis on the alternative processes of knowledge production that critical fabulations can spark. In this respect, I feel that the most interesting contribution of the book to STS researchers is an invitation to experimenting with material objects and practices as methodological tools to be added to the STS traditional toolbox (e.g. interviews, observations, archive research, etc.) in order to detect issues and intervene in the field. Such a commitment resonates with the emergence of a "collaborative mode of practicing STS" (Farías 2017) based on dialogue, mutual learning, and caring relationships with other research fields and disciplines as well as with non-academic collec-

tives. After all, one of the orientations informing critical fabulations is precisely *making alliances* in order to cultivate transformative collective actions by standing with the groups with which we inquire.

Critical fabulations is a compelling reading for STS scholars interested to find their distinctive way into design as much as for designers to rethink and retool their practice from a critical point of view. It is a tool that can help building fruitful bridges between design and STS, fostering promising alliances and possibilities.

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Tiago Saraiva and Marta Macedo (eds.)

Capital Científica. Práticas da Ciência em Lisboa e a História Contemporânea de Portugal [Science Capital. Science Practices in Lisbon and Contemporary History of Portugal], Lisbon, Imprensa de Ciências Sociais, 2019, pp. 410

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Capital Científica [Science Capital] examines how Lisbon became not just the official (political) capital of Portugal but also the capital of its scientific system and how scientific knowledge helped build the contemporary city outlook.

This book is an edited volume that brings together ten chapters authored by some of the leading scholars in History of Science in Portugal, from the main universities and research centers dedicated to this discipline, such as Tiago Saraiva (University of Drexel), Ana Carneiro and Maria Paulo Diogo (New University of Lisbon), Ana Cardoso de Matos (University of Évora), Ana Simões (University of Lisbon, current presi-

dent of the European Society for the History of Science). It stems from two research projects funded by the national agency (Portuguese Foundation for Science and Technology) focusing on the development of science and technology between the mid-19th and the mid-20th century. Although each chapter focuses on a particular subject, they are structured around a few crosscutting issues, such as the importance of place in the production of knowledge, the construction of new urban landscapes, or the role of scientific research and some professional groups (scientists, engineers, doctors) in policy making and policy implementation. As the editors state, science is a lens through which to understand the historical dynamics of contemporary Portugal. At the same time, the book shows how urban problems in Lisbon inspired the work of scientists and engineers and, conversely, how their work changed the city in material, social, and symbolic terms.

The connections between science and the political regimes are made clear. The book is divided into three sections that pertain to different chronological and political periods in Portugal: the later stages of the monarchy (mid-19th century to early 20th century), the First Republic (1910-1926), the Dictatorship (from 1926 until 1974). The first section addresses the role of scientific institutions in modernizing the nation, by mapping the territory, standardizing time and providing expert support to public services such as street illumination, water, and sewage systems, the design of parks, gardens and streets. The second section shows how the Republican project of education and health for all had repercussions on the creation of new hospitals and biomedical research institutes and also of 'people universities', institutions devoted to the education of adults with low formal education. The third section illustrates how the Fascist regime concentrated its efforts on research institutions under its direct supervision, namely State Laboratories and hospitals, and on applied scientific disciplines (namely medicine and engineering), while neglecting universities and persecuting academics.

Some chapters focus on specific research institutions (Chapters 2, 3, 6 and 10), others on teaching institutions (Chapters 1, 4 and 7), or on the intersection between research, teaching, and professional practice (Chapters 5, 8 and 9). A few chapters (1, 2, 3, 5, 8 and 9) examine how the architecture of purpose built scientific institutions, such as the Polytechnic School, the Astronomical Observatory, the office of the Geological Service, the Faculty of Medicine, the Institute of Engineering or the Oncology Hospital, serve both practical and symbolic functions. Some of them (Chapter 1, 5, 8, 9) show how the neighborhoods in the vicinity of scientific institutions suffered significant transformations, in terms of hygiene, rationalization, and civic architecture. Only the chapter on Industrial Institutes and public illumination (Chapter 4) explores the connections between art (literature, theatre, opera) and technoscience.

The chapters cover a fairly wide array of scientific disciplines (astron-

omy, geology, physics, microbiology, engineering, and medicine), though the social sciences are entirely absent. Omissions in terms of institutions and scientific disciplines are acknowledged by the editors in the Introduction. Some chapters pay particular attention to the training of new professionals, such as engineers (Chapters 1 and 8) or physicians (Chapters 5 and 6), whereas others focus on the promotion of science and technology education for factory workers and adults with lower educational backgrounds (Chapters 4 and 7). Most chapters also include some biographical detail of historical figures of particular relevance, such as doctors (Chapters 5, 6, and 9), architects (Chapter 1 and 8), astronomers (Chapter 2), geologists (Chapter 3), industrialists (Chapter 4), or university professors (Chapters 7 and 8). It is notorious the absence of women in these narratives, with the exception of the wives of doctors in the Oncology Hospital that conducted philanthropic work (Chapter 9) and one female researcher who worked in a biomedical laboratory (Chapter 6).

The book follows in the footsteps of other works on the relations between science and territorial or urban contexts (see, for instance, Agan and Smith 1998 or Nieto-Galan and Hochadel 2019) and the relevance of the architecture of spaces in knowledge production (see, for instance, Galinson and Thompson 1999). It is closely connected to the previous work of the editors, namely their PhD theses: Saraiva's (2005) take on science and the city with regard to Madrid and Lisbon and Macedo's (2012) analysis of the role of engineers in producing science and territory in the 19th century.

The chapters seek to establish an extensive dialogue with the international literature on the topic, in particular by drawing parallels with studies on other European or American cities, on architects and urbanists from other countries, on research and education institutions in France, Russia, or USA, and on the history of particular scientific disciplines or technological innovations. Some chapters also draw on research on contemporary science and technology issues, going beyond the time limits of their scope.

As in any edited volume, the quality of chapters is slightly uneven. Some chapters are mainly descriptive, whereas others show more concerns with interpretation and contextualization. Some chapters draw from previous published books and articles, so the innovative nature of these texts is to some extent doubtful. The title of the book is somewhat misleading, since scientific practices, in the sense of the everyday life of laboratories, offices or lecture halls or how science was actually produced, taught, applied or disseminated, are mostly absent. Rather, the chapters mostly focus on institutions, spaces, and agents of science, medicine, and engineering. The absence of an index at the end does not afford the reader an opportunity to browse for particular topics.

Nevertheless, the book is profusely illustrated, with maps, photographs, plans, and portraits. The writing style is clear and accessible to a

wide audience. Given the dearth of publications in History of Science (and STS) in Portugal, this book provides a much-needed contribution to the field. Also, the book brings to the light the "invisible" scientific endeavors carried out in a southern European country during the 19th and early 20th century, putting into question the dominant narrative that Portugal had barely any scientific activity until the accession to the European Community in the 1980s.

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Howard Shrobe, David L. Shrier and Alex Pentland (eds.) *New Solutions for Cybersecurity,* Cambridge MA, MIT Press, 2018, pp.491

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Cybersecurity and cybercrime are fast becoming two of the most important issues of our digital society and, as such, they deserve attention from Science and Technology Studies (STS). We can define cybersecurity as the theory and practice of preventing or detecting attacks on digital systems. We can define cybercrime as the unauthorised access to digital systems for a variety of purposes, which can include disruption, manipulation, deception and crime more generally, among others. Much of what exists in social sciences research especially around cybercrime comes from criminological studies. However, criminologists are debating on the problem of using traditional criminological approaches (that focus on the study of human criminals and social structures) to the study of phenomena deeply ingrained with digital technologies. Thus, criminologists speak about the problem of the "Novelty of Cybercrime" (e.g. Yar 2005). Few authors in criminology have started to look at STS approaches as poten-

tial alternatives to traditional approaches. At present, we indeed have limited STS contributions studying cybersecurity and cybercrime. Few of the known exceptions are the papers by Van Der Wagen and Pieters (2015; 2018) on cyborg crimes and hybrid victims. I would also like to highlight a recently funded research project in the UK called "Scaling Trust: An Anthropology of Cyber Security", led by Matthew Spencer at the University of Warwick.

We live in a world increasingly shaped by digital technologies, whether computers, algorithms, infrastructures or the Internet of Things, and all come with the purpose of serving a multiplicity of needs such as the running of business, the offering of public services or making our cities smart, among others. However, it has long been known that computers (and by extension all digital technologies) can be attacked often with malicious intents. Designing secure systems has been a main concern since the creation of shared computing resources in the early '60s of the last century. Security still is a major concern today as it is clear that the increased complexity of our digital technologies, their pervasiveness and our overreliance on them can only bring increases in risks and in the sophistication of the attacks toward them. All of this could cause major disruptions to our society's life, as the quite recent case of the Wannacry attack has demonstrated (ENISA 2017). Cybercrime is major problem for many actors, whether companies, public authorities or even just citizens. Consequently cybersecurity becomes a necessity, which is however often overlooked for a variety of reasons that can include costs, lack of skills or simply disinterest.

The book *New Solutions for Cybersecurity* edited by Shrobe, Shier and Pentland (2018) thus contributes to this important field. The book contains chapters written by leading academics and researchers from the MIT. Now, to be clear, this book does "what it says on the thin", to use a catchphrase. It is a book that offers solutions, i.e. practical solutions to cybersecurity problems. It is not a book that advances theoretical thinking or empirical research specifically, although all the chapters are based on high quality research. The book does not have research or academia as its main audiences. This is a book aimed at practitioners, people working for companies, public authorities and organisations, which are looking for recent and advanced cybersecurity solutions, hence the title "new solutions". Solutions, those offered in the book, which could be often readily implemented to solve technical or organisational problems around cybersecurity. Each of the chapter is very lightweight in terms of discussing debates, theories or providing reviews. Each focuses on a solution to a specific problem, whether this is a more secure computing architecture, the need for tapping into bug-hunters expertise or advances in social network analysis that can be used for prevention or detection of crimes. The book is organised in three main blocks geared respectively toward: a) "Management, Organizations and Strategy", b) "Architecture" and c)

"Systems". The first block proposes mostly solutions that can be implemented at organisational level for incresing or improving cybersecurity. The second block reports on solutions for the architecture of secure computer systems and for overcoming limits in the traditional design of computer architectures. The third block contains chapters wich broadly encompass a variety of systems, such as Internet of Things security or the DarkWeb. The three proposed blocks seem also an emergent way of organising and clustering a variety of solutions, as proposed in the book's chapters.

Now I will concentrate on some of the chapters, in order to highlight a few of the main contributions of the three main blocks of the book. I will also concentrate on the chapters that I believe are representative of the content of the book and that in my perspective may be of interest from an STS angle.

The chapter 1 of the book entitled *Institutions for Cybersecurity: International Responses and Data Sharing Initiatives* is part of the "Management, Organization and Strategy" block of the book. It provides an overview of the main institutional actors involved in cybersecurity, also detailing different institutionalisation processes that took place in both the USA and Europe. The main contribution of this chapter, I would suggest, is a table providing a detailed list of organisations and their roles in cybersecurity. This table thus offers a useful reference map to navigate the quite complex variety of institutional actors dealing with cybersecurity, including Computer Emergency Response Teams (CERTs), Information Sharing and Analysis Centers (ISACs) and other national and international players.

Chapter 4 entitled *Fixing a Hole: The Labor Market for Bugs*, also part of the "Management, Organization and Strategy" block, offers an interesting analysis of the labour market associated with bug-bounties programs, that is, companies offering rewards to programmers (defined as researchers or sellers) that can find critical bugs in their software. This chapter does well in describing the stratification of the bug bounty labour markets and provides interesting recommendations for companies wishing to use this specific form of labour for reducing the vulnerabilities of their software. The main solution is the suggestion of developing programs geared toward attracting low numbers of sellers but capable of delivering high volume of results (i.e. identification of bugs), rather than large numbers of sellers, which have shown to deliver much less, due to a variety of reasons including lack of knowledge of the codebase.

Although strictly a technical chapter devoted to an architecture called CHERI (Capability Hardware Enhanced RISC Instructions) for increasing systems trustworthiness, and thus included in the "Architecture" block, Chapter 6 *Fundamentals Trustworthiness Principles in CHERI* is quite enjoyable in its discussion and revision of the Saltzer/Schroeder principles of information security (Saltzer and Schroeder 1975). I would

recommend this chapter to get a sense of how security policies and mechanisms functions in most advanced secure and trusted architectures. Consequently, the chapter provides an interesting reference point for knowing how current advanced security architectures work toward overcoming the security limits of previous computer architecture designs.

Chapter 10 *Who's Afraid of the Dark Web?*, included in the block on "Systems", provides an interesting discussion about the concepts of privacy, anonymity and the Dark Web. This is, perhaps, the chapter that least of all proposes a specific solution to a problem. It offers, instead, reflections on the role of technologies enhancing privacy and anonymity (such as the onion routing and encryption more general). The chapter also reflects on the difficulties of maintaining the balance between the positive use of these technologies for e.g. protecting privacy and the prevention of their use for fostering criminal enterprising.

Some warnings about the content of a few chapters. Although, as I said earlier, this is not a book particularly strong on theory, I need to flag up that in some chapters there is pervasiveness of positivism and deterministic thinking. I refrain here in this review to discuss a critique of positivism in the field of cybersecurity and I would suggest that probably the measure of success to apply to each of the proposed solution is the extent to which they really offer something to address specific cybersecurity problems. Nonetheless, the positivistic perspective is for example clear in the chapters describing the concept of "social physics" (Chapter 11 chiefly *Social Physics and Cybercrime*, part of the "Systems" block) that, as the term goes, clearly builds a parallel between social action and mechanics, with the intent of identifying patterns in human data, based on "socio-behavioural laws". This perspective is a critique to machine learning, i.e. technology driven and highly expensive approaches to make prediction based on big data. However, social physics clearly resembles the idea that there are laws governing social behaviour and that now, with the amount of data (or better human signals) been generated, by knowing the laws we can anticipate the evolution of behaviour (in this case associated with security). Likewise, the chapter *Cybersafety: A Systems Theory Approach to Managing Cybersecurity Risks* (Chapter 2, included in the "Management, Organization and Strategy block") clearly advocates a strict top-down approach to cybersecurity based on the idea of cybersafety. In this approach the actions to be enacted toward better security (in particular the identification of why control systems were ineffective in incidents) are deduced from set of high-level principles/factors, in particular encompassing missing constraints, inadequate safety, inadequate safety control commands, commands incorrectly executed at lower level and inadequate communications. The authors promote this approach as an alternative to technology driven approaches to control and safety.

To conclude this is not a book I would recommend to a colleague or a student looking for a first introduction to the topics of cybersecurity and

cybercrime. I would also not recommend this book specifically to the social scientist that is looking for a publication describing the current theoretical thinking around these topics, from any specific area or research tradition. The main audience of this book, as I stated earlier, are practitioners in medium to large organisations, looking for new solutions and the publication does well in presenting them with the state-of-the-art of what is possible with novel advances. As this stands, it is possible to approach the book only with prior knowledge of the areas of cybersecurity and cybercrime and, for most chapters, with sufficient knowledge of computing and current evolution of cybersecurity.

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Cornelia Sollfrank (ed.)

The Beautiful Warriors. Technofeminist Praxis in the Twenty-first Century, Colchester, New York and Port Watson, Minor Compositions, 2020, pp. 151

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The #MeToo movement has recently broken silence on feminist matters worldwide. Using mostly social media, the movement has mobilized hundreds of thousands of people on topics such as sexual harassment and sexual assault. With reference to their digital practices, we could well associate the movement with cyberfeminism. This genre of contemporary feminism emerged in the early 1990s. Focusing on new digital technolo-

gies, activists have developed techno-utopian feminist visions of opportunities through technological innovations, theoretical grounds in the fields of science and technology studies, and strategic tools for cybertechnical feminist interventions.

Thirty years later, the early movement has given rise to technofeminism, which again fosters the rise of feminist technoscience. Coined by Judy Wajcman (2004), the concept of technofeminism gathers reflections on the interrelation between technical innovations and specific constitutions of gender (inequalities). Technofeminist elaborate feminist readings of human-machine interrelations. Therefore activists take up critical discourses and subaltern perspectives as well as developing new theoretical positions (e.g. in reference to new materialism), responding to today's technological state of the art. The recently published anthology, *The Beautiful Warriors. Technofeminist Praxis in the Twenty-first Century*, introduces technofeminist positions on social and aesthetic interventions against misogynist (technological) settings. This comprehensive volume, edited by the artist Cornelia Sollfrank, an early cyberfeminist and founder of the Old Boys Network, selects current technofeminist positions from the fields of academic theory, political activism and artistic work.

The volume starts by declaring no less than war against patriarchal structures, by quoting authors such as Donna Haraway, Gilles Deleuze, and Adrienne Rich. The preface situates the volume's warriors, mentioned in the title, in struggles against the political economy, with its exploitative and discriminatory outcome. In this context, Sollfrank enunciates the theme common to the eight assembled articles: the authors' analysis of and practices with technologies are inherently bound to economic and ecological matters. To sum up, all of the authors' references to technologies can be regarded as socio-political and aesthetic interventions.

The anthology can be subdivided into four dominant technofeminist themes: Hacking, subaltern perspectives, co-creational practices, and contemporary artistic interventions— even though all four aspects appear, in one way or another, in all of the contributions.

Sophie Toupin discusses hacking from a feminist perspective. In her understanding, hacking is a certain kind of computer programming, strategically used to interfere with the conditions for oppressive gender constitutions— online and offline. The author demands more accessible entry points for future feminist hackers to traditional hackspaces and a broader awareness of the dynamics of their current exclusion. Isabel de Sena, on the other hand, understands hacking in a metaphorical sense: she displays her criticism of the *Xenofeminist Manifesto*, published in 2014. The Manifesto calls for a new, pro-technology and anti-naturalist feminism, which draws on transfeminist and queer theory as well as philosophical rationalism. De Sena points out the inconsistencies of the quite abstract *Xenofeminist Manifesto* and notes the way the *Manifesto* runs counter to some basic feminist principles—as for example in its concept

of universality, which has a key claim of current feminism, accountability, at stake. In closing, De Sena links to this idea while calling for a common struggle for accountability and, along with that, a joint revolutionary process.

The second technofeminist theme is dedicated to the distribution of subaltern perspectives. Such a feminist position derives from postcolonial studies and critical theory, which emphasize the needs and demands of populations that are socially, politically, and geographically outside the hierarchy of power. In this case, Spideralex's contribution gives a voice to feminist Latin American online activists. These activists are cited for their interventions against machismo and violence in both online and physical spaces. Spideralex highlights how digital infrastructures have strengthened macho culture and violent living conditions, while giving space to an openly misogynistic agenda, including the disproportionate proliferation of hate groups, fanatical religious, and conservative movements. Against this background, the chapter addresses (cyber)feminists' self-defense and the creation of safe spaces, both online and offline. It calls for transforming these material and ideological settings.

The third major theme is the promotion of co-creational processes. Femke Snelting reflects, as a form of feminist hacker initiative, the potential benefits of a regulatory framework in the shape of codes of conduct. These codes could influence a community's culture of communication by promoting diversity and respect while simultaneously preventing harassment and mechanisms of exclusion. She argues that working communally on a document that enunciates shared values may create a platform for self-reflection and for learning about discriminatory language and behavior. In a similar fashion, the activist hvale vale reports on a multi-year process fostered by activists who are members of the Association for Progressive Communication (APC). During a Feminist Internet event in Malaysia in 2014, a first version of "Feminist Principles of the Internet" was created. At the same time, the #feministinternet meme surfaced. A co-created version 2.0 of "Feminist Principles of the Internet", reprinted in this anthology, covers topics from the need for open access through public participation, alternative economies, and freedom of expression, to agency for informed decisions. Because the document was co-created, contributors hope to inspire and support a broader struggle for informational and sexual self-determination. That means, the right of the individual to decide what information about oneself is communicated to others and under what circumstances as well as keeping one's sexual life and body free from determination by anyone else.

The fourth theme brings contemporary art activism into focus. The chapter *Viral Performances of Gender* by Christina Grammatikopoulou puts contemporary protest-art phenomena on display. She dedicates her analysis to social media interventions, which take place either as online performances or as interrelation of online and offline spaces. Gram-

matikopoulou discusses the work of artists who express feminist issues, focusing on how they use "virality" and "noise" as communicative strategies. "Virality" denotes a strategy using humorous, catchy, or provocative content, which also allows for feedback loops between the online image and offline corporeality. "Noise" denotes a strategy that deploys intercepting and confusing messages until they become progressively less clear to the readers. By using these strategies, feminism can gain ground, but the same strategies can also be turned against it. Grammatikopoulou concludes that contemporary feminists need to develop new strategies of visibility, expressing the hope that those she has introduced might provide some orientation. In a similar vein, Yvonne Volkart argues on the basis of her analysis of contemporary works of art. She develops the idea of Techno-Eco-Queer-Feminism. Therefore, Volkart integrates two conflicting feminist concepts: eco- and technofeminism. Ecofeminism originated in the '70s and postulated a close relationship between women and nature in contrast to men's exploitative and oppressive behavior, enabled by technology. In contrast, in the late seventies, European ecofeminists distanced themselves from such an essentialist identity and argued from a social-constructivist perspective on gender. In the nineties, Queer Ecologist challenged the dichotomies in which nature/technology and gender stereotypes are formulated. Volkart's concept of Techno-Eco-Queer-Feminism integrates these earlier feminist ideas and combines them with some ideas from "New Materialist" thinkers, as in the "agential realism" of Karen Barad. For Barad (1988), phenomena emerge through particular interactions between humans and non-humans, between materiality and meaning. In Volkart`s account, in recent capitalist societies nature and technology are entangled, contingent, and interacting phenomena.

The anthology is interesting to read and accessible to a broad audience. For STS scholars in particular the compilation brings a compact overview of current feminist STS debates. The anthology therefore displays the technological and theoretical enhancements that have occurred since early cyberfeminism, as well as the alterations in interests and perspectives in on- and offline feminism. The assembled authors propose new ideas of spaces (e.g. the entanglements of the online sphere and material environments), they queer dichotomies, refer to the agencies of things, and elaborate emancipatory cultures of resistance. In doing so, the authors walk in Haraway's (1991) footsteps by calling for the reconceptualisation of digital practices and by designing strategies for emancipation.

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Shoshana Zuboff

The Age of Surveillance Capitalism. The Fight for a Human Future: at The New Frontier of Power, London, Profile Books, 2019, pp. 704

Adrienne Mannov, Astrid Oberborbeck Andersen and Jaqueline de Godoy *Aalborg University*

Authors: Alexa, who is W. H. Auden?

Alexa: Winston Hugh Auden was a British American poet. Auden's poetry was noted for its stylistic and technical achievement, its engagement with politics, morals, love, and religion, and its variety in tone, form and content. By the way, you can now ask another question, without having to first say Alexa. Enable this feature by saying turn on follow-up mode.

It is not customary that books reviewed in an academic STS journal have been translated into 17 languages only one year after publication. Shoshana Zuboff's *The Age of Surveillance Capitalism. The Fight for a Human Future at the New Frontier of Power*, published in 2019 by Profile Books, is not a customary book. Zuboff's story is both personal – each chapter begins with an excerpt of W.H. Auden's poetry – and draws on her work as a scholar of social psychology, but the book is not a scientific publication. For that reason, we approach the book as a quasi-scholarly work and as an object-phenomenon that exists within the broader field of contemporary computing and those concerning science, technology and society. This makes it worth reading for STS scholars for reasons we will elaborate upon shortly.

Daily press reviewers have qualified *The Age of Surveillance Capitalism* as "a scaffolding of critical thinking" (Silverman 2019), offering "in-depth technical understanding and a broad, humanistic scope" (Bridle 2019) and that Zuboff's life-work and "merciless analyses peak"(Jakobs 2018) in this publication. But scholars whose areas of expertise are Organization Studies, STS, Law, and critical journalists have criticized the

book for not citing contemporary, relevant literature (Ellinger 2019), for circular argumentation (Morozov 2019) and for hyperbole (Cuéllar and Huq 2019). In what follows, we offer a summary of the almost 700 page "brick", critical reflections on Zuboff's arguments and the ways in which it presents as a social and material phenomenon in and of itself. We close with how we envision the kind of field that Zuboff carves out for scholars of science and technology studies.

Zuboff's central claim is that surveillance capitalism and its societal effects represent an unprecedented threat to Enlightenment values of humanity (p. 323). Zuboff begins with eight definitions for Surveillance Capitalism. The first is: "A new economic order that claims experience as free raw material for hidden commercial practices of extraction, prediction, and sales". The last is: "An expropriation of critical human rights that is best understood as a coup from above: an overthrow of the people's sovereignty". In what follows, we attempt to summarize her path of argumentation between the two.

Part I begins with a re-telling of a Marxist narrative in which assembly line workers are "individualized", having distanced themselves from the "traditions of village and clan"(p. 33). This leads us to neoliberalism, which "reverses (…) claims to self-determination" (p.37) and "thwarts our pursuit to effective life" (ibid). In this atmosphere and with the introduction of the internet, individual users' "data exhaust" could be seen as an untapped resource for tech companies, rebranding this as "the discovery of behavioral surplus"(p. 74). This holds the promise of an "advocacy-oriented capitalism", enabling consumers' search queries to be tailored to their interests. But the "dot-com bubble" at the dawn of the new millennium pushed budding tech companies to re-think their avenues to profit, leading first Google, then others, to the realization that "data exhaust" could be used to sell ads. This "mutation" (p. 76) saved the big tech companies financially, and according to Zuboff, kick-started surveillance capitalism. Referencing the well-worn capitalism-critical story about how "human life" came to be redefined as "labor" for capitalist endeavors, and "nature" to "real estate", Zuboff draws a line from Marx's notion of "primitive accumulation" and "original sin" (citing Arendt, p. 99), to David Harvey's "accumulation by dispossession", arriving at her own "digital dispossession". Thus, "human experience" becomes a source of profit, free to be taken by tech companies, repackaged as prediction products, and sold to advertisers (p.100). Having discovered this gold mine, Zuboff details how big tech companies protect their treasure with claims of "freedom of speech" (p. 106) and the seduction of a neoliberal state (the US) impressed by new surveillance capabilities in a post-9/11 era. This included deeply entangled relationships with state actors. Part I ends with the "division of learning", a contemporary riff on the division of labor (p.181), in which "a new priesthood" is lured away from academia to lucrative positions in big tech companies (p.189). Surveillance capi-

talists' power is consolidated because they now know a lot about us, but we know little about them.

In Part II, Zuboff painstakingly and convincingly documents the history and methods with which "ubiquitous computing" (p. 199) moves from exclusively online fora (defined as "virtual") to public and private physical spaces (consistently referred to as "real"). The introduction of Internet of Things (IoT) technologies ushers in the goal of "digital omniscience" (p. 207-208). Zuboff identifies developments in "telemetry" or animal tracking devices, as the beginning of this trend, implying that they are the inspiration for "wearables" and other devices that move with us through the physical environment, documenting – and later, modifying – our behavior. Leaning on metaphors of territorial conquest, Zuboff argues that, with these connected and "smart" devices, surveillance capitalists conquer our "still wild spaces" (p. 238). This includes details such as facial expressions, social media posting patterns, voice recognition, personality traits, floor plans of a home and "block-by-block map data" (p. 317) detail, including your backyard. Under the guise of "personalization and customization"(p. 256), Zuboff explains that innovators wish to create products that "nudge" the citizen toward certain behaviors, often using "gamification" tools (p. 313) in a "living laboratory" (p. 312), generating a market utopia with "guaranteed outcomes"(p. 214). These innovations are presented as intentionally misleading, likening them often to the Trojan Horse. Surveillance capitalists make strategic use of "lawless space" because technology tends to develop faster than the regulations meant to govern them (p. 105). Zuboff shows how "consent" is a Kafkaesque exercise in futility, privacy and anonymization are moving technical and legal targets, and these changes are framed as inevitable anyway. Technology giants like Google and Facebook use their power to redefine social norms, to dodge privacy activists and to pay off government officials. For Zuboff, nothing less than free-will and democracy are at stake.

In Part III, Zuboff outlines her theory of the power that underpins the age of surveillance capitalism, and the consequences it has for human society and social relations. The vision of surveillance capitalism, according to Zuboff, is that machine processes replace human relationships so that certainty can replace social trust and democracy. She dubs this power "instrumentarian", and defines it as "the instrumentation and instrumentalization of behavior for the purpose of modification, prediction, monetization, and control" (p. 352). Using it as a foil, she explains that totalitarianism worked through *ideology*, seeking to gain and modify souls; it was a political project that operated through the means of violence. Instrumentarian power, in contrast, does not seek to modify souls but human behavior; "to achieve its own unique brand of social domination", Zuboff locates the roots of instrumentarianism in the intellectual field of "radical behaviorism", pioneered by the psychologist Barrhus F. Skinner (p. 353), whose classes Zuboff followed at Harvard when she was

a young graduate student. Skinner held that human behavior could be studied, known and even engineered through thorough observation of external action. For the behaviorist, the human could be objectively observed as "the Other-One". Here, the human was seen as an organism, with no free will to make choices. Freedom was considered an illusion, and thus also democracy. Big Other is the name that Zuboff gives to this instrumentarian form of power. As a hybrid concept that brings together Big Brother – that fictional character and figure symbolizing totalitarian power from Orwell's dystopic novel *1984* – with "the Other-One" from radical behaviorism. Zuboff warns that surveillance capitalism is breaking down the walls of our homes as sanctuary, and, ultimately, risks the right to a human society in which we are free to decide our future, threatening the very right to a "future tense"(p. 329).

As should be clear, Zuboff is outraged. The text is maddeningly repetitive, and we miss more detail and reflection about her role and research methods. Almost no contemporary, critical work in this field are cited, such as that of Paul Dourish, Mary Gray, Ian Lowrie, Nick Seaver, Lucy Suchman, Peter-Paul Verbeek and many more.

In addition, Zuboff's analysis is highly US-centric. In fact, she situates herself as a product of the immigrant, capitalist American Dream, where hard work can earn you "the good life"(p. 34), including physical comforts, education, the arts, and civic engagement. This is perhaps why she is so enamored of the poet W. H. Auden. We prefaced this review Alexa's explanation of Auden's work, because Zuboff's prose can, despite her critique, read as manipulative as the prodding of a digital assistant.

But perhaps we are not the audience meant to be nudged. In a review in *Surveillance and Society,* Kirstie Ball suggests that "this book was not written for us. It is intended as a wake-up call for the educated business reader to recognize the massive power of the tech platforms" (Ball 2019, 253). As a professor emerita from Harvard Business School, Zuboff's critique comes from within this community, not as an outsider.

If Zuboff's intended audience is "the educated business reader", then it may be useful for STS scholars to think about this tome as an event, a material phenomenon and a public debate. Despite the book's shortcomings, Zuboff makes surveillance capitalism a dinner table conversation, rather than an esoteric realm reserved for math geeks. We understand that this dinner table is likely located in a wealthy, white, suburban one-family house, and that might be the point. The wide-spread use of contact tracing apps in connection with the current Covid-19 pandemic suggests that engagement with broader publics about surveillance capitalism and digital trust (Bruun et al. 2020) are timely. Thus, the book's physical presence and its language can be re-positioned as boundary objects, tools, and powerful actors and interlocutors. This is an approach inspired by Annelise Riles's (1998, 378) suggestion to consider documents as "aesthetic objects", where form itself has meaning. Continuing in this vein,

what insights might be won by interacting with *The Age of Surveillance Capitalism* as an event and gift, as a performance of relations (Sansi and Strathern 2016) at the dinner table? Zuboff's work may also inspire an inward dialogue (Kumar 2019) with our own sociotechnical tools. *The Age of Surveillance Capitalism* will exhaust you, but it does not exhaust all that there is to be said. On the contrary, it is a public door to debate through which STS scholars should enter with our detailed, nuanced and in-depth analyses of the digitization of social relations and its consequences.

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TECNOSCIENZA

Italian Journal of Science & Technology Studies

Vol. 11, Nr. 1, June 2020

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