

Science beyond the second watershed

“We have developed speed, but we have shut ourselves in. Machinery that gives abundance has left us in want. Our knowledge has made us cynical. Our cleverness hard and unkind.”

— Charlie Chaplin (1940) *The Great Dictator*

Science is a part of human culture. Many contemporary societies are democratic, neoliberal-capitalist, and technologically advanced. The organisation of science reflects that: universities are democratically governed by faculty but also pervaded by a business-like logic, funded with public means that are constantly under pressure, and organized around central databases. Meanwhile, society faces wicked problems such as climate change, aging populations, and biodiversity loss, for which science seems an essential source of evidence-informed responses.

To make sense of various aspects of science today, I turn to ideas of Ivan Illich, a philosopher of culture and of technology. In the 1970s, Illich developed a theory of technological development in terms of two watersheds or turning points. At the first watershed, new social and technological tools bring many benefits: the invention of the internal combustion engine gave a big impulse to our mobility, and the centralization of health care in hospitals improved public health. When these tools are scaled up and institutionalized, however, they tend to create more problems than they initially solved. At the second watershed, the system risks collapsing under its own side-effects: mobility decreases because of traffic jams, and resistant hospital bacteria pose new threats to health.

Illich (1973; p. 65) associated the second watershed with the emergence of a “radical monopoly”, that is “the dominance of one type of product rather than the dominance of one brand”. Examples of industrialized tools and institutions that constitute radical monopolies include cars and schools, which satisfy a societal need but control this area of life completely by outcompeting nonindustrial alternatives. According to Illich, such radical monopolies lead to “modernized poverty”: “Poverty levels rise because industrial staples are turned into basic necessities and have a unit cost beyond what a majority could ever pay” (Illich, 1973; p. 84).

In systems that have passed their second watershed, centralization, marketization, and bureaucratization have taken over. In his introduction to Caillé *et al.*’s (2014) convivial manifesto, which was inspired by Illich, Adloff summarized two main causes for such problems: “the primacy of utilitarian – in other words self-interested – thinking and action, and the way in which belief in the beneficent effects of economic growth is accorded absolute status.”

Here, I argue that Illich’s analysis applies to the current organization of science as well.¹ The first turning point in the organization of science occurred around the eighteenth century, with the advent of a system of government-issued scholarships and university-paid positions for research

¹ Reference to earlier work suppressed for anonymous review.

professors. Before that, the practice of science had been reserved only for aristocrats: they practiced it as a hobby or sponsored less privileged individuals with a better aptitude for research. From the eighteenth century onwards, however, science became a career, accessible even to people of modest means. Initially, this had a beneficial effect both for research and (potential) researchers. Indeed, more people could contribute to fundamental knowledge, which eventually led to technological, medical, and societal progress as well.

Over the next centuries, science became more professionalized, with an emphasis on increasing efficiency of its processes.² And this way, gradually, science reached its second turning point.³ Many problems with the current system of science and science education are well-documented, often discussed under the header of the “neoliberal university” (see, *e.g.*, Connell, 2019). Or, as Andrews (2023) put it: “I allude to the industrialisation of science. [...] The infrastructure of our science echoes the economic systems and the governmental and societal structures we inhabit. We have created a science of bureaucrats, of meaningless repetitive tasks, of obsession with a quantitative metrics of productivity that no longer bear any relation to desirable output.”

Furious about fast science

“Don’t give yourselves to these unnatural men – machine men with
machine minds and machine hearts! You are not machines!”
— Charlie Chaplin (1940) *The Great Dictator*

The problems highlighted by the tour at the start of this paper stem from a handful of systemic causes common to many aspects of contemporary societies. The aim of this paper is to view these various problems through a unifying lens and to start imagining a better alternative.

Stengers (2012) introduced the term ‘fast science’ for the “academic pseudo-market ruled by blind competition” and “the bubble and crash economy” in research. Fast science breeds sloppy science, which is thought to play a major role in the replication crisis. Stengers also observed the imperialism of the empirical and applied sciences, whose models have been imposed on other research fields, even though they are antithetical to the humanities, and in particular philosophy. So, ‘fast science education’ does not allow to waste time on questions that can’t be answered with routine methods of the empirical sciences.

² Heath & Burdon (2013: p. 380): “the much-diminished government funding now allocated is justified in terms of outcomes delivered rather than in terms of the public good.”

³ Similar trends apply to higher education. Fleming (2021) distinguished four shifts: (1) the nineteenth-century *Bildung* (or formation) ideal; (2) the 1960s democratization of admission and massification; (3) the 1980s emergence of the neoliberal university with top-down managerialism and metrification of academic work; (4) the 2020s accelerated corporatization due to the pandemic, which turned the university into an “edu-factory”.

Looking back on his career in control engineering, Willems (2007) wrote: “It is absurd to assume that someone who writes 10 articles a year does five times as much research as someone who publishes two articles a year.” In a blazing argument, Sugimoto (2021) reiterated the growing insight of recent years that thoughtless use of simplistic metrics reinforces structural bias. Sugimoto implored policymakers to keep Goodhart’s law in mind: when a metric becomes a target, it ceases to be a good metric. As long as science policy does not question the basic assumptions of why we want more science faster in the first place, it may keep tweaking the incentives while alienating and driving out the best researchers.

The current system favours fast and sloppy careerists over slow and reliable researchers, and the former spread more rapidly (Smaldino & McElreath, 2016). This way lies ruin, and it has been foretold. When the National Science Foundation was about to be founded in the US (which happened in 1950), this prompted Szilard to write a dystopian novelette, in which he foresaw the long-term consequences of such funding agencies (written in 1948, reprinted in 1961, p. 101):

“First of all, the best scientists would be removed from their laboratories and kept busy on committees passing on applications for funds. Secondly, the scientific workers in need of funds would concentrate on problems which were considered promising and were pretty certain to lead to publishable results. For a few years there might be a great increase in scientific output; but by going after the obvious, pretty soon science would dry out. Science would become something like a parlor game. Some things would be considered interesting, others not. There would be fashions. Those who followed the fashion would get grants. Those who wouldn’t would not, and pretty soon they would learn to follow the fashion, too.”

Meanwhile, Brazilian soil scientist Leão (2021) observed that individual scientists – in particular those from developing countries – have less and less control over the scientific process.⁴ Instead, a shrinking number of companies increasingly influence universities: scientists rely on commercial lab equipment and techniques, for which companies set up special training programs. Academics themselves also protect application-oriented research through patents – sometimes defensively (to avoid monetization), but not always. Moreover, scientific research and teaching is too dependent on private and for-profit software and databases.

In 2019, the rectors of all Dutch universities signed an open letter to warn for the rapid digitisation of their institutions, which has increased privatisation and dependence on (mainly American) technology companies (Rectores, 2019). The dependence creeps in via operating systems, email servers, and general office applications; these are often coupled to cloud services provided by Google or Microsoft. In addition, researchers use commercial websites such as Google Scholar, ResearchGate, and Academia.edu. Students and professors have to use online learning platforms such as Blackboard and Canvas (which log student data for ‘learning analytics’), or Coursera and EdX in the case of MOOCs, while many of their assignments must

⁴ Reference to earlier work suppressed for anonymous review.

be uploaded to TurnItIn for plagiarism detection. Their letter was written before the pandemic, which gave a boost to applications such as Zoom, Slack, and video surveillance tool Proctorio (Niessen, 2021). The Dutch rectors concluded that this trend undermines public values such as freedom, independence, autonomy, and equality. This is the true cost of cheap, convenient tools.

The rectors did not mention the big ‘academic’ publishers, such as Elsevier, Springer, and Wiley, which monetize their online archives. Yet, on many analyses (including that of Leão, 2021), the publication model emerges as a major intersection of problems. Indeed, the bulk of scientific articles is published in for-profit journals. The revenue model of this industry sounds too absurd for words: journals do not pay their authors. Instead, they may collect a fee from authors to publish their article or require them to give up their copyright. They do not pay scientific editors and peer reviewers either. In the end, they sell the articles to members of the same scientific community. In this process, public funds flow lavishly to a small number of companies with extremely high profit margins (*cf.* footnote 6). For-profit publishers contribute hardly anything of value but have made themselves indispensable for academia: they constitute a radical monopoly.

Buranyi (2017) described how it started. In the late 1950s, business leaders of a former British publisher, Pergamon, went to conferences to lure scientists to serve as editors of a new scientific journal. They exploited their vanity flawlessly, giving the journals ringing names (the *International Journal of* such and so). Pergamon and others also took over existing journals traditionally published by scientific societies, for whom it seemed an easy solution. In 1991, all of Pergamon’s titles were acquired by Dutch competitor Elsevier. The multinational Reed Elsevier (now RELX) drove up subscription prices substantially in the following years. University libraries complained, but they had no alternative. RELX continues to reap gigantic profits and can now be considered a surveillance publisher, because it “derives a substantial proportion of its revenue from prediction products, fueled by data extracted from researcher behavior” (Pooley, 2022).

There is a growing consensus on the problems associated with evaluation and competitive funding, tech giants and publishers listed on the stock exchange. Still, resistance from within remains difficult: publications have become academic currency, and you need a lot of them to gain access to scholarships and status. If you refuse to participate, you can’t wield power for change either. So, we must find ways to implement an alternative model collectively.

As we have seen, the managerial research culture leads to a fixpoint where we pay scientists to fill out paperwork full-time. Should we hope that rich hobbyists will step up once again, or are there other solutions? We look for better alternatives in the next section.

Imagining science for human flourishing

“To those who can hear me, I say do not despair.
The misery that is now upon us, is but the passing of greed [...]
Let us fight for a world of reason, a world where science and progress
will lead to all men’s happiness.”
— Charlie Chaplin (1940) *The Great Dictator*

In contrast to a society oppressed by industrialized tools, Illich imagined a ‘convivial’ society that limits its technologies and institutions that fail to empower people. In Caillé *et al.* (2014), Adloff described the positive view of ‘convivialism’, “from the Latin ‘con-vivere’, to live together”, as based on the following concern: “the quality of our social relationships and of our relationship to nature”.

In the first “Convivialist manifesto”, Caillé *et al.* (2014, p. 30) use ‘convivialism’ “to describe all those elements in existing systems of belief, secular or religious, that help us identify principles for enabling human beings simultaneously to compete and cooperate with one another, with a shared concern to safeguard the world and in the full knowledge that we form part of that world and that its natural resources are finite.”

We take our inspiration in these convivial approaches to imagine an alternative to the current institutionalized science. Convivial science puts the needs, means, and social relations of individuals (scientists and non-scientists) central stage. It employs tools that empower people, not tools that centralize power and industrialize institutions to increase the efficiency of production.

Luckily, we do not have to start from scratch completely. Many of the problems highlighted in the previous section have spurred calls for reform and collective action. We do have to check, however, whether they present real alternatives that may escape the shortcomings of the current system or whether they merely constitute the next iteration of such a system. For instance, Illich (1973: p. 96) wrote: “Educators who are aware of the breakdown of schools usually engage in a frantic search for advice that permits them to teach more people about more things.” Likewise, we need to avoid advocating change with the goal of optimizing shallow metrics while keeping one eye at current rankings.

With that caveat, let’s consider some candidate convivial approaches. Regarding convivialism, Caillé *et al.* (2014, p. 24) mentioned that there are “countless initiatives already working along these lines, with the backing of tens of thousands of organizations and groups and hundreds of millions of individuals.” One of their examples applies to our case, too: “slow science.”

The term slow science was introduced by Stengers (2012) in contrast to the publish-or-perish culture of fast science. It is a slow and steady mode of doing curiosity-driven research. Partially inspired by Stengers, Frith (2020) advocated “doing ‘less but better’.” Martinson (2017) suggested a cap on the number of words a scientist may publish. Berg & Seeber (2016) discussed

the idea of slow research from their own perspective as professors in the humanities trying to cope with the demands of current academia. They see collegiality and community as fertile grounds for reflection, to overcome complacency, and to organize collective action. They even used the term *conviviality*, though their inspiration came from the slow food movement.⁵

Perhaps slow science should follow Su's (2020) example for mathematics and call its goal "Science for Human Flourishing". Paraphrasing Su, we may argue that a society without a sense of science is like a city without museums or concerts. We should refuse to link science to superficial utility and opt decisively for deeper values: a quest for truth, freedom, justice, and beauty. Research offers a way to cultivate human virtues, such as patience, perseverance, and cooperation. Su's book includes letters by Christopher Jackson written from prison. Jackson had contacted Su about a distance course at the university. There was no such option, but the two started corresponding. Jackson's quest illustrates that mathematics belongs to all people – so should science. Su also traces the roots of mathematics in different cultures, which illustrates a way to answer calls for decolonization of science and its curriculum in a convivial way.

Slow science is different from retarded science, which is fast science impeded by internal frictions. The latter was illustrated by Szilard's story (quoted on p. 3): the founder of the fictive foundation believed that "scientific progress is too fast as it is" (1961, p. 100) and wanted to retard science. Indeed, the ways in which bureaucratic foundations impede science are analogous to Illich's analysis of mass transport that focuses on speed and thereby wastes time – by traffic jams, but also by highways that encumber travel by bike, car owners waiting for repair parts, etc.

Slow science should be allowed to be boring: reliable, cumulative processes are rarely newsworthy. Reproduction attempts that succeed show that no news is good news. And, if we want to be able to compare measurements over time, metrology better not be disruptive either.

But slow science can be provocative, too. Under the header of 'punk science', Leão (2021) defended an alternative model based on do-it-yourself and open-source principles. He wanted to make science more inclusive, so that everyone with relevant input can contribute effectively and everyone has access to the results. Caillé *et al.* (2014, p. 24) also mentioned "the digital sharing-economy (Linux, Wikipedia etc.)" and "the new commons' thinking". In the context of science, these examples remind us of Free and Open Source Software (FOSS) as applied to scientific computing and especially the Open Science movement.

Regarding FOSS, Niessen (2021) recommended universities should adhere to the 'public money, public code' adage of the Free Software Foundation Europe. Universities should be model institutions for reclaiming the open, decentralized internet: they embody the same core values, have the technical expertise and can pass on responsible digital practices to their students.

⁵ As pointed out by Adloff in his introduction to Caillé *et al.*'s (2014: pp. 7–8): "The notion of *conviviality* has a second, much older root in a quite different domain [...] coined in the early 1800s by the gastronome and philosopher Jean-Anthelme Brillat-Savarin [...] to denote the joy of coming together socially and of engaging in easy, amicable communication around the dinner-table."

Moreover, participating in decentralized networks, where acceptable behaviour needs to be negotiated on a continuous basis, is excellent practice for participating in democracy at large.

Some researchers and universities are indeed exploring federated non-commercial social media in the ‘fediverse’, including the network of microblogs on Mastodon. Thousands of scientists have signed up for accounts on servers such as mathstodon.xyz, fediscience.org, and scholar.social. Among institutions, MIT was an early adopter (they are hosting mastodon.mit.edu since 2017) and the ICT provider for the Dutch educational sector provided authenticated access for their students and employees (social.edu.nl; SURF, 2023).

Probably the best-known aspect of Open Science is Open Access (OA). OA may prove effective against the power of commercial publishers, especially if public funds are invested in non-profit journals managed by scientific societies: that model is called diamond OA. The ‘gold’ route to OA, however, is offered by for-profit publishers and requires large fees from authors. This exacerbates unequal access to publishing and reinforces the position of the large publishing companies.⁶ Moreover, when advocating for change to such a vital aspect of the scientific cycle, we should be sensitive to crucial differences in fields, practices, and contexts (Leonelli, 2022).⁷

Another convivial change to publication is related to the writing process: collective authorship. Publishing under a collective pseudonym resonates with the convivial theme of community. Although this is not entirely new – recall Nicolas Bourbaki: the collective pseudonym of a twentieth-century group of French mathematicians – current collectives, such as Amarante Swift or Camille Noûs, want to emphasize the collective nature of scientific research or to share the registration cost of expensive conferences. In their manifesto, Camille Noûs (2021) protested bureaucracy, self-promotion, and a one-sided focus on individual success stories. She welcomes the growing consensus criticizing the status quo but seeks a more radical alternative. The connection to Illich’s ideas is even clearer from Convivialist International (2020), who collectively authored the *Second Convivialist Manifesto*.

Regarding the reproducibility crisis, it is encouraging to see that junior researchers take the initiative to discuss better alternatives in local chapters of ReproducibiliTEA. Although PhD students individually may lack institutional power, collectively their actions shape science, so they can help to decide how science will evolve to resist perverse pressures.

⁶ See Vermeir *et al.* (2018) for two very different scenarios of how OA may influence the research landscape. Wiley demands from editors a steady increase of the number of articles to pocket article processing fees (Stilz, 2023).

⁷ A very different response to excesses of for-profit publishers, which has been supported by individual researchers (and used by many more, according to Bohannon, 2016) but not by institutions, is that of piracy. The Sci-Hub project was started by Elbakyan in 2011 and makes paywalled copyrighted academic publications freely accessible. Its self-described goal is “to provide free and unrestricted access to all scientific knowledge ever published in journal or book form”. Piracy is a coping mechanism, not a convivial alternative, because it presupposes the paywalled content.

Ultimately, however, problems due to sloppy science can only be addressed by changing the incentive structure. There are plenty of good intentions: many universities and funding agencies have signed the San Francisco Declaration on Research Assessment (DORA) and the Hong Kong Principles for assessing researchers. Fortunately, there are also concrete attempts to implement these principles. Under the header of “Recognition and Rewards”, Dutch universities aim to make “room for everyone’s talent” and to evaluate the contributions of academics regarding education, research, social impact, leadership, and teamwork (VSNU *et al.*, 2019). The aim is to stop requiring that individuals excel in all these areas; instead, academics with different strengths should contribute to these collective goals. A related trend is the introduction of narrative CVs with less emphasis on quantitative metrics, but it remains to be seen whether they succeed in overcoming the old problems or are merely a new iteration of them.

In response to the excesses of competitive funding, there are growing calls for more egalitarian approaches: basic funding (not unlike equally convivial pleas for universal basic income) and experiments with lotteries for funding allocation (which give up the illusion of meritocracy underlying many competitions). In fact, universities may be crucial in rethinking the economy at large, for instance, inspired by Raworth’s (2017) doughnut economics and Robeyns’s (2022) economic limitarianism. As such, convivial approaches align with attempts at realizing a ‘sustainable university’. To go beyond green-washing, this requires finding local implementations of the global Sustainable Development Goals.

This local approach to educational and research-related activities is also part and parcel to the mission of civic universities, which take their concrete local embedding as the starting point for contributing to social beneficence. Civic universities may choose to engage in citizen science and stakeholder-involved research, as well as dialogical approaches to science communication, with due awareness of the importance of differences between groups and individuals that constitute our society. As Swamidass (2020) put it, in his description of “Peaceful Science”, this can be achieved: “by seeking dialogue in discord and understanding across disagreements, by fostering interdisciplinary scholarship engaged with science and the public, and by encouraging conversation around the grand question: what does it mean to be human?”

In any case, all truly convivial approaches require doing the legwork: making connections, entering into dialogue, and compromising.

Epilogue: It is this simple – and this hard

“You, the people, have the power, the power to create machines, the power to create happiness. [...] Then, in the name of democracy, let us use that power, let us all unite.”

— Charlie Chaplin (1940) *The Great Dictator*

“Radical monopoly is generally discovered only when it is too late” (Illich, 1973; p. 69).

Unfortunately, this is also true for institutionalized science: “Monopoly is hard to get out of when it has frozen not only the shape of the physical world but also the range of behavior and of imagination” (Illich, 1973; p. 69). Paraphrasing Illich, we see that many more scientists are against for-profit journals than are against publishing in them. They are against them because they are extortive, but they publish in them because they need high-impact publications and consider the effect of their choice insignificant. Similarly for many other aspects of fast science.

So, now what? Solnit (2023) wrote: “A monastic once told me renunciation can be great if it means giving up things that make you miserable.” Although we have come to associate ‘austerity’ with budget cuts, Illich remarked that austerity is originally a virtue. Solnit applied this idea to the climate crisis, but it applies to fast science, too. She attributed our reluctance to systemic change to “the assumption that it means trading abundance for austerity [...] But what if it meant giving up things we’re well rid of [...] the complicity in destruction? What if the austerity is how we live now — and the abundance could be what is to come?”

There is no friction-free path towards the abundance of convivial science. No well-oiled machine will arrive to pave the road for us. Convivial science is not the next big thing, but a lot of small things: slow and open, boring and punk, sustainable and federated, and more still!

Realizing convivial alternatives cannot be reduced to a checklist either. Caillé *et al.* (2014, p. 30) did identify four hierarchical principles: (1) common humanity, (2) common sociality, (3) individuation, and (4) managed conflict. Applying this hierarchy to diagnose current science may be helpful as a starting point, but it cannot play a decisive role in a convivial approach. After all, it is merely a tool, which can never replace our own critical thinking. The list does illustrate, however, that overcoming fast science requires rethinking our priorities and acting accordingly.

So, how can you help realize this convivial science? You can start here and now. Many have already started, and you are welcome to join us. All that is required of us, researchers, is that we become aware of the systemic issues, and how our collective choices influence them. We need to reflect on the tools that we use and why we do what we do. Then we must change our practices accordingly, step by step and in dialogue with each other. We will have to do this amid the current dominance of fast science and its incentives.

It is not going to be easy, but nothing of value ever is. We will have to be brave and speak truth to power. It does get easier, however. Living your values takes practice, but you can start today. Science is too valuable not to try – and rather than ‘excellent’, it is going to be lovely.