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ESCAPE VELOCITY. COMPUTING AND THE GREAT ACCELERATION

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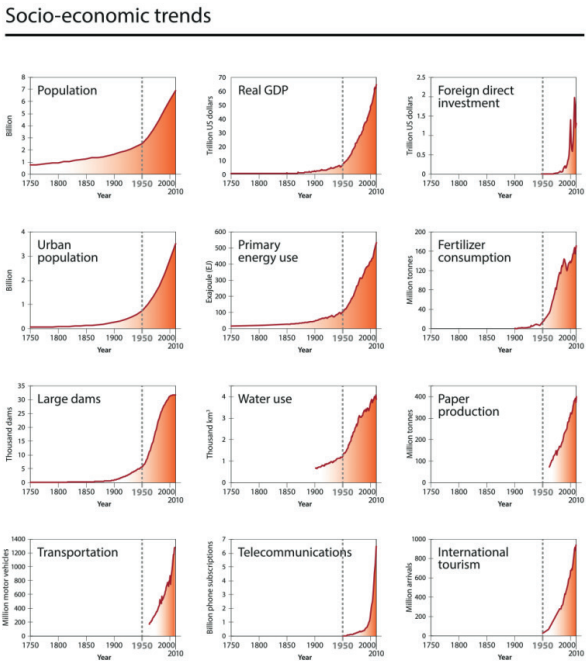
After 70 years of acceleration, human civilisation has now reached escape velocity, enough energy to move the Earth system out of the steady state of the Holocene, the relatively stable climate pattern in which human civilisation unfolded over the last 10,000 years, and into the uncharted, and as for now unchartable,[1] territory that is the Anthropocene. The notion of the "great acceleration" was first proposed in 2004 and updated in 2015.[2] It captures the fact that key socio-economic (such as world population, primary energy use or real GDP) and Earth system indicators (such as atmospheric carbon dioxide, stratospheric ozone or coastal nitrogen) all share a common feature: they show a kink, a sharp upward movement from approximately 1950 onwards.

These indicators point towards an unprecedented intensification and acceleration of human activity and self-destructive use of resources necessary to sustain this development under capitalism. Which begs the question: what happened in the early 1950s to enable this process? There is certainly no single answer to this question, my intention is to focus on one cause that has been relatively overlooked in this debate: computing. To connect computing and the great acceleration might be somewhat counterintuitive since computers are often thought of as "clean technologies" and working with computers often as "post-industrial" or "immaterial" labour. Also, computing is often understood as

1 Bridle, J. (2018). *New dark age: Technology, knowledge and the end of the future*. Verso.
2 Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O., & Ludwig, C. (2015). The trajectory of the Anthropocene: The Great Acceleration. T*he Anthropocene Review*, 2(1), 81–98. https://doi.org/10.1177/2053019614564785

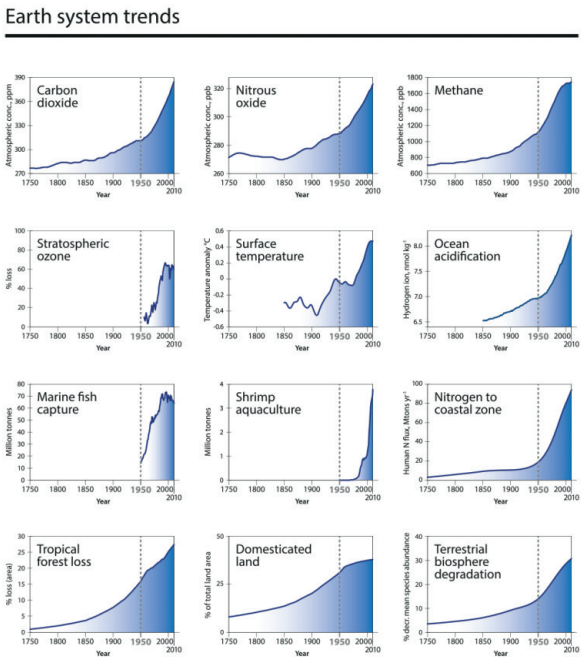


Source: futureearth.org, based on Steffen et al., 2015

a "disruptive" technology, yet the great acceleration itself is a rather continuous upward movement that shows little sign of disruption in itself.

To be fair, "Telecommunications" is one of the 12 socio-economic indicators included in the original paper, where it represented the number of landline telephones globally. In this case, however, I mean something different: computing understood as a general-purpose infrastructure that increases by orders of magnitude the capacity for all kinds of information gathering, processing and exchange across all distances and scales. In effect, this infrastructure enabled not only a much larger, faster and deeper coordination of economic activity, but also an intervention in natural processes on all scales in previously unthinkable ways (from nanotechnology to geoengineering).

This dynamic relationship could also be examined through the impact of



computing as an enabler and driver of the great acceleration, which I propose to divide into three phases: In the first, which extended roughly from the mid-1950 to 1990, the impact was largely organisational: industrialism was ramped up through new forms of organisation (which the Soviet system could not match) and this phase was characterised by the outsourcing of production and the flexibilisation of consumerism. In the second phase, which might be ending now, the impact has been extractivist, that is, entirely new types of resources were opened up for extraction. This phase was characterised by fracking (or, more generally, the use of "non-conventional" oil resources) and datafication. In the third phase, which, arguably, has already begun, the impact of computing is ontological, meaning that completely new classes of objects are created and forms of agency are developed with and through them. This phase is characterised by geoengineering and the increasing importance of non-human intelligence.

These phases are not strictly consecutive, but like all techno-political paradigms, they overlap and are unequally realised. The defining features of one phase do not disappear once a new phase begins, rather they move into the background, are taken for granted and are no longer the cutting edge of economic accumulation and social transformation, even if they continue to grow in quantitative terms. Also, what we are talking about here are transformations within the capitalist logic, not the transformation of that logic itself; this indicates that the empowerment of digital technology was captured by the already dominant, which have further increased their power rather than distribute it across a greater range of actors.[3]

The First Booster Stage: Flexible Industrialism

Computing provided both the theory and the practical infrastructure to reorganise industrial production, by which consumerism was able to substantially expand beyond the Fordist framework. It supported a form of organisation that was at once more distributed, more flexible, more expansive and more tightly integrated. The Second World War can be seen as the apex of Fordism, when unprecedented numbers of industrial products were churned out on a vast scale, first for the largest war effort in human history and then for the post-war economic boom. However, at the same time, the first indications of the limits of this paradigm also came to the fore, as the degree of complexity created by this effort ("regimes of accumulation") reached the limits of its organisational structure ("modes of regulation").[4] Cybernetics and operations research, both a direct answer to the new complexities of advanced warfare, provided new ways of overcoming these limitations, conceiving open dynamic forms of organisation, and generating ways of optimising organisational efforts in the face of uncertainty and multiple constraints. Strictly speaking, both approaches preceded modern computers, but once

3 Columbia, D. (2009). T*he cultural logic of computation*. Harvard University Press.

4 These terms stem from the regulation school's analysis of the transformation of capitalism after WWII (see Aglietta, M. (2000). *A theory of capitalist regulation: The US experience* (D. Fernbach, Trans.; New ed). Verso).

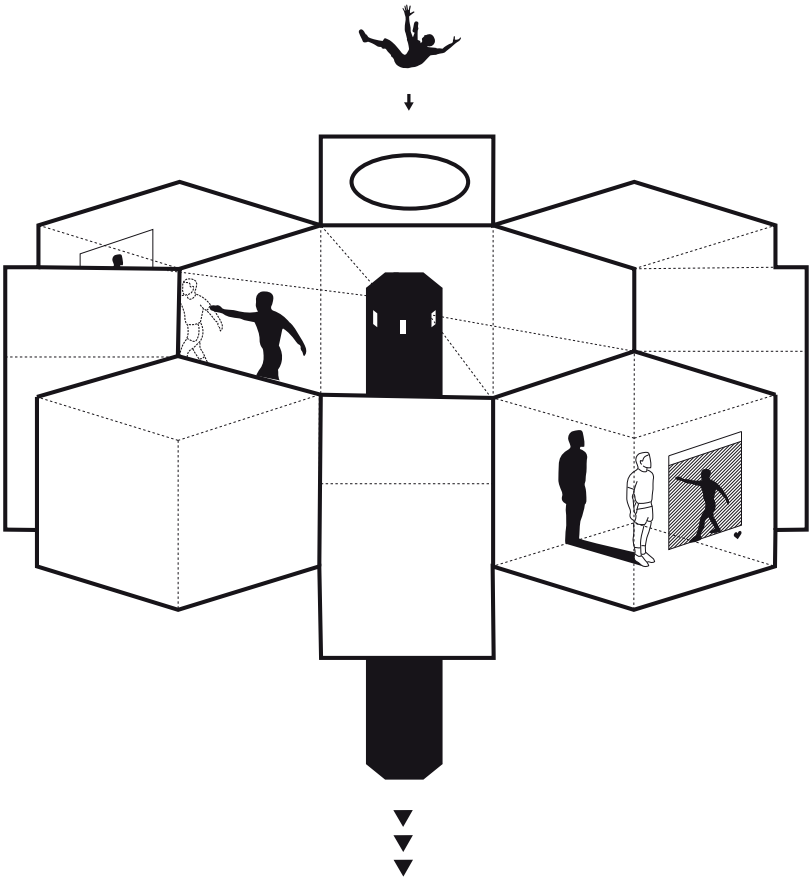
computers became available on a large scale and made it possible to overcome the practical limitations of manual computation, they led a push into entirely new forms of (applied) mathematics, such as the theory of optimum allocation of resources, which won the Nobel Prize in Economic Sciences in 1975.

The result of this was an acceleration on three levels. The so-called "flexible specialisation"[5] accelerated the pace of economic production (just-in-time), stimulated innovation and expanded the market into ever new niches. The "logistic revolution"[6] expanded and accelerated the flows of goods that underpinned globalisation, the expansion of industrialism to Asia and the outsourcing of production. The flexibilisation of consumerism not only vastly increased the flow of commodities that, after ever-shortening cycles of use, were destined for the landfill but also transformed subjectivity in advanced economies, creating what Brian Holmes[7] called the "flexible personality" or Richard Sennett[8] "the corrosion of character", both of which denote the consequences of the new hegemonic culture of networks and networking in an open and unpredictable world. This is precisely the condition that cybernetics and operation research, made practical through ever-growing computing infrastructures, helped to manage and thereby expand across the globe. This transformation gave rise to what Manuel Castells[9] called "the network society".

The Second Booster Stage: Comprehensive Extractivism

In the 1990s, the character of this relationship between computing and the great acceleration changed. The first cracks began to appear in the narrative of economic development through neoliberal globalisation. First, the expansion

5 Piore, M., & Sabel, C. (1984). *The Second Industrial Divide*. Basic Books.
6 Levinson, M. (2006). *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger.* Princeton University Press.
7 Holmes, B. (2004). *The Flexible Personality: For a New Cultural Critique.* Retrieved March 8, 2022, from http://www.16beavergroup.org/pdf/fp.pdf
8 Sennett, R. (1998). *The Corrosion of Character: The Personal Consequences of Work in the new Capitalism.* Norton.
9 Castells, M. (1996). *The Rise of the Network Society, The Information Age: Economy, Society and Culture, Vol. I.* Blackwell.



Vladan Joler, *New Extractivism*, 2020

of computing infrastructure on all levels – undersea cables, satellites, data centres, sensors, Internet of Things, as well as end-user products as such as PCs, laptops, smartphones and other gadgets – gave a boost to industrial activity, a process which the Rio Earth Summit clearly, yet inconsequentially, marked as "unsustainable" as early as 1992. Even by itself, however, computing increased the demands for many rare primary sources ("rare earths"), setting off a neo-colonial scramble for resources and triggering conflicts all over the world. In short, the intensification of production increased to such a degree

that new sources of energy and raw materials had to be brought into the system. What was added to the system were "unconventional" fossil fuel resources and agrofuels (which created competition between food for people and fuel for machines).[10] This was made possible by a combination of high prices and new prospecting and mining technologies. More recently, renewable energies have also been made available, though they have not yet replaced carbon sources and therefore have not reduced the overall CO2 emissions, only slowed down the increase. In other words, energy provision is becoming cleaner in relative terms, but all gains are eaten up by the continuous growth needed to sustain capitalist expansion.

Second, the same infrastructure also made it possible to manufacture a new resource, data, whose value increased steadily, which in turn created competitive pressures for expanding the infrastructure of its creation and processing. A new field of accumulation, a new type of capital was opened up and, like all forms of capital, it had no built-in limits.[11] As more is always better, this capital made an all-out effort to "capture everything" because it expected that all of it could serve as future operational input.

These two movements share deep connections and structural similarities which we attempt to highlight by applying the term (neo-)extractivism to both of them. Extractivism here is understood as "a particular way of thinking, and the properties and practices organised towards the goal of maximising benefit through extraction, which brings in its wake violence and

10 There is a deep, yet underexplored relationship of mutual acceleration between the oil and computing industries (see Mody, C. C. M. (2022). Spillovers from Oil Firms to U.S. Computing and Semiconductor Manufacturing: Smudging State–Industry Distinctions and Retelling Conventional Narratives. *Enterprise & Society*, 1–26. https://doi.org/10.1017/eso.2022.6), which, according to IBM's own account (https://www.ibm.com/ibm/history/ibm100/us/en/icons/optimizingoilsupplies), began in 1912 and has continued all the way to today's provision of specialised cloud services. Since the 1990s, new data-intensive seismic imaging technologies have helped to locate and access previously hidden oil deposits.

11 Sadowski, J. (2019). When data is capital: Datafication, accumulation, and extraction. *Big Data & Society, 6*(1), 205395171882054. https://doi.org/10.1177/2053951718820549

destruction".[12] Extraction is the concrete act of forcefully taking resources at the expense of the local human and non-human environment from which the resource is separated. The notion of extractivism was initially developed in the Latin American context in the 1970s and has always had an explicit connection to colonialism. In the digital context, it points to the fact that "data is taken without meaningful consent and fair compensation for the producers and sources of that data".[13]

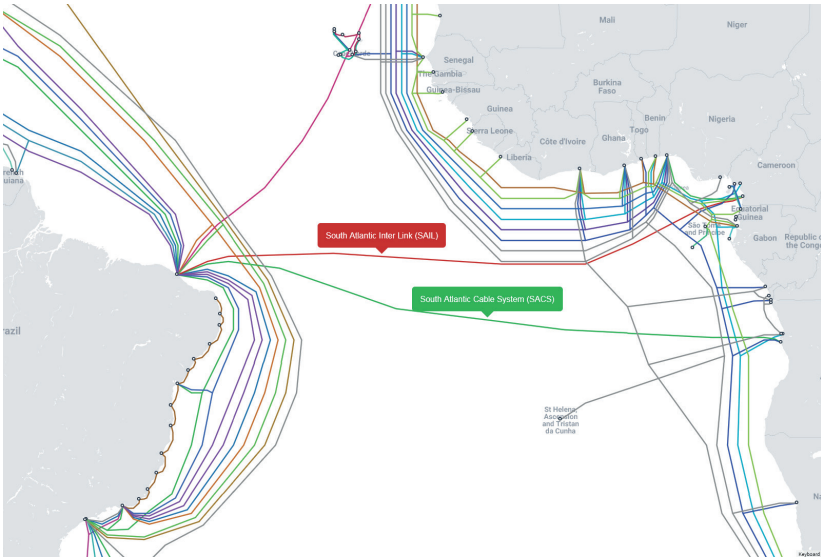
From this vantage point, what characterises the second phase of the great acceleration is the renewal and expansion of the colonial matrix of dominatio. It shapes in systemic ways not just the way we understand and treat nature (as an exploitable store of free resources, made accessible by technologies old and new) but also how value is centrally accumulated and costs are distributed to the periphery. What is new is that the range of resources has massively increased and that in the contemporary production of centre/periphery the geographical and the functional do not fully overlap. Instead, they are fractured and folded into one another discontiguously, globally, but also locally in cities, sometimes even within households (for example in terms of gendered and racialised domestic labour).

Such colonial relationships of dominance – dehumanisation, thingification,[14] exploitation – also shape the entire stack of digital technologies, from mineral mining – at certain times with archaic, at other times with very advanced technologies – to the construction of infrastructures that often follow colonial routes and reaffirm old nodes of control. This has been changing very slowly. For example, the first cable between Africa and Latin America, the South Atlantic Cable System (SACS) that connects Angola to Brazil, went operational only recently, in 2018. A second cable connection from Cameroon to Brazil was added in 2020.

12 Durante, F., Kröger, M., & LaFleur, W. (2021). Extraction and Extractivisms. In J. Shapiro & J.-A. McNeish (Eds.), *Our Extractive Age* (1st ed., pp. 17–30). Routledge. https://doi.org/10.4324/9781003127611-3

13 Sadowski, 2019.

14 The equation "colonisation = thingification" was famously formulated by Aimee Césaire (2000, *Discourse on colonialism* (R. D. G. Kelley, Ed.). Monthly Review Press, p. 42).



Source: https://www.submarinecablemap.com

In terms of data extraction, two elements are of particular importance, and they both reflect old and create new forms of colonialism.[15] One is the accumulation of data as the basis for new dominant industries which centralise profits and distribute harms. Of course, nobody is forced at gunpoint to use digital technologies, but the perceived "voluntariness" rings more than hollow if the price of participating in contemporary society is subjugation and (data) expropriation. The other is the reduction of people, and all other forms of life, to mere objects. Even though we live under intense surveillance, commercial actors in particular are not interested in us as actual human beings. Indeed, these actors have fused the authoritarian approaches of colonial administration and behaviourism and provide no means for people to account for themselves; instead, they rely on third parties to measure only those aspects of reality that are relevant for administrative and extractive

15 Couldry, N., & Mejias, U. A. (2019). *The costs of connection: How data is colonizing human life and appropriating it for capitalism.* Stanford University Press.

purposes. They have a purely instrumental view of subjects, as dividuals[16] to be dynamically de- and re-composed according to shifting corporate demands.[17] Everything else disappears from view, and the majority of these things, such as happiness, justice, and purpose, are, incidentally, important to social life.

In their examination of training sets used in machine vision, Kate Crawford and Trevor Paglen[18] called the gaze that results from this process "predator vision": the constant scanning of the landscape of quantifiable objects for the purpose of value extraction without consent or benefit to the people who – often unwittingly – provide the data. It turns people into prey, not just in the sense that they are analysed purely for their value as a resource to the predator, but also in the sense that they are subjected to outside forces they cannot influence or understand, which introduces existential insecurity. For example, an algorithm that assesses whether or not to grant parole in the criminal justice system might have an accuracy rate of 90% (however that is measured). While this might be impressive as an aggregate number on a system level, if it's used in one million cases, it still means that the lives of 100,000 people will be altered in ways that follow no human logic, are inexplicable and thus completely arbitrary.

The fracking of the landscape and human life in the search for ever more resources is part of the same logic of acceleration enabled and advanced by computing technology. Although extractivism destroys both human and non-human environment, it still belongs to a system that treats, against all the accumulating evidence, the environment as a stable, essentially infinite resource from which one can take whatever one wants without regard for the harms produced. A system that still counts on "externalities". And this system is about to end.

16 Raunig, G. (2016). *Dividuum: Machinic capitalism and molecular revolution* (A. Derieg, Trans.). Semiotext(e).

17 This is a highly stratified process, in which the elites of society are still treated as people with in-person services, while the rest are increasingly subjected to algorithmic governance.

18 Crawford, K., & Paglen, T. (2019). *Datafication of Science* [Talk]. Stop Making Sense, Haus der Kulturen der Welt, Berlin. Retrieved March 8, 2022, from https://www.hkw.de/en/app/mediathek/video/69622

The Third Booster Stage: New Ontologies

Recurring wildfires, heatwaves, droughts, floods and zoonotic pandemics on all continents at a scale unimaginable (or at least highly improbable) just a few decades ago make it increasingly hard to maintain the illusion of externalities (things that simply disappear from the calculus). It is well understood now that the Earth system is materially and energetically a (almost) closed system and that the reservoirs that have been absorbing waste over the last 200 years – and have thus made it appear as if externalities existed – are now overflowing.[19] And it is this overflowing that creates new entities that cut across the linear systems that continue to dominate Western thinking structured around an ontology of mutually exclusive dichotomies such as nature/culture, organic/inorganic, rational/instinctive, intelligent/mechanical, male/female, beginning/end, earth/sky and many more. In their stead, new entities and agencies are being created that constitutes a different, as of yet unnamed, ontology.

What drives this creation of a new ontology is the computing infrastructure, the expansive processes of datafication. Half a century of collective data collection and computer-based modelling provide a fairly detailed understanding of the Earth system and the various flows of matter and energy within and across its different spheres. The same processes – large-scale datafication and adaptive computer modelling – are also leading to a new understanding of "intelligence" as a form of open-ended, purposeful relationship to the world that is no longer understood as an exclusively human capacity. Indeed, artificial intelligence is rapidly becoming a general-purpose infrastructure transforming the space of what is possible.[20] Both the breakdown of the old, modern ontology[21] and the material conditions for

19 Lenton, T. (2016). *Earth system science: A very short introduction* (First edition). Oxford University Press.

20 Understanding AI as a general purpose infrastructure is not the same as "general artificial intelligence". Rather than claim some form of singularity where computers become more intelligent than people, it points to the proliferation of narrow artificial intelligences, optimised for specific tasks, across an ever larger set of domains.

21 Latour, B. (1993). *We Have Never Been Modern*. Harvester Wheatsheaf.

a new one are already here. This is why it might be justified to assume that the phase of extractivism is about to end (which, importantly, does not mean that the acts of extraction will end as well; in fact, they may well increase in intensity as the stocks decrease).

At the moment, I see two very unequal approaches to the attempts at filling the vacuum. The dominant one is an extension of the logic developed during the first two phases, which is now geared towards integrated systems. The central claim is that the Earth system is a mechanical system and that we have acquired a sufficient understanding of its feedback loops – monitored in real-time and extended into the (near) future through modelling – to purposefully intervene through geoengineering.[22] This approach recognises that nature is not an external category and that the Anthropocene and climate breakdown are real and faintly echoes Stuart Brand's slogan in the first edition of the Whole Earth Catalog: "We are as gods and might as well get good at it."[23]

There might well be a case for trying to mitigate the worst effects of the climate catastrophe by intervening at the system level,[24] but the danger of extending the systems and technologies that have a profoundly colonial character and an extremely unequal distribution of benefits/harms is so grave that it is hard to even contemplate how necro-politics could be instituted on a continental scale. To prevent this phase, which is possible, perhaps even likely, to come next, we need to understand the character and consequences of the current system of extractivism. What is more, if we are to convey an alternative vision – and reality – we need to separate the capacities of computing from the dynamics of the great acceleration. For better or worse, the Earth system can no longer

22 While the technologies of geoengineering are not yet available on the relevant scale, the desire for its effects is already widespread. With every volcano eruption there is now hope that the sulphur dioxide injected into the atmosphere will reduce global heating (thus achieving by natural means what geoengineering attempts by technical means). The recent, devastating eruption of a volcano on the island of Tonga (15 January 2022) triggered some hopeful speculations that the skies might become dark enough to affect climate at least in the short term. Subsequent studies, however, showed this effect to be negligible.

23 Brand, S. (Ed.). (1968). *Whole Earth Catalogue* (fall). Retrieved March 8, 2022, from https://archive.org/details/1stWEC-complete/.

24 Buck, H. J. (2019). *After geoengineering: Climate tragedy, repair, and restoration.* Verso.

operate on its own, we need to take care of it from now on. And to do this, we need a detailed knowledge of the system at geographic and temporal scales that only science, datafication and modelling can provide.

The outlines of an alternative vision already exist. They include not only science and further levels of abstraction, as necessary as they are, but also an understanding of both artificial intelligence and the full range of non-human intelligences, from animals to plants and ecosystems such as rivers as the backbone of bioregions. This calls for an expansion of computing, but also a limit to it. The latter comes when we recognise the value of epistemic systems outside the realm of the computational, of different ways of being in the world, of experiencing the world, of acting in the world. The notion that the Earth needs to be cared for is hard to grasp only in terms of a Western ontology and impossible to grasp within a colonial framework. In other words, even though extractivism might have provided us with some of the tools necessary for a new understanding, it needs to be dismantled in order to prevent the next phase, where the responses to the impending climate breakdown will become deeply authoritarian.

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