
CW
TECH
A guide to the politics and philosophy of technology

TECH

A guide to the politics and philosophy of technology

Corporate Watch

First published 2020 by Corporate Watch Cooperative Ltd.
c/o Freedom Press
Angel Alley
84b Whitechapel High Street
London, E1 7QX

0207 426 0005
contact@corporatewatch.org
www.corporatewatch.org
@CorpWatchUK

ISBN 978-1-907738-27-2

Written by Corporate Watch

Book design and set by Oriana Garzon
orianagarzon.com

We would like to thank everyone that helped in the production of this book, for editing and proofing, for emotional support, and for the invaluable contributions from those who know far more about the subject than we do.

About Corporate Watch

Corporate Watch is a not-for-profit co-operative providing critical information on the social and environmental impacts of corporations and capitalism. Since 1996 our research, writing, analysis and training have supported people affected by corporations and those taking action for radical social change.

Corporate Watch is run non-hierarchically as a workers' co-op. To maintain our independence we do not accept funding from corporations or the state. We aim to bring our work to as wide an audience as possible and make sure all our published materials are available online free of charge.

See our website for more of our work, our principles and values, and how to support us: www.corporatewatch.org

Contents

A guide to the politics and philosophy of technology

Introduction

Technology is everywhere. Its influence on our lives and the world around us is enormous. But what exactly is it? How does it function? How does it affect us? Who does it serve? How should technology be viewed in the context of increasingly authoritarian governments, corporations that hold immense, unaccountable power and multiple global ecological crises? Can technology play a part in supporting radical social change towards free and equal societies living in harmony with nature? How?

Are humans fated to wind up as pets for hyper-intelligent robot hamsters?

Would that be a bad thing!?

These are – mainly – important questions. Technology is seen both as our saviour and liberator (through geo-engineering, a pandemic halting vaccine or a cure for cancer), and as our enemy and slave master (in the form of artificially intelligent robot uprisings or Big

Brother social control). Often people hold both negative and positive views simultaneously. However, although attitudes and perspectives vary, the dominant view presented in society is that technology is apolitical and inevitable, that it represents human progress and makes our lives easier, more fulfilling, or just 'better'. Let's dig a little deeper.

We are at a unique moment in human history – an ecological precipice, perhaps a social tipping point. Unprecedented changes are approaching. Whatever path we take, unravelling technology and the dilemmas it presents will give us a clearer view of the horizon ahead of us.

What's the point of this book?

Thinking about technology, its origins and implications, its nuances and complexities, can be a dizzying exercise. In writing this book we want to help people think about the role that technology plays in everyone's lives.

Of course a lot has been said and written about technology, so we're not going to start from scratch. This is just a short introduction where we will present a summary of some of the thinking already done, and add a few thoughts of our own here and there. Much that is written on the subject is inaccessible and academic in nature, so we'll do our best to keep things non-academic and we'll direct you to further useful reading and resources. We should also say that we are not experts on the subject, so there will inevitably be mistakes and omissions. Hopefully not too many!

While we want to present various ideas and positions, we are not writing from an entirely neutral perspective. We particularly challenge the narrative of technology as being an inherently benign or progressive force, and likewise the idea that technologies are neutral or apolitical.

We want to explore more nuanced viewpoints, neither naively positive towards technology nor rigidly opposed to it. We examine the political realities and possibilities around different technologies as they intersect with the wider world.

We also happily confess to writing from a position of bias against capitalism and authoritarianism. We believe in striving for societies that co-exist with each other and the non-human natural world (as opposed to trying to dominate or somehow exist outside or beyond nature).

However, even if you're not quite on the same page as us with all of that, we still think you'll find some interesting ideas. Technology throws up challenges for everyone, wherever you're coming from.

In many cases we will be posing questions rather than providing the answers to them. So as well as a general introduction and an exploration of what has been previously said on the subject, it is also an attempt to provoke reflection and discussion.

In summary, the book is intended as **a brief introduction to the politics and philosophy of technology** - a simple guide to the ideas around how it functions and interacts with society and the world around us. We hope you find it useful.

A Guide to the Book

Here's a little explanation of the structure of the book to talk you through how we are going to explore the idea of technology. There is quite a lot of overlap between different chapters, but we've tried to make sure that they are fairly conceptually distinct and that each of them flows into the next. We've also included a series of questions at the end of most of the chapters, intended to highlight some important considerations.

First, in **What is it?** we give a very brief introduction of the term 'technology', how it is defined and used, and how we will use it in the book.

Next, in **A Brief History** we try to get to the roots of where the modern idea of technology and its problems came from. We describe the thinking and view of the world it is based on and the implications this has had. Particularly we look at the Enlightenment and its perspective on nature.

Nature, looks at the fundamental relationship between technology and nature in a bit more depth.

In **Society** we examine another big theme in technology, its relationship and interaction with wider society: how they influence and are dependent on one another. In particular, we look at technological means and ends.

Then in **Direction**, we consider how technology progresses, how its direction is controlled and by whom.

So how have other people approached technology? What opinions and attitudes are out there? This is discussed in **Politics** - a quick overview of some political positions on technology.

Many have also tried to think about the principles on which technologies could be based, the ways to use them and where all of this can go wrong. This is dealt with in the next chapter, **Good Tech**.

Now looks at how technology relates to current social and ecological situations, such as climate change, social control technologies and struggles against capitalism.

Finally, the last chapter, **The Future**, delves into how things might be, how inspiration can be found in the creativity and imagination of science fiction.

What is it?

So what is technology? Easy: it's computers and hovercraft and steam engines and cyborgs and remotely operated sex toys and stuff, right? Well yes, but actually it's not so easy. Although extremely common, the term 'technology' is not as well defined as its usage might suggest [1]. The difficulty in finding a satisfactory definition means that some critical writers on the subject prefer to always refer to specific technologies or technological processes, rather than technology as an abstract concept.

Rather than evaluating the various formal definitions of technology, or coming up with our own, we'll instead present a very quick introduction to how the word is and has been used.

As well as being somewhat difficult to define, the term is also relatively new. Despite a very long history of tool use and 'technological' development, the word technology only became widely used in the 20th century. It is formed from a combination of Greek τέχνη, techne, "art, skill, cunning of hand"; and -λογία, -logia, roughly translating as "science of craft", and originated as a translation of the German word technik [2].

In discussions around technology, certain ideas are frequently repeated. Most definitions refer to things (tools, machines or techniques) being used to solve problems or satisfy human needs or purposes. It is also generally accepted that the tools and machines need not be physical, that things such as organisational methods or computer software fall under the definition of technology. So does this mean something like language counts as a technology? Maybe, maybe not. Some, such as W. Brian Arthur, use extremely broad definitions, extending the meaning of 'a technology' as far as "a means to fulfil a human purpose" [3].

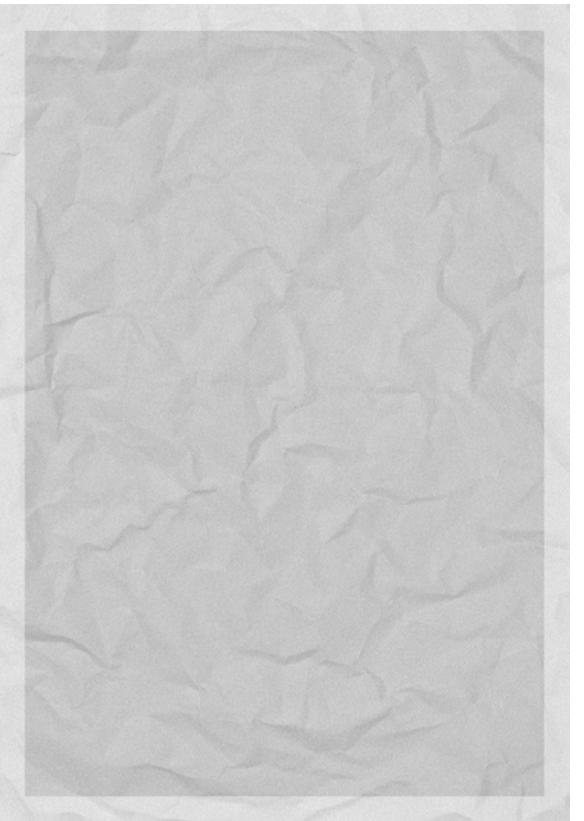
Science also often comes up in writing about technology and many definitions of technology refer to the the application of scientific knowledge to do something. They are certainly closely related to one another, with scientific discoveries allowing the creation of new technologies, and technological development allowing further observation, measurement and analysis. In fact, science and technology are so intimately connected that it is often difficult to distinguish between them.

Stemming from this, the understanding of nature through observation and measurement, and the ability to influence or even control natural processes and our environment are other common themes in technology.

Technology also concerns the interaction between the technological tools and techniques and the people and systems that create, use or are affected by them. The idea of technology includes a social context and there is a continually evolving relationship with other aspects of society or culture. Technologies are hugely influenced by ideologies and social structures, such as capitalism, and act as real world manifestations of the ideas behind them.

So technology includes tools and machines, needs and desires; it involves science, society and nature, and it is inherently political.

We will look into these various aspects of technology. In the next chapter we give a critical look at the dominant modern idea of technology, one that treats it as apolitical, inevitable, that represents human progress and is based on domination of nature. Where did these ideas come from and why are they important to discussions around technology today? In the rest of the book we take a broader view, one that sees technology as not necessarily based on the manipulation and control of nature, or the most efficient means to achieve a specific end. Instead we approach it as something that is part of wider culture and has the potential to be used in a way that encourages harmonious relationships between humans and with nature.



A Brief History

Although tools have been used by humans and other animals for millions of years, the word technology and the ideas associated with it are actually relatively recent, not being widespread until the period of rapid industrialisation in the early 20th century (sometimes called the Second Industrial Revolution).

Here we present a very brief, incomplete and undoubtedly imperfect history of how the modern idea of technology came about. We're not trying to describe a history of technology in terms of how different artefacts and practices developed over time (there's plenty of material on that kind of thing for those who are interested). We're also not trying to put forward a rigorous description of the history of the concept of technology [4]. Instead we want to identify some of the origins of the dominant contemporary conception of technology and examine the kind of thinking and worldview that generated it. We hope this will help in considering how things have gone wrong and how to go about trying to change them.

People have been making tools and other physical artefacts for a very long time. The phrase 'material culture' is used by some to describe the objects created and used by humans. For example, the change from food gathering to food storage and the development of agriculture around 10-15 thousand years ago marked a significant change in material culture.

In terms of the tracing the origins of the modern idea technology, we will look at one part (or maybe one version) of the history of the knowledge and practices around material culture in Europe. In the past, some who studied material culture have used it to 'prove' the superiority of their societies. This was typically done by upper-class Europeans showing examples of more 'primitive' societies from other parts of the world, demonstrating how 'Western' cultures were the pinnacle of cultural evolution. In focussing on Europe we certainly don't want to reinforce such a Eurocentric view. In fact, we're highlighting this viewpoint as an issue that needs unpicking.

In a Critical History of a Concept [5], Eric Shaatzberg describes how historically, since the time of Aristotle, the crafts, i.e. the practical knowledge around making things, had been considered lower than

'higher forms' of thinking such as philosophy. From the time of ancient Greece until quite recently, 'art' referred to all kinds of making, and a lot of what is now viewed as technology was considered part of the practice of art and craft. Throughout the medieval period this separation continued with scholars making a distinction between the 'mechanical arts' and the 'liberal arts', often associating the former with those considered lower in the social hierarchy.

Jumping forward to the Scientific Revolution of the 16th and 17th centuries (we said it was an incomplete history!), the separation between practical 'arts' and science remained. This despite the pivotal role played by 'technologies' in enabling the precise measurements required for experimental verification and the advancement of science.

Anthropocentricism

This is the idea that humans are metaphorically 'at the centre of the universe', considering them to be more important than other lifeforms or generally viewing the world and existence from an exclusively human perspective. Many environmentalists identify anthropocentrism as being at the heart of ecological problems, leading to the attitude that nature is only there to be exploited for shallow humans ends.

The Scientific Revolution played an important part in the development of the modern idea of technology. It is sometimes described as starting in 1543 with the publication of Copernicus' 'On the Revolutions of the Heavenly Spheres'. His idea that the Earth revolved around the sun (heliocentricity) later proved to be controversial and a challenge to religious authority. However, despite controversial 'discoveries', such as heliocentricity, an aspect of Christian anthropocentricism endured in understandings and attitudes to the non-human world.

The prevailing view in the new scientific thinking reflected this: nature existed separate from humans, something to be dissected, manipulated and controlled. This was strongly influenced by Francis Bacon's view that science should seek to control nature to serve humanity rather than understanding it for its own sake, something we'll discuss in more detail in the next chapter.

The 'Age of Enlightenment' was also a key period shaping in today's understanding of technology and the role it plays in society.

The Enlightenment

The Age of Enlightenment, The Enlightenment or the Age of Reason took place in the 18th century and was characterised by rationalism and scientific knowledge becoming dominant in Europe, largely replacing the control of religious authority over knowledge and ideas. It celebrated the power of reason to understand the world and improve the human condition. Reason and rationalism were used to challenge tradition. People were enlightened by illuminating the world, making it clear for all to see.

" 'Have courage to use your own reason!'- that is the motto of enlightenment." Kant [6]

At least this is one side of the story. Many (particularly Eurocentric) versions of history present the Enlightenment in this way, as a period of intellectual emancipation, of rationality and science triumphing over dogma and superstition. However, more critical perspectives also describe the Enlightenment as being a time when other forms of knowledge were controlled and co-opted, with religious authority being replaced by other forms of domination. It was also a pivotal time in the development of capitalism. Silvia Federici's Caliban

and the Witch [7] discusses how the witch hunts, which preceded and overlapped with the Enlightenment, were used to eliminate other knowledge systems and techniques, to control women's bodies, and allowed for primitive accumulation (the transfer of common resources to private property), laying the foundations for modern capitalism.

It was certainly a period of significant change and it didn't just take place in the realm of philosophy and science. Many social norms and cultural values were questioned and new forms of art emerged. The undermining of the authority of religion and monarchy is also seen as instrumental to the ensuing political turmoil of the 18th and 19th centuries, particularly the French and American Revolutions. Famous thinkers of the Enlightenment include Voltaire, Hume, Diderot, Kant and Adam Smith, who is renowned for popularising Enlightenment ideals of free-trade, the free market and individualism.

The concept of 'progress' was central to Enlightenment thinking. Science and reason were seen as driving forces throughout human history, pushing towards better, more 'civilised' societies. Some Enlightenment thinkers such as Rousseau challenged the Enlightenment ideal of progress through civilisation, particularly its tendency to separate people from their natural environment, but the dominant view was that it was a positive force, improving lives and advancing humanity.

There is debate among historians about the significance of the Enlightenment's feminist currents and how they influenced later feminist politics, with some seeing it as a step forwards and others an obstacle [8]. However, there were certainly influential Enlightenment women thinkers who are often ignored [9]. Perhaps the most renowned Enlightenment contribution to feminist philosophy is Mary Wollstonecraft's 'Vindication of the Rights of Women' [10]

published in 1792 in which she argued for women's rights and against the idea that women are inferior by nature, famously describing marriage as "legalised prostitution".

Mary Shelley, Frankenstein and Prometheus

Prometheus is a figure from Greek mythology famous for giving humans fire, for which he was punished with an existence of perpetual torment (he was eventually freed by Heracles). He is associated with the quest for scientific knowledge but also the tragedy of unintended consequences. Promethianism is sometimes used as term for the association of technology with freedom and progress. Novelist Mary Shelley, Mary Wollstonecraft's daughter, was another prominent woman around the time of the Enlightenment. Her hugely influential novel 'Frankenstein' is alternatively titled 'The Modern Prometheus' [11]. A tale of the hubris of science in its attempts to control nature, it has been described as the first work of science fiction.

Most of the Enlightenment took place in Europe, which is not to say that there weren't other important and influential intellectual movements in other parts of the world at the time. In fact many Enlightenment ideas were influenced by Europeans being exposed to and interacting with other cultures (partly through colonialism and the slave trade). As well as being influenced by thinking in other parts of the world, some have commented on how particular Enlightenment ideas were based on a similar mindset and worldview under which colonialism took place. For example, indigenous peoples being categorised as part of nature, separate from 'Man' and there to be controlled and exploited, provided a philosophical justification for slavery.

Enduring Ideas

In terms of influencing the concept of technology, the Enlightenment and preceding Scientific Revolution promoted ideas of progress through civilisation, rationality and the advancement and application of scientific knowledge. Importantly, this also combined with the view of nature as being something to control and dominate towards human ends.

The Industrial Revolution of the 18th and 19th centuries saw the widespread and rapid expansion of industrial technologies around the world. Many argue that the process of industrialisation and the technologies this entailed further separated people from their natural environment, reinforcing the attitude of domination towards nature. Movements such as Romanticism, which emerged in the 19th century, challenged and countered these views on nature, but still their influence endured.

During the Industrial Revolution terms such as 'useful arts' and then 'industrial arts' began to be used alongside 'mechanical arts' [12]. It was also in this period that knowledge systems of the practical arts, such as the skills of craftspeople, were erased or became controlled by the owners of the new industrial machines. Craft labour and commons-based subsistence were undercut and undermined, creating dependency on industrially-produced goods.

The concept of art continued to be used to describe practices around material culture into the early 20th century. It was at this time that the modern term 'technology' began to take shape. Initially it was used to mean 'science of the useful arts', then as the 'art' began to be used exclusively to describe 'fine art', **technology as the application of scientific knowledge** became more popular. This could be seen as a continuation of the millennia-old separation between science and

the practical 'arts'. As art took on a narrower meaning, technology was used to refer to applied science only. Whereas in fact the practical and theoretical aspects of science are inextricably linked.

In the late 1920s Charles Beard started to explicitly link technology with progress, describing it as an unstoppable force shaping human history [13]. This idea of **technology developing under its own volition, being the key determining factor in human history** and representing progress is still common to this day.

The 20th century concept of technology was also highly gendered. The erasure of women's role in material culture from the witch hunts and Industrial Revolution was continued and solidified. Engineers projected a vision of **technology as predominantly modern, male and Western**. This protected the social status of white middle class men, by creating technology as a symbol of progress associated with their markers of identity[14].

Postmodernism of the mid to late 20th century can be seen as a response to many of the developments and dominant ideas involved in 'modernity' (usually defined as the period beginning in the 17th century and ending with the Second World War), including the central role of the scientific method, technology and the ideal of 'progress'. There were also significant movements in the 1960s and 70s criticising industrial technologies, their role in society and the kind of thinking they engendered. The publication of Rachel Carson's 'Silent Spring' [15] in 1962 had a profound effect on the public's consciousness of ecological issues and the role of certain technologies in bringing them about. Some of these counter-cultural trends remained influential in certain aspects of society, running in opposition to the ills of technocratic, capitalist society. Occasionally they became mainstream, but rarely dominant.

The legacy of the Enlightenment and the Scientific Revolution can be seen in the continuing powerful influence that Francis Bacon's interpretation of science has on knowledge systems and values, and the fact that many still see **technology as synonymous with progress**. It is also present in the enduring anthropocentric view, **based on nature being something to control or dominate for human ends**, a perspective that is now commonly identified as a root cause of current ecological crises.

In summary, the modern conception of technology that emerged, still dominant today, sees it as:

- the application of scientific knowledge
- developing under its own volition, being the key determining factor in human history
- predominantly modern, male and Western
- synonymous with progress
- based on nature being something to control or dominate for human ends

We look at this key aspect of technology, its relationship with nature, in more detail in the next chapter.

Recommended Reading:

- *Technology : Critical History of a Concept* by Eric Schatzberg (ISBN 978-0226583976)

- *Caliban and the Witch* by Silvia Federici (ISBN 978-1570270598)

Nature

The roots of anthropocentrism can be found in the Judeo-Christian Bible. However, the idea of separation from nature was strongly reinforced by 17th century French philosopher René Descartes' influential description of nature as a machine. His framing was supported by the ideas of the Scientific Revolution, particularly Isaac Newton's mechanical depiction of the universe, where everything operated like a giant clockwork apparatus. This understanding of the workings of nature became less popular in the 20th century, particularly following the revolution in physics due to Einstein's theories of relativity and the advancement of quantum mechanics. However, the machine metaphor remained influential and the instrumental, exploitative relationship with nature endured.

Francis Bacon and Nature

Francis Bacon is referred to as the father of the scientific method due to his belief in the advancement of knowledge through controlled experimentation. As mentioned above, his conception of nature was particularly influential on subsequent thinking in science. Bacon was a Christian, and believed that the fall from the Garden of Eden led to man losing his domination over nature. He thought this could be regained through science and technology: "Man by the Fall, fell at the same time from his state of innocence and from his dominion over creation. Both of these losses can in this life be in some part repaired; the former by religion and faith, the latter by arts and science." [16].

According to Bacon, in order to regain our control of nature, so it can be bent to our will and used to our benefit, we must first force it to give up its secrets through experimentation: "nature exhibits herself more clearly under the trials and vexations of art than when left to herself" [17] ... "under constraint and vexed; that is to say, when by art and the hand of man she is forced out of her natural state, and squeezed and moulded"[18].

He goes on to describe how the mechanical arts do not "merely exert a gentle guidance over nature's course; they have the power to conquer and subdue her, to shake her to her foundations" since "the dominion of man over nature rests only on knowledge". This, he says, will establish the "Dominion of Man over the Universe" and render nature the "slave of mankind" (he probably wasn't much fun on wildlife walks).

"But man is a part of nature, and his war against nature is inevitably a war against himself." Rachel Carson [19]

The Death of Nature and Reinventing Eden

Carolyn Merchant traced the origins of the mechanistic view of nature to Bacon and Enlightenment thinking in her highly influential 'Death of Nature' [20]: "Rational control over nature, society, and the self was achieved by redefining reality itself through the new machine metaphor."

She is a fierce critic of Bacon's view of nature, highlighting it as a root cause of our current ecological crises. She notes how Bacon and much of Enlightenment thinking gendered nature as female and described the link between the patriarchal domination of women and the attempts to control and manipulate a 'female nature'. Merchant proposes an alternative conception and relationship towards nature based on a 'partnership ethic':

"Nature, traditionally represented as mother, virgin, or witch, is not gendered as female to be managed, controlled, or exploited, but instead is accepted as a partner with humanity."

"A partnership ethic holds that the greatest good for the human and nonhuman communities is in their mutual living interdependence."

In 'Reinventing Eden' [21] she explains how a human community in a sustainable relationship with a nonhuman community is based the precepts of:
-Equity between the human and nonhuman communities.
-Moral consideration for both humans and other species.
-Respect for both cultural diversity and biodiversity.
-Inclusion of women, minorities, and nonhuman nature in the code of ethical accountability.
-An ecologically sound management that is consistent with the continued health of both the human and the nonhuman communities.

Separation vs Connection

The view of nature as something separate from humans to be controlled and dominated can also be seen reflected in modern technology-related movements such as techno-positivism, transhumanism and to some extent, eco-modernism (see below for descriptions of these). Likewise, it leads to uncritical proposals to use genetic modification and geo-engineering as solutions to ecological problems. A key defining feature of many technologies is their ability to influence or manipulate our environment, and this often goes hand in hand with a view of human superiority.

Marx and the 'Metabolic Rift'

Marxism is often criticised for having an ecological blindspot, and it's true that what was called 'communism' in practice involved widespread industrialisation and destruction of nature. However, in his writings on the relationship between humans and nature, Marx recognised an increasing division. John Bellamy Foster coined the term 'metabolic rift' [22], to describe Marx's idea that capitalist production represented a break, a rift, in the harmonious self sustaining or 'metabolic' relationship between humans and the natural environment. Marx saw humans as part of nature and labour (or perhaps human action) as the connection between humans and the natural world, the way of sustaining the metabolic relationship. In this way, as we interact with nature we change it, but as we are part of nature we are also changing ourselves[23]. Marx's most famous statement on the nature of technology also refers to human interaction with the rest of nature: "Technology reveals the active relation of man to nature, the direct process of the production of his life, and thereby it also lays bare the process of the production of the social relations of his life, and of the mental conceptions that flow from those relations." [24]

So is technology inherently predisposed to further separate humans from the rest of nature, or are there ways in which technology can be used that don't further divorce us from the non-human world? Some have suggested that there might even be ways of using technology that bring us closer to it.

Murray Bookchin on Technology and Nature

Murray Bookchin was a political philosopher and social theorist from the US. He was particularly influential in the ecological movement from the 1960s onwards, linking social and ecological thinking in his theory of 'social ecology'. Bookchin believed that domination between humans leads to the domination and destruction of nature, and called for decentralised democratic communities that live in harmony with their ecological surroundings. He also believed that technology had an important part to play, having the potential to both free people from the toil of repetitive labour and to reconnect them with the environment [25]. In fact, some say his vision relied too heavily on the role of technology [26].

He argued that the move to urbanisation along with industrial technologies left most people alienated from nature. According to Bookchin there is a need to break down the difference between urban and rural existence, that city dwellers need to re-integrate with the countryside. However, he wasn't promoting a return to a hard life of agricultural toil. He said that modern technologies, including mechanisation, could be re-purposed for smaller 'human scale', ecological forms of agriculture. He drew on examples from throughout human history to show how technology could work in co-operation with nature rather than exploiting it. By carefully studying the ecology of the land, he argued, communities could exist within the environment's carrying capacity with forms of land management that are appropriate to local ecosystems.

However, he also stressed that while technologies had a part to play radical social changes were also needed to achieve freer, ecologically-based communities (see below) [27].

Eco-modernism represents a radically contrasting view to those who seek to repair the harmonious relationship between humans and nature.

Ecomodernism

Ecomodernists argue that, using technology, humans should separate from nature rather than depend upon and harmonise with it. They believe that modernity (and particularly the advancement of technology) has benefited humans by freeing them from nature, creating liberal democracy, better standards of living and longer life expectancies and releasing women from patriarchal gender roles. They argue that humans should use technology to separate themselves further from the natural world, both reducing dependency on nature and preventing further environmental harm. Nature, no longer affected by humans, would be allowed to return to a state of 'wildness'. Eco-modernists enthusiastically promote the use technological solutions to ecological problems, for example supporting the use of genetic modification of crops and intensive agriculture, and using carbon capture and storage to address climate change. On the surface these can appear to simply be practical attempts to apply science and technology to address environmental issues, but although this is rarely acknowledged, they represent an underlying eco-modernist philosophy of human separation from nature.

Ecomodernism is strongly opposed to other philosophies proposing that humans 're-connect' with nature. Its critics say it fails to understand that the philosophy of domination of nature, and the way it has shaped modern technologies, is a primary cause of environmental crises: thus advocating as solutions the very things which produced the problems.

Secondly, it speaks consistently of a general 'human' impact upon nature, failing to include any understanding of social and political dynamics, or critique of the role of colonial and capitalist systems in environmental destruction.

Others who seek to protect the environment can have similar views on the relationship between humans and nature. A stewardship model based on a conservationist approach says that humans should look after nature and protect the wilderness. However, it is another example of an anthropocentric view and depicts nature as something separate from humans, wild, pure and unchanging. In addition, it is sometimes criticised for failing to recognise that nature is ultimately uncontrollable, that it is arrogant for humans to assume that they are capable of dominating nature in order to conserve it in a form that suits them. The conservative stewardship approach to nature has also historically been used to dispossess indigenous populations from their land, and still is.

Non-anthropocentric views of nature recognise the intrinsic value of the non-human world, rather than considering it as being for the benefit and at the disposal of humans. For example ecocentricism is used to describe a view that prioritises ecosystems rather than just humans.

Although they are extremely varied, many indigenous cultures and knowledge systems have non-anthropocentric views of nature. Some describe 'cosmovisions' - ways of explaining and understanding the universe, or cosmos, and a culture's place within it. Indigenous knowledge also tends to be contextual and based on relationships, as opposed to claims of purely objective understanding. Scientific and technological knowledge for example are often presented as being value-neutral. However, as with all forms of knowledge, they still involve relationships of power and are inevitably imbued with

values of one form or another [28] [29].
Indigenous stewardship is often promoted as an alternative to conservationism. This is partly due to it being based on a living relationship with the land, rather than trying to simply protect and preserve it [30].

Here are some questions to help guide discussions around nature and technology:

- Why is the mechanistic view of nature so deeply entrenched and so powerful, and how can it be challenged to avoid instrumental attitudes to nature? What can be learned from alternative metaphors and visions (for example, indigenous 'cosmovisions' or 'non-Western' traditions)? How can these ideas be most effectively communicated and spread?

- What principles could be adopted in relationships between human and non-human communities? How would these principles be promoted and supported?

- Are there ways in which technologies can be used to promote harmonious interactions with the natural world, to reverse alienation, to 'reconnect' us? What would these non-anthropocentric technologies or technological systems look like?

- How can attitudes towards and use of technology respect non-human nature and nurture a harmonious relationship with it, without encouraging the idea of essentialised natural purity or unchanging wildness?

In assessing specific technologies:

- What direct and indirect effects does the technology have on ecosystems and the natural environment?

-What attitudes and understandings of nature are reflected in the technology? And what relationships does the technology engender or sustain between humans and the rest of nature? Do they involve further separation and alienation or reconnection and coexistence?

Recommended Reading:

• *The Death of Nature: Women, Ecology, and the Scientific Revolution* and *Reinventing Eden : The Fate of Nature in Western Culture*, both by Carolyn Merchant (ISBN 978-0062505958 and 978-0415644259)

• *Science, Colonialism, and Indigenous Peoples : The Cultural Politics of Law and Knowledge* by Laurelyn Whitt (ISBN 978-1107675070)

• For those interested in exploring issues around the nature of scientific knowledge, look up Scientific Realism, Positivism, and Instrumentalism.

Society

So what is the relationship between technology and society and how does this shape our understanding of the role technology does and could play?

Which Came First?

There are ongoing heated discussions about the influence that technology and society have on one another. Technological determinism, for example, is the view that society is shaped by technology, and that particular technological developments have fundamentally influenced the direction of society and even human evolution. It also sees technology as evolving autonomously, outside human influence (sometimes called 'hard determinism'). Although technological determinism has become less popular among those studying technology, it still has widespread influence and is frequently (if not explicitly) promoted in the media and corporate world.

Social construction (or social determination) of technology, on the other hand, is the view that technologies are determined by human action, by the societies from which they arise. Technologies are developed according to the dominant needs and desires in the societies that they emerge from.

Of course there are many positions between these two extremes or outside the spectrum. For example, where technologies can be shaped by social factors but then in turn have an influence on the societies that created them. This is sometimes termed 'mutual shaping'. Exploring this middle ground, the 'rainbow grey area' of the dynamic between technology and society is perhaps the more useful terrain for those interested in developing critical positions on technology.

Did the Stirrup Lead to Feudalism in Europe?

An example in the debate over the chicken and egg relationship between society and technology is shown in the influence of the stirrup on feudalism

in Europe. A stirrup holds the foot of someone riding a horse, offering greater control. It was originally invented in South and East Asia and made its way via Central Asia to Europe, where it started to become widely adopted around the 8th century. It has been argued that this represented a key development in the technology of warfare, allowing for heavily armoured cavalry and shock combat, and that this in turn led to portions of land being awarded to mounted warriors in reward for their service, laying the foundations for feudal society [31]. Others debate the significance of the European adoption of the stirrup, saying that the move to cavalry was actually the result of social and political developments, such as lack of a central government, or that the stirrup was just one of a variety of influencing factors. Whatever really took place, the debate over the stirrup illustrates some of the complexity of the interaction between technology and society. Both can influence the other to the extent that it can become difficult to differentiate between cause and effect.

Inherently Political

One idea related to the interaction between technology and society is the so called 'inherent politics of technology'. This is a way of challenging the view that technologies are simply neutral tools, that can be used for good or ill, depending on who is using them and how they are used. Instead it is argued that technologies contain inherent politics in their design or nature. For example, certain technologies may only be compatible with certain social structures or ways of organising society. Nuclear power is sometimes used as an example to demonstrate this: it is only possible to provide energy from nuclear technologies if you have a centralised authority to control it, that it requires militarised security in order to protect facilities etc.

Langdon Winner famously critiqued technological neutrality in his 1980 essay "Do Artifacts Have Politics?" [32]. He said that while social

determination of technology is a useful counter to naive technological determinism, taken to its extreme it could mean the things created don't matter at all (i.e. that technologies do not influence society). He particularly highlighted how technologies can be political in their specific form of design, implementation etc. and how they can be inherently political in their very nature. He said they can also be a mix of both.

He also argued that while technological means are developed to serve human ends, human ends can end up adapting to technological means (and often do). He stressed that it was important to look at these implications of technology because people tend to be more willing to make drastic changes in their lives to fit with technical innovations than they are to make such changes for political reasons.

"Technologies are not merely aids to human activity, but also powerful forces acting to reshape that activity and its meaning." Langdon Winner [33]

Automation

The word automation originated from the car manufacturing industry in the 1940s, where machines were increasingly used on production lines, often replacing human labour. Automation now more generally refers to the increasing use of technological systems with minimal human interference, a process which has been taking place in various forms since the Industrial Revolution. The promise of automation is that it will free humans from arduous repetitive labour, increasing efficiency and productivity while allowing for greater time spent on leisure activities.

However, in practice automation often involves replacing labour without removing the imperative to earn wages to survive, undermining people's source of livelihoods whilst making more profit for those who own the machines. The Luddites realised this in the 19th century and organised against the encroachment of automated technologies on their ability to sustain themselves (see Luddites). This highlights the importance of who owns, controls and profits from the automation process, something notably absent in the corporate celebration of the wonders of automation.

Similarly the question of what aspects of labour or human activity should be replaced by machines is rarely discussed by those trying to extract profit from the process. Rather, it is assumed that automation, as with the advancement of technology in general, is an unquestionable force for good. Joseph Weizenbaum, considered an important figure in modern artificial intelligence (AI) argued AI technology should not be used to replace people in positions that require respect or care; that without genuine empathy from people in these positions we would find ourselves alienated and human dignity threatened [34].

Means and Ends

"Tools satisfy perceived ends but in doing so create new ends" Arthur Bradley [35]

Consider the following as an example of how the introduction of a technological means aimed at satisfying human ends can lead to a series of unforeseen results, feeding new socio-technical interactions and dynamics, and even resulting in significant reshaping of human ends.

The flying shuttle was invented by John Kay in 1733. It was a mechanical device to speed up weaving, meaning fewer weavers

were required. However, it still required people to spin yarn to feed the weaving process. The increased demand for yarn led to another invention, the Spinning Jenny, allowing for greater yarn production. Spinners were generally more skilled and unionised, and as a result better paid [36]. Increased demand, combined with the desire to cut wage costs and undermine unions, led to another series of inventions in the spinning process, eventually resulting in Crompton's Mule. The Mule further increased yarn production, in fact now to the point where it exceeded weavers' capacity to use it. This in turn led to further mechanisation of the weaving process, which then put pressure on the cotton suppliers, leading to the mechanisation of the cotton 'picking' process. This meant more land devoted to cotton fields and increased demand for slave labour. At the other end of the production process, the increased output of cloth led to new products, commercial methods, and a need for greater consumption.

Of course the role of technological inventions is just part of the picture. Sometimes this section of history is described as a simple story of a series of ingenious British innovations spontaneously leading to the Industrial Revolution and all its wonders spreading across the world. The reality was of course much more complicated and much less glorious. It included the dispossession of peasants from common land through the Enclosures to create pools of cheap labour; the theft of indigenous American land to create cotton plantations worked by enslaved people imported from Africa; and brutal new colonial practices carried out to undermine the competition for the newly created cotton products [37].

However, the example illustrates how social pressures resulted in a relatively simple technological intervention in the process of production which then set off a chain of consequences reaching far beyond its original context. It not only played a part in transforming an industry, but helped build the conditions for modern capitalism and widespread

exploitation of workers (we're not saying this was all John Kay's fault of course). The Luddites (see below) caught on to all this early on, but despite their foresight and some success in sabotag, they and other movements were unable to prevent their livelihoods being undermined by new industrial technologies.

Cars are a more recent example of how human ends can be reshaped by technical means. Originally they were intended as a means to increase mobility and 'freedom' (or at least promoted by manufacturers as such). However, over time they had radical widespread effects on culture and urban design to the point where moving around a city on foot or by bicycle could be a difficult and dangerous endeavour. The negative social, environmental and health effects of car culture eventually became either accepted, ignored, or extremely difficult to challenge. Certain freedoms, choices and movement became restricted and curtailed, human ends were shaped by the technical means of the car.

Mobile phones are another recent example. Intended as a tool for easing communication, they have significantly changed the forms and cultures of communication (texting, smilies, selfies, always being 'on call'). They are also one of the most effective forms of technology in aiding surveillance and social control, greatly enhancing authoritarian capabilities. Attitudes to freedom and privacy have been significantly influenced by their adoption and acceptance.

Of course in the examples of both cars and mobile phones it is important to bear in mind that the motive to a make profit was also present alongside or even above the desire for increased utility.

'Planned obsolescence' serves as an example of how social power structures directly influence the human aims to be met by technological means. Most understand it as the designed failing of parts of technological gadgets and appliances or software purposefully becoming

outdated and unsupported over time. However, it's not just about commercial technologies becoming intentionally unusable, it also involves "obsolescence of desirability" where marketers attempt to wear out the product in the user's mind. Brook Stevens, who popularised the term, defined it as "Instilling in the buyer the desire to own something a little newer, a little better, a little sooner than is necessary." [38]

This issue of technological means and ends is fundamental and has been explored by many writers and thinkers [39]. Some have argued that we live in a technological society. They say technologies were initially developed as a means to improve efficiency for a specific goal. However, the obsession with ever-increasing efficiency became an end in itself. This has come to dominate society, having a profound influence on political systems and human relationships. In his 1954 book, 'The Technological Society', Jacques Ellul described this phenomenon using his idea of 'technique'[40], meaning not just technologies produced towards an end, but a series of means affecting almost all aspects of life: "the totality of methods rationally arrived at and having absolute efficiency in every field of human activity."

"Modern technology has become a total phenomenon for civilization, the defining force of a new social order in which efficiency is no longer an option but a necessity imposed on all human activity." Jacques Ellul [41]

Whose Ends?

So technologies are shaped by and shape society: they can originate from human needs and desires (social determination of technology) and they can also profoundly influence them (technological determinism). Technologies can have inherent politics, both wound up in the individual technologies themselves and in the specific way they are designed,

distributed and implemented.

But what societal needs and desires are reflected in technological development? As well as general conceptions of and attitudes towards technology (such as 'technology as progress'), the direction taken is strongly influenced by economic and political systems. Certain priorities are followed, others are ignored. Certain sections of societies have influence, others are influenced. Social structures and power dynamics are fundamental drivers of the kinds of technological tools that are created and how they are then woven back into the social fabric.

Capitalism has a profound affect on the direction of technological development. Whether or not a certain technology can be used to directly generate capital (i.e. money or things used to make more money) or protect or advance the interests of the owners of capital, often entirely determines whether or not it will be brought into being. A large proportion of technologies are developed by corporations who often manufacture the desire for the technology as well as the product to satisfy it.

States also have a huge influence on technology. Many technologies are developed as a result of government-funded research and this both reflects the priorities of those in government and the interests of states in general. For example, vast amounts of resources are poured into military technology, and many technologies – such as the digital computer or the internet – originated from military research programmes. Some technologies, such as nuclear power, would likely have not come about at all if it were not for military concerns being considered more important than economics [42].

We will look at the relationships between the State, capitalism and technology a little more in the next chapter 'Direction'.

Assemblage Theory

Another idea that may be useful in considering how technology and technologies function, including their relationships to social, ecological and political contexts, is assemblage theory. Assemblage theory, which could also be considered a kind of analytical metaphor rather than a concretely formulated theory, was developed by Gilles Deleuze and Félix Guattari [43] [44]. They are famously cryptic in their writing, and we certainly won't attempt to explain their thinking fully here (if such an explanation were even possible!). Instead we'll give a very crude description and introduce some of the ideas so we can borrow from them to try to better conceptualise how technology is bound up in other aspects of the world.

Assemblage theory draws from the study of complex systems, which looks at systems that behave in complicated ways due to the interactions between the parts they are made up of. A country's energy infrastructure, the Earth's climate and an organism's immune system are all examples of complex systems. Instead of thinking about the social world as being made up of things as fixed social objects, assemblage theory encourages a different approach, a metaphorical description of a fluid, patchwork, changing configuration. It describes assemblages as made up of various types of components that enter into relationships with one another. The components could be physical, like bodies, but they can also be immaterial, like signs. The components can themselves also be composed of other things, be part of other assemblages and have different spacial and temporal scales. The relationships are also not fixed, but change over time. Assemblage theory is about the patterns and dynamics that result from different types of things in society interacting and self organising.

For example, if you consider a university as a kind of assemblage: It consists of different types of things, some physical, some conceptual: the buildings, the lecturers, the students, trends in academia, research funding policies, the university's social media presence etc. The buildings have temporal scales of decades or even centuries whereas the students come and go in cycles of several years. Thinking of the university in terms of an assemblage can help examine the dynamics that exist between the elements that make it up. For example how the organisation of and relationships between the workers in the university and the geographical distribution of physical infrastructure affects the educational experience of the students, and then how all of this might be disrupted and then reformulated after cuts to funding.

When considering specific technologies, types of technology or technological processes, the following questions might help in examining their implications for society:

-Does the technology require a particular way of ordering society, or particular power structures? What are they and how are they required by the technology? If not necessarily required, are they strongly compatible with such structures, or do they encourage or reinforce them?

-Does the way the technology is designed or implemented have implications for certain groups in society? Who does it serve and how? What are the 'inherent politics' of the technology? How are social relations of identity based on sex, race, class, ability, etc. affected by the technology?

-What are the implications of the technology for social justice? How are the people involved in the production, distribution and disposal of the technology affected? For example, miners, factory

workers, those working in toxic waste dumps. How is the technology liberatory or oppressive for everyone involved in its complete life cycle?

-Is the development of the technology a reflection of specific social ends? How will the technology affect wider human ends? What ensuing dynamics between means and ends might emerge?

-What ideologies, needs and desires are reflected in the technology or the system of technological development and, where necessary, how could this be changed?

- What are the implications around autonomy and dependency created by the technology? What does the technology allow the user to do, and what dependencies does it create? What are the dependencies of society on these technological developments? What happens if society does not have the resources to maintain these technological developments?

- Can technology be used to solve problems without creating more problems requiring more technology? How? And what role in general can technologies play in escaping or resolving problems that were created by technology?

Recommended Reading:

•*The Social Shaping of Technology: How the Refrigerator Got Its Hum* by Donald MacKenzie and Judy Wajcman (ISBN 978- 0335150274)

•*The Whale and The Reactor : a Search for Limits in an Age of High Technology* by Langdon Winner (ISBN 978-0226902111)

•*Tilting at Paper Tigers* by David Edgerton (DOI 10.1017/S0007087400030144)

•*Of Bicycles, Bakerlites, and Bulbs: Toward a Theory of Sociotechnical Change* by W E Bijker (ISBN: 9780262023764)

Direction

Many critiques of the role technology plays in society are based on the fact that current technological direction is largely determined by the interests of the state, capital, or those with power to dominate in society. Some argue that if you could change these social relations and the worldviews that engender them, then technology could be reimagined and repurposed, allowing humans to flourish and avoiding the creation of ever-greater controls on our existence.

So how is the development of technology directed and by who? How could this be changed? And how could certain technologies or areas of technology be prevented or encouraged?

A Garden of Forking Paths

Fundamental to all of this is challenging the idea that technology is neutral and that technological advancement is an unquestionably socially-progressive force. The dominant view is that the path towards continually more sophisticated technology is inevitable and that stopping, diverting or even questioning it is not only undesirable, but is also implausible; that humans are committed a future of unbridled technological 'advancement' and the only hope is to try to use new technologies as best we can. This fuses with the idea of technological neutrality, that technologies themselves are neutral and that politics or ethics are only involved when considering how technologies are used by people.

"Technological progress has merely provided us with more efficient means for going backwards."
Aldous Huxley [45]

However, as well as ignoring the social forces behind the development of technology, the idea that if a certain kind of technology is imagined and then becomes feasible means that it will inevitably be developed is dangerously simplistic. It overlooks the fact that with each technology that is developed or implemented, there are potentially other technological pathways that are stymied or cut off entirely. For example developing nuclear power may hinder the development of other energy technologies. A corporate-controlled search engine becoming ubiquitous may prevent a 'free/libre software' (see below)

or democratically-produced alternative being popularised.

Each stage of technological development both opens up and closes off other possibilities. The prevention of the development of a specific technology could, instead of limiting the options open to us, actually result in the potential for a whole new branch of technological exploration. Instead of seeing technology as an inevitable linear progression, it could be viewed as a 'garden of forking paths', progressing in multiple directions and involving human agency.

"Technology is not neutral. We're inside of what we make, and it's inside of us. We're living in a world of connections — and it matters which ones get made and unmade." Donna J. Haraway [46]

Cybernetics

Cybernetics involves the study and control of complex or regulatory systems, where a system can be observed and then changed to achieve a desired outcome. Feedbacks are particularly important in cybernetics: situations where the outputs from the system are used as inputs. For example, a thermostat measures temperature (output) and turns heating on or off (input) in order to achieve a stable temperature. Cybernetics can be applyied to a wide variety of fields: technical, biological, or social, so the system could be a form of business management, a human body or an automated assembly line. To give another example, the movement of vehicles in a city could be monitored to see how it is affected by changing the timings of traffic lights, with the aim of optimising traffic flow.
Some have argued that cybernetics in combination with the development

and application of specific technologies is resulting in a powerful form of social control where human desires and actions can be measured, analysed and ultimately controlled through more or less subtly influencing factors affecting them. They say that this use of cybernetics to model and control society encourages technocracy (see below), where experts apply scientific knowledge in order to manage people, treating society as a technical apparatus to be optimised towards greater 'efficiency'. The increasing use of digital technologies in 'smart cities', the 'internet of things', facial and gait recognition, mobile phones and social media are all examples of technologies that can enable this form of social control through increased monitoring, measurement and modelling. Strategies to counter this have been proposed that involve avoiding being drawn into the feedbacks of cybernetic control. For example using speed and rhythm to stay ahead of and outside systems of control; to increase noise and 'fog' and fluidity and mobility; to experiment with and use varied autonomous approaches to overcome and destroy cybernetic control [47]. ***"There is probably no domain of man's thinking or material activity that cybernetics will not come to have a role in someday." Georges Boulanger [48]***

It is also commonly held that technological progress is always towards the more advanced or sophisticated. But this is not necessarily the case. New technologies can proceed in different directions and also often mix with old ones, creating multiple simultaneous branches, routes and trends. There are also instances where certain new technological directions have not been pursued or technologies have become unfashionable or forgotten, or previous versions have been reverted to. To take an example from reproductive technologies, the popularity of the condom dropped dramatically after the introduction of the contraceptive pill, but became widely used again after the arrival of HIV. In transport, electric powered vehicles pre-dated those using combustion engines, and are now becoming

popular again. Super-sonic passenger planes such as Concord have quickly gone from futuristic to anachronistic [49].

"I think every age lives in a blend of technology so there's always older ones mixed in with newer ones, and when the new technology goes down, the immediate fallback position is either that technology just before that or one several technologies back."
Margaret Atwood [50]

Grey Goo

A term coined by nano-technologist K. Eric Drexler in Engines of Creation in 1986 to describe an apocalyptic technological scenario where self-replicating nano-bots multiply uncontrollably and consume all life on earth, turning it into 'grey goo' [51]. Although Drexler regrets introducing the term ('grey goo guy' is not exactly a flattering moniker) it is often used in discussions around new technologies with potentially disastrous unintended consequences.

New technologies are also often described according to a 'genie out of the bottle' effect. Once a technology is out in the world, once the genie is out of the bottle, there's no going back. While this may be true of some technologies (nuclear weapons seem to be a particularly stark example) there are other cases where it's not so straight forward; for example technologies that have been partially or entirely relinquished, sometimes before being developed or implemented (such as certain biological weapons).

This relates to the 'Collingridge dilemma' in the development and control of technology [52]. It says that on the one hand, it's difficult to

know the impacts of a technology before it has become widely used, and on the other hand that it is very difficult to control technology once it has become entrenched. The precautionary principle (see below) has been suggested as a possible way to resolve the dilemma.

There are also times when a technology becomes widely very adopted, making it difficult to replace despite there being a preferential alternative. This is sometimes termed 'lock-in', usually in the context of monopolies, propriety technology and free-markets, but it can also apply to standard models such as with the QWERTY keyboard. The benefits gained from changing (perhaps a more efficient layout and faster typing) need to be weighed against the costs of adoption of the new standard (people relearning how to type, replacing existing keyboards, being able to convince enough people to change etc.). Widespread adoption of a technology can also mean that something that began as an option can become a requirement of participating in society and not using it becomes very difficult (e.g. computers, mobile phones, credit cards).

Reflections of Power

"A technology is deemed viable if it conforms to the existing relations of power." David Noble [53]

So how do forces such as capitalism and the state direct the development of technology? The subject is far too large to cover here in any detail [54], but it may help to look at a few examples to demonstrate how it takes place.

One powerful illustration of the process can be found in the internet and digital communication in general. Capitalism's constant need to

generate profit leads it to expand into new areas as others become exhausted or not sufficiently profitable. So the internet and the world of digital communication became a new sphere from which to extract profit. And as historically workers were separated from the products of their labour and turned into consumers, so now people are separated from 'their' information: that which relates to them or is produced by them. It is extracted, processed and commodified by the corporate monoliths dominating the web. In exchange people are given the 'free' services offered by social media platforms, search engines, email accounts and the like. However, this goes deeper than just control of modes of communication and flows of information. Through digital communication technologies, capitalism's insatiable appetite has pushed it further into the realm of people's mental processes and their social ties [55].

Due to underlying systems of power, the tools and technologies designed to improve people's ability to communicate have radically altered the way they communicate. The ideologies embedded within digital communication technologies have fundamentally shaped the new behaviours and cultures of communication that have emerged. For example the corporate/neoliberal influence on online social media is enormous. Individualist self-promotion and branding influence social identities and interactions. Clickbait instant gratification affects attention spans, the depth of content and critical thinking. The insidious influence of profit extraction can be seen throughout. Vast amounts of data are collected, stored, analysed and commodified, leading to huge intrusions on the privacy of billions of people and increasing the susceptibility of their behaviour to be modelled, predicted, profited from and controlled. This is an example of how interests of corporate profitability and state social control intersect. They reinforce one another in shaping technological processes and aligning them to their priorities [56].

The 'smart city' is another related example of the overlapping interests of state and capitalism. The increasing measurement and informatisation of the city and its inhabitants simultaneously provides lucrative new avenues of profit extraction and enhanced capabilities of surveillance and social control.

The Covid-19 pandemic provided another opportunity for corporations and states to solidify and extend their influence. Many were quick to warn of the potential for the crisis to be exploited by authorities and companies seeking to gain greater access and control over people's data, and this proved to be the case across the world [57]. Digital track and trace technologies are fertile ground for both the surveillance state and surveillance capitalism. The crisis also highlights issues around medical technologies as drug companies and states used vaccine development as another area to compete for prestige and profit [58].

Redirection

So how could this be changed? And what are the options for considering which technologies to adopt and develop and which to limit or prevent?

The obvious if somewhat tricky to implement reply is that it's the power relations in society that need to change. Unfortunately we aren't able to say exactly how here (sorry!), but we'll suggest some ideas for further consideration in the 'Now' chapter below.

In terms of approaches to specific technologies, one idea for how to respond suggests three dimensions: abolitionist resistance, disillusioned adoption, and active promotion [59]. In some cases certain technologies are entirely inappropriate to free, equal societies (sophisticated military hardware is given as an example), in which case the only response

would be that of trying to stop development or end the use of the technology entirely.

In others it may no be so clear cut; the technology may not ultimately be desirable or sustainable but there may be ways in which it could be used in the short and medium term as a tool for subversion while it still exists. For example modern telecommunications infrastructure may be unsustainable in its present – energy intensive – form, but the internet could still be used as an organisational and communication tool for those seeking social change. Finally, there are examples of useful technologies that are actively promoted, for example low-tech innovations in energy and food, traditional craft practices, recycling and repurposing existing technologies.

Others, such as the radical journal Endnotes, have proposed similar considerations:

"In the course of struggles just as in any possible post-capitalist world, we will inevitably have to judge each specific technology by its "affordances": will it help or not? What unintended side-effects might it have? How might it contribute to the shape of our actions? Will it be harmful or not? How will it change how other things work? Does it make any sense in the absence of specifically capitalist social forms? Is it a straightforward obstruction?" [60]

Many have suggested the 'democratisation' of technology, taking control out of the hands of corporations and states and into the hands of the communities who make and use the technologies. This then poses another difficult question about the form of democratic organisation to be used, especially given the many deeply flawed systems of 'democracy' that currently operate around the world.

Megamachine

Lewis Mumford was an influential figure in the philosophy of technology, advancing a critique of scientific and technological 'progress'. He introduced the 'megamachine' concept, a kind of social structure manifesting a convergence of science, technology and economic and political power, able to coordinate workforces to carry out vast, complex projects.

Within the megamachine humans are just treated as replaceable cogs, carrying out their functions without agency or understanding of the purpose of their efforts or their role in the greater project. Megamachines are hierarchical bureaucratic structures, allowing leaders (often military) to fulfil their grand projects without regard for human need. As examples of megamachines he gives the building of the pyramids, the armies of the World Wars and the nuclear super-powers of the Cold War.

Mumford was not entirely opposed to technology, and made a distinction between authoritarian and democratic technologies. He believed that technical means could be used to enhance social well-being if they operated within human-scale communities and were limited to human purposes and values such as individual development and social cooperation [61] [62].

A consideration that arises in these discussions is the degree to which development and control of technology is centralised or decentralised. For example should there be central authorities that determine the direction of technological development, or should individuals and decentralised cooperatives be allowed to freely explore and implement technologies? Many who are critical of the current role of technology identify centralised control as a key aspect of the problem [63]. But are there technologies or approaches to technology that require coordination over larger geographies or communities, perhaps continental or even global? For example, do global ecological

crises require technological coordination on a global scale, and if so, how would this be organised in a democratic manner? Could ideas like democratic technological communities be scaled up without losing their integrity, and how would these communities operating over different scales interact with one another? One possible way of addressing these issues is to have widely-agreed and adopted standards, norms and practices developed using democratic principles and without the need for a central authority to define and enforce them.

As mentioned above, some technologies are only appropriate for centralised control or heavily industrialised societies, while others are the opposite, being commensurate with decentralised social structures or engendering ecologically harmonious relationships. The picture can also change over time. With the example of the internet, initially it was decentralised networks and autonomous communities that were nimble enough to adopt and adapt, increasing their relative power and freedoms. Early on, the internet's liberatory potential flourished. But pre-existing power structures (namely corporations and governments), while slow at first, were later able to exploit the new terrain and reinforce their dominance. It's far from over, but they now very much seem to have the upper hand in the battle for the internet [64].

So another issue around how technologies are controlled or the direction of technological development, is how the types of technology themselves relate to the underlying power dynamics within society. The definition of a 'good technology' could include it being appropriate to certain kinds of societies (decentralised, democratic, feminist or socially just for example) and not others (authoritarian, patriarchal, exploitative or unequal). The ideas for how to define 'good technologies' is discussed in chapter nine: 'Good Tech'. First we will examine the various established views on technology in the next chapter, 'Politics'.

Here are some questions to consider when thinking about the control of technology and the direction of technological development:

- Can the techno-genie be put back in the bottle? What to do once it's out? (other than a good rave)

- How can technology be effectively democratised and decentralised? How would decisions be made about which technologies are developed and which are not? What are the limits to decentralisation? How can coercion and alienation be avoided in coordination of technological systems?

- Does the development of a certain technology prevent the development of another, perhaps better alternative? What are the implications for future possibilities when choosing specific branches of technological exploration? How will choices made now affect choices in the future?

- How can critical, nuanced attitudes to technology in society be promoted in order to influence the direction of technological development? How can these positions on technology be established while challenging existing oppressive power structures, so that both courses of action support one another?

- How can the precautionary principle be sensibly applied to technological development? (Getting round the Collingridge dilemma). How can risks be better anticipated and how can it be ensured that these conversations and decisions take place in wide sections of society, instead of a technological elite?

Recommended Reading:

•*America by Design: Science, Technology, and the Rise of Corporate Capitalism* by David Noble
(ISBN 978-0195026184)

•*Caught in the Net. Return Fire* vol.4.
(Available at Anarchist Library)

•*Myth of the Machine* by Lewis Mumford
(ISBN 978-0151639755)

•*Whose Streets? Anarchism, Technology and the Petromodern State* by Michael Truscello and Uri Gordon (issn 0967 3393)


ZO MA DI WO DO VR ZA
DIM LUN MAR MER JEU VEN SAM
SON MO DI MI DO FR SA
1 → 2 → 3
8 → 9 → 10
15 → 16 → 17

Politics

In this section we'll introduce a few different positions and areas within the politics of technology, to give an idea about the various existing view points on the nature of technology and the role it plays in society.

Attitudes to technology vary enormously. Some are staunchly opposed, seeing it as a threat to human well-being and the natural world, and calling for a return to a more primitive form of existence, perhaps relinquishing 'technology' altogether. Others deify it, viewing it as being the pinnacle of human achievement, radically improving lives and freeing human potential, maybe even taking us beyond human and into some 'higher' form of existence (they've clearly not spent much time on Twitter!). Then of course there are a multitude of positions between these poles, cautious optimism, sceptical acceptance or simply agnosticism.

Let's first look at one of the more critical positions: primitivism.

Primitivism

Primitivism, in the context of technology, is a critique of the origins and 'progress' of civilisation and the role of technology in modern societies and cultures. It is is often associated with deep ecology, which focusses on recognition and promotion of the value of nature and non-human life. The use of terminology varies but anarcho-primitivism is often considered synonymous with primitivism and there are at least significant overlaps with anti-civilisation ('anti-civ') views, although they are also sometimes described as being in opposition on specific issues.

Though a broad church with a variety of opinions and positions, primitivists are generally in favour of abandonment of industrial and large-scale technologies and are opposed to techno-optimist (see below) solutions to social and ecological issues. They argue that modern technology is based upon systems of domination and has alienated us from nature and each other.

Many trace the problems with the modern world back to the development of agriculture and some argue that hunter-gatherer societies are the ideal form of human social organisation. The ultimate desired level of technological sophistication varies between primitivists, but critiques that primitivists want to go 'back to the Stone Age' have been responded to by saying that there is no precedent for what primitivists are striving for, and that they view 'primitive' societies as a source of inspiration rather than a goal [65].

Some primitivist thinkers have identified the root of the problem in the transition from tool use (things made by individuals or small groups for specific tasks) to 'technology': involving extraction, production, distribution and consumption and the development of abstract systems of power and impersonal institutions, leading to coercion and control [66]. Others see the increasing use of symbolic

representation in cultures (such as number, time, language, art) as abstracting from directly experienced reality, leading to objectification and alienation [67] [68].

Many who are also critical of civilisation, 'progress' and the role of modern technology, reject primitivism. They argue it sidesteps vital social justice issues and that, among other things, it would require vast reductions in human population and severely impact those who need technologies to survive (for example those relying on medical technology). Although of course primitivists debate this and there are ongoing wide-ranging discussions within primitivist thinking.

"Technology is not a simple tool which can be used in any way we like. It is a form of social organization, a set of social relations. It has its own laws. If we are to engage in its use, we must accept its authority. The enormous size, complex interconnections and stratification of tasks which make up modern technological systems make authoritarian command necessary and independent, individual decision making impossible." Fifth Estate [69]

To give a view of the terrain, lets now look towards the other end of the spectrum.

Techno-Optimism

Techno-optimism is the general positive view of technology: that it improves human lives and that many of our problems can be solved using technological solutions. Techno-optimism isn't new, for example many argued that the technologies emerging from the Industrial Revolution would do away with the need for human labour. It is closely linked and overlaps with related ideas such as techno-utopianism, the idea that technology will bring about an ideal technological society;

and techno-progressivism, that positive change should be realised through technological advancement combined with social progress such as the use of democratic structures. Critiques of such positions revolve around the overstated potential of technology to improve well-being, the dangers of reliance on technology, and the lack of critical understanding of the role of technology in the origins of social and ecological problems.

The Luddites

The Luddites were a group of textile workers in England in the 18th century, famous for their actions of sabotaging textile machinery which they believed were harming the common good. The term Luddite is now commonly used in a derogatory sense to mean someone who is against technology (technophobia) or 'progress' in general. However, the Luddites were primarily concerned with preserving their livelihoods and opposing class exploitation. They were only opposed to specific technologies that were harming their and others' well-being. They were against, in their words, "all Machinery hurtful to Commonality" [70]. Sometimes when carrying out raids they would only destroy the machines they believed to be harmful, leaving others untouched.

Although the Luddites are the best known example, there have been other similar movements at other times and in other parts of the world [71]. However, as is often the case, many such histories remain unwritten.

A more generous and historically accurate definition of the term 'Luddite' could be those who take a critical approach to the development and implementation of new technologies, evaluating them on the basis of whether or not they serve the common good.

Bookchin and Politics of Technology

As mentioned above, Bookchin believed that technology had the potential to improve relationships between people and between people and nature. His view of technology has some similarities to Aristotle's 'techné' or technique, which encompasses wider social and ethical considerations (although Aristotle is strongly critiqued for not addressing the hierarchical and exploitative nature of the slave society in which he lived). Bookchin judged technologies based on their ability to enhance human freedom and reintegrate societies with natural processes. He said that certain technologies reinforced exploitative social structures and the instrumentalisation of nature while others supported social liberation and "a sense of haunting symbiosis" [72] with ecological systems. Central to Bookchin's view is the need for technologies to be compatible with his vision of direct democracy, based on local assemblies. He stressed that the important thing was to live in self-governing communities which could then decide for themselves what level and type of technology was needed.

Bookchin had criticisms of ideas like appropriate technology (see below), saying that without wider structural change they would still only benefit certain sections of society, or would not by themselves create the desired changes to society. So while he sees the potential of technology to end scarcity and reconnect to nature, the problem remains of how to change society so technology can be used to benefit everyone.

Despite attempting to address such concerns, Bookchin is sometimes critiqued for localism and reformism (as opposed to seeking more radical social change) or even techno-optimism and lack of awareness and experience of the reality of certain technologies [73] [74].

Race and Technology

As with many topics covered in the book, discussions around race and technology cannot be covered here in any detail. However, much has

been written on the subject and it is an important area for struggles against racism [75] [76].

In some cases, technologies are used to deliberately exclude sections of society based on ethnicity. In 'Do Artefacts Have Politics', Langdon Winner used the example of Robert Moses (known for his racist views) purposefully designing low bridges to prevent buses and thereby poorer and black residents of New York from gaining access to Long Island resorts and beaches [77]. Although this particular example is disputed, there are plenty of cases where technologies are used to reinforce social hierarchies based on race. For example facial recognition technologies have been developed to purposefully aid ethnicity-based discrimination [78].

The use of machine learning in training facial recognition has also resulted in striking examples of societal biases inadvertently being manifested in technologies. Data sets contained racial and gender biases, meaning the algorithms developed were much better at recognising white faces than black, and men than women. This led to a host of false arrests and prosecutions. Such 'algorithmic oppression' has become widespread and appears in a range of contexts [79] [80].

As well as examining how racism can be immediately manifested in and exacerbated by technologies, the relationships between technology and race have been explored in other ways.

Afrofuturism

Afrofuturism means different things to different people, but it can be seen as a way of imagining and bringing about different realities relating to race and technology. Originating in African-American science fiction, it is generally characterised as a cultural aesthetic that encompasses visual arts,

music, literature and philosophy. It looks at the the intersections between the African diaspora and technology, often imagining technological futures through a black cultural lens[81].

Although it is debated whether or not her writings should be defined as such, Octavia Butler is frequently credited with producing some of the seminal works of Afrofuturism. Often set in science fiction settings, she explores ideas around social hierarchies, race and identity, sex and power, otherness, difference and diversity. Sheree Renée Thomas's anthology, 'Dark Matter: A century of Speculative Fiction from the African Diaspora'[82], is also considered important to Afrofuturist literature, retroactively applying the genre to various historic instances of black science fiction.

Afrofuturism is also widely known from its musical expression. Sun Ra and George Clinton's Parliament-Funkadelic are recognised as architects of Afrofuturist music, blending styles and incorporating experimental electronic sounds. Their legacy can be seen in their influence on many contemporary artists. The electronic music genre Techno, pioneered by black artists in Detroit, USA was significantly influenced by Afrofuturism.

Feminist Theories of Technology

There are extensive studies on the relationship between technology and feminism, or gender more broadly, with variations among different feminist schools of thought [83].

Early feminist movements focused on how technology supports patriarchy, and how male culture within technology reinforced gender stereotypes: men being associated with industrial machinery, strength and technical proficiency, women with fragility and incompetence; women were forced to adopt various perceived 'male' traits in order to participate in engineering and technical industries. For some, these

gender stereotypes related to technology were a result of 19th century industrialisation, professionalisation and the changing definitions of what technology meant. Artefacts and material practices associated with women were not considered technology, and their related knowledge systems were undermined [84]. Fabrics, for example, were not deemed within the realm of technology.

Later movements were less focussed on equality within industry and looked more at how technological objects and the process of their design and use were gendered. Whereas liberal feminists tended to frame the issue as male dominance of neutral tools, radical feminists highlighted how technology embodied social relations around gender [85]. Third-wave feminists then incorporated a critique on the differences between women and how feminism related to race, class and sexuality, leading to a view of many dynamic changing feminisms.

Donna Haraway's influential cyborg metaphor (see below) described how people are merged with technology, which forms part of their identity, and examined the possibilities offered by technology to change ideas around gender. This informed more recent developments which see gender as fluid and socially-constructed, and technology and society as mutually constituting one another. In this view, gender relations can be embodied in technologies and technologies can influence notions of gender. So technology and gender mutually shape one another over time and in various contexts [86] [87].

Technocracy

The term usually refers to governance by experts, or 'technocrats' with a high degree of technical knowledge, intended as a way of organising society through 'impartial' rule, based on scientific principles. For example, those supporting technocracy might argue that the decisions affecting the

running of the economy are best left to those with expert knowledge in the field rather than politicians.

The term is also used to describe a general tendency towards the use of technology to manage society and control nature, and a culture of prioritising efficiency and the ideal of the 'smooth running machine'. Under this approach problems of all kinds are seen as technical issues to be resolved through technological means (see 'technofix' below).

Critics argue that technocracy risks exacerbating many of the problems it seeks to resolve. They say that in seeking solutions it applies the same kind of thinking that generated the problems in the first place. For example, using a mechanical or instrumental view of nature, or treating people as cogs in an apparatus with efficiency as the ultimate goal, denying them agency over their own lives.

Hacking

Most commonly used to refer to subverting computer security (sometimes also called 'cracking'), a definition largely popularised by the mainstream media in the 1980s when illegal computer hacking started to get a lot of attention.

However, 'hack', is increasingly used in its original sense, meaning a playful or clever way of achieving a goal, or learning how something works by tinkering with it, often by subverting software or other technology from its original purpose. A cracker might use someone else's code or technique to crack a system, whereas a hacker might imagine an elegant solution to dealing with the problem not involving any 'crack'.

Computer hacking has been subdivided into white hat, grey hay and black hat. White hat hacking is legal and performed by those intending

to help improve computer security systems by demonstrating faults, often being commissioned and paid for their efforts. Grey hat hacking is generally done for fun, it can be illegal but is not usually performed for financial gain or with malicious intent. Black hat hacking is done to damage, destroy or undermine secure networks, sometimes to steal data or money. This can be done for political ends such as attacking an authoritarian security apparatus.

'Hacker culture', the community of people utilising hacking and their surrounding subculture and ethics, have a lot of potential for positively influencing broader conceptions of and attitudes to technology in society. Particularly the focus on creativity, openness, 'playful cleverness', sharing and collaboration might guide how a community of users could create, develop and utilise technologies.

Cyborg Manifesto

Some have suggested that we should view technology as inseparably part of who we are, that humans, nature and technology are all enmeshed in each other. In her highly influential essay 'A Cyborg Manifesto', Donna Haraway says that we are all cyborgs, "theorized and fabricated hybrids of machine and organism". The manifesto, a sometimes obscure piece, deliberately left open to interpretation, is described by Haraway as an attempt to build an "ironic political myth" [88]. It challenges Western traditions such as patriarchy, colonialism and essentialism, saying how they are based on antagonistic dualisms, which Haraway deconstructs using the cyborg metaphor.

For Haraway, what it means to be a woman is also based on this metaphor of cyborg existence. She particularly attacks the idea of 'female-as-nature' promoted by some feminists, and instead says we should view gender, and identity in general, as being fluid and

constructed. She describes how the distinctions between natural and artificial, mind and body, machine and organism, have all become ambiguous and says that we should fight domination by forming alliances based on affinity rather than identity.

Some have critiqued Haraway's cyborg metaphor for encouraging the idea that we should just accept or even embrace technological realities: as we are so intimately connected with technologies, we shouldn't waste our time trying to affect how they manifest. Others argue that while a common interpretation, this is a misunderstanding. They respond that she is actually saying we are tangled up both in technology and in our own domination. Instead of just accepting this and being open to all aspects of it, we can chose to form specific alliances within this interconnected world in order to advance our own liberatory aims [89].

Questions

Here are some questions relating to the various existing political positions on technology:

- How can we use approaches and cultures such as hacking, without losing the critique of the 'progressivist' understanding and role of technology? What are the limits of a hack approach and how can people decide when a 'hacked' technology is appropriate and useful or just an amended version that still suffers from the same underlying structural problems or embodied ideologies?

- What useful things can be learned and applied from primitivists' critiques? For example: how could abstract systems of power or impersonal institutions be prevented from forming in the development of technological processes? How can it be ensured that technological systems don't alienate users from their tools or from the things they

are interacting with via the use of tools?

- How can better relationships be established between people and the tools and technologies they use? On what principles could these relationships be based? For example, how does the relationship affect the way the user feels? How does it fit with other technological relationships?

- Can existing technologies that are part of the problem be used to undermine the systems that created them? If so, what are the dangers, advantages and limits with this approach?

- How can advanced or sophisticated technologies be developed and used without creating or reinforcing systems of control/technological elites/alienation from technology? For example when it is not possible for the user to know everything about the functioning of the technology? Does the relationship between user and technology need to be with an individual or could it be a community/societal? What are the mechanisms and cultures that would be required to ensure these relationship are 'convivial' and alienation prevented?

- How can technologies be prevented from reflecting inequalities or reinforcing oppression based on identity (e.g. sex, gender, race, sexuality, ability or class)? How can positive visions of technology be imagined and realised that challenge and reverse inequalities and prejudices?

Recommended Reading:

•Primitivism: A couple of particularly influential writings in primitivist thinking: *Against History, Against Leviathan* by Freddy Perlman (ISBN 978-0686877134). *Elements of Refusal* and *Future Primitive* by John Zerzan (ISBN 978-1890532017)

•*Luddites: The Making of the English Working Class* by EP Thompson (ISBN 978-0140136036)]

•*Race and technology: Technicolor: Race, Technology, and Everyday Life* by Alondra Nelson, Thuy L. Tu, Alicia H. Hines (ISBN 978-0814736043)

•*Feminist Theories of Technology* by J Wajcman (DOI 10.1093/cje/ben057)

•*A Cyborg Manifesto* by Donna Haraway (see reference 46 below)


First Aid Kit

Good Tech

Apart from the absolute extreme ends of the debate, it is generally accepted that technology, in the broad understanding of the term, has the potential for good and bad, to help us or harm us. This can be through the technologies themselves, the manner in which they are used, or the contexts in which they exist and arise from. It can also be through the ideologies, values and ideas they are manifestations and reflections of. So how can good uses of technology, good technologies or good technological frameworks be defined?

Many considering this question have proposed various ideas for evaluating technologies based on certain characteristics. Here are a few framings that have been suggested.

Alternative Technology

The term 'alternative technology' was coined by Peter Harper in the 1970s to refer to more environmentally friendly alternatives to existing technologies. An alternative technology movement emerged soon after, partly due to having to deal with the reality of power cuts and fuel shortages during the 1973 oil crisis. It was characterised by concern over the impacts of industrial society and a desire to show workable, practical, small-scale alternatives. The 'alt tech' movement led to the establishment of a number of 'intentional communities' aimed at demonstrating the possibilities of low impact living. It also overlapped with the emergence of the concept of appropriate technology.

Appropriate Technology

Appropriate technology was an idea originally developed in relation to 'Third World' development projects. It was used to ascertain whether new technologies were consistent with the cultural and social traditions where they were being implemented, or whether they were damaging or destroying them. Influenced by economist EF Schumacher's 'Small is Beautiful' [90] the term took on a wider sense in the 1970s radical technology community: to examine whether or not certain technologies were 'appropriate' to the kind of societies they envisioned, particularly with respect to environmental impact.

Various features have been suggested for what constitutes an 'appropriate' technology and there isn't a single accepted definition.

Common themes often found in discussions on the subject include: scale, democratisation, ecological sustainability, and skills and know-how required to use the technology. A list of characteristics by John Clark gives a more in-depth definition of an appropriate technology, covering a range of concerns:

> •"low consumption of resources;
> •utilization of widely dispersed, renewable energy sources;
> •minimal disturbance of ecosystems;
> •human scale;
> •comprehensibility;
> •compatibility with aesthetic values;
> •feasibility of continual reassessment and fundamental redesign in relation to analysis of needs;
> •multifunctionality;
> •capacity to fulfill basic human needs;
> •tendency to reduce artificial scarcities;
> •incompatibility with technocratic and bureaucratic structures;
> •compatibility with democratic control of society, decentralized decision-making, and nonhierarchical social structures;
> •conduciveness to production processes involving enjoyment, creativity, and human development." [91]

Some criticise the appropriate technology movement for placing too much focus on individual technologies and not giving enough attention to the social contexts in which they are developed and applied. So even if a technology was designed according to well-defined appropriate principles, it may still end up creating or exacerbating social or ecological harm if, for example, it was used in a capitalist or authoritarian society.

The Precautionary Principle

The precautionary principle is an approach to risk management. It has various definitions and interpretations but can be broadly summarised as following the principle of 'caution practised in the context of uncertainty' in cases where the potential costs are extremely high. With a precautionary approach, if an action has a plausible risk of causing significant harm to the public or to the environment, then the burden of proof that it is not harmful falls on the people taking the action. If, for example, there is a possibility of irreversible damage to the global environment and there is no established scientific consensus on the level of risk, then the precautionary principle should be applied.

With new technologies, such as geo-engineering, a precautionary approach would mean those implementing technologies would be required to take on the responsibility for establishing whether or not that technology is harmful. If it were found to be potentially harmful then they would have to minimise or eliminate the harm. One issue with this is the potential lack of independence of those carrying out risk assessments. Techno-optimists tend to oppose the precautionary principle as applied to technology, arguing that it hinders technological advancement and the benefits it would bring. Many environmentalists cite the precautionary principle as central to the prevention of environmental damage.

Open, Free, Libre

'Open source' is a term that originated in the programming community, more specifically the free software movement, meaning software that could be freely used and modified by others, as opposed to a proprietary model where the programming source code has a legal owner. The Linux operating systems are perhaps the best known examples.

However, 'open source' has been criticised for veering from it's original intent and becoming depoliticised. Critics point out that it's good to be open to some things and not to others, as 'openness' is likely to be exploited by existing dominant systems of power. They say that in practice, open source means being open to the market and incorporated by capitalist economics instead of being a challenge to it. For example, corporations exploiting open source development to create new products which they then control and profit from. To counter this some prefer to use the term 'free software' or the French/Spanish word 'libre', to emphasise free in the sense of freedom (as opposed to price). FOSS (Free and Open Source Software) or FLOSS (Free/Libre Open Source Software) are also sometimes used to refer to both approaches together. Although some say this glosses over the fundamental difference between the open source and libre philosophies [92].

Nevertheless, the original principle of having open or free content that can be copied or modified without asking permission is popular and it has been applied far beyond computing software. As well as freeware, copyleft (as opposed to copyright) and creative commons material, there is an active Open-Design Movement and the open content philosophy has been applied to a huge range of areas, including open hardware. For example there are now 'open content' text books and education materials, building designs, vehicles and medical equipment. The idea has also been combined with that of appropriate technology: open content appropriate technologies try to include social, environmental and cultural considerations in their design and are free to be used, modified and distributed. There are ongoing debates on how to ensure that the original principles of free/libre content are maintained and how to stop it being exploited and incorporated by capitalist processes of technological development [93].

Conviviality

The idea of 'conviviality' in relation to technology was introduced by Ivan Illich in his 1973 book 'Tools for Conviviality' [94]. As with others previously mentioned, Illich is highly critical of the industrial mode of production. He described how the tools developed during industrialisation, while initially providing some benefit to society, came to dominate people instead of helping them. He said people became slaves to their tools: "tools overwhelm people and their goals," adding that mass production "extinguishes free use of people's natural abilities" [95]. People are kept in a state of dependence on elite members of society, "an out-of-control system in which the humans become worn-down mechanical parts". He describes the need to, "invert the present deep structure of tools" in order to reverse the relationship between people and tools.

By allowing people to make things that affect them and those around them Illich believes people would be able to connect with themselves and others, rebuilding the fabric of community. He argued for giving people the ability to shape technological objects and systems, according to their desires and needs: "People need not only to obtain things, they need above all the freedom to make things among which they can live, to give shape to them according to their own tastes, and to put them to use in caring for and about others."

Illich believed that tools created and used in this way would encourage a "graceful playfulness" in personal relations, which he summed up by calling such tools 'convivial'. These tools would "foster conviviality to the extent to which they can be easily used, by anybody, as often or as seldom as desired, for the accomplishment of a purpose chosen by the user." He explains his use of terminology: "I choose the term "conviviality" to designate the opposite of industrial productivity. I intend it to mean autonomous and creative intercourse among persons, and the intercourse of persons with their environment; and this in contrast

with the conditioned response of persons to the demands made upon them by others, and by a man-made environment."

Technological conviviality had widespread influence, particularly in the early conception and design of personal computers and the internet. It is still a guiding principle for many seeking to create new cultures of or approaches to technology. "A convivial society would be the result of social arrangements that guarantee for each member the most ample and free access to the tools of the community and limit this freedom only in favor of another member's equal freedom."

Feminist Technologies

There are various ways in which a technology could be considered a 'feminist technology'. For example, it could be in the design process and how the technology was brought about. It could be in the technology itself relating to or having specific implications for women or feminism. It could also be in the way the technology is used by women or men. In addition, there is a lot of variation between different schools of thought on what feminism means and therefore how this would be manifested in technologies. Further complexities arise from the varying understandings of technology and gender, and the fact that the concept technology itself is gendered.

In some cases there is also significant disagreement over the implications of specific technologies for women. For example reproductive technologies have sometimes been identified as means of extending patriarchal control over reproduction [96]. On other occasions they are seen as enhancing women's freedoms and control over their bodies [97].

Various suggestions have been made for the basis of what could constitute a 'feminist technology'. Linda Layne suggests a concise definition:

"technological innovations that would enhance women's lives through women's agenda to make them equal" [98].

Deborah Johnson suggests the following different ways of exploring the idea of feminist technology [99]:

- Technologies that are good for women
- Technologies that constitute gender-equitable social relations
- Technologies that favor women
- Technologies that constitute social relations that are more equitable than those that were constituted by a prior technology or than those that prevail in the wider society

In her analysis, Johnson discusses how socio-technical systems are made up of technological artefacts and the social relations associated with them. She says exploring the question of feminist technology requires looking at both the materiality of the artefacts themselves and the socio-technical systems in which they exist. For her, although it may not be possible to say whether a specific technology or system is 'feminist', the important thing is that technology stays in the sights of the feminist social movement.

An example of an attempt to apply the concept of feminist technology is the 'Feminist Principles of the Internet' which lists 17 key principles following this introduction:

"A feminist internet works towards empowering more women and queer persons – in all our diversities – to fully enjoy our rights, engage in pleasure and play, and dismantle patriarchy. This integrates our different realities, contexts and specificities – including age, disabilities, sexualities, gender identities and expressions, socioeconomic locations, political and religious beliefs, ethnic origins, and racial markers." [100]

Questions

Some questions when considering what constitutes 'good technology':

-How can concepts such as appropriate technology and conviviality be applied in a manner which helps challenge capitalism and authoritarianism rather than simply 'polishing the technological turd'? How can these ideas be effectively deployed to influence broader understandings of technology in society?

-How can people be convinced to sacrifice some degree of ease and comfort in adopting non-corporate, community-controlled alternative technologies?

-What new framings of 'good technology' can be developed from combining and experimenting with ideas such as appropriate, convivial, libre and feminist technologies? How do they apply in real-world examples of social and ecological contexts?

-How can ideas such as 'open source' or 'open content' be adapted so they are not open to everything? I.e. not open to being exploited by existing systems of domination and exploitation. How can libre/free, copyleft and non-proprietary models of technological design and sharing be promoted and popularised? How can these and other ideas such as 'conviviality' be prevented from being coopted by capitalism?

Recommended Reading:

•*Feminist Technology (Women Gender and Technology)* by Linda Layne, Sharra Vostral and Kate Boyer (ISBN 978-0252077203)

•*Tools for Conviviality* by Ivan Illich (ISBN 978-0714509730)

Now

Part of the aim of this book is to help people think about technology in the context of situations currently faced. Multiple overlapping ecological crises, increasingly powerful authoritarian states and corporations, and the vast gulfs in wealth and power that exist between and within societies. As we write the effects of the Covid-19 pandemic are reverberating around the world. What role did technology play in bringing these situations about, and what role might it play in changing them?

Related to this, existing technologies or those already in development pose serious threats. For example, technologies which enable ever greater manipulation of the natural world, whether from the construction of DNA to create 'synthetic life', through to the geo-engineering of the planet's climate systems, to mining asteroids or the moon. There are technologies of social control that enable governments and corporations to track, predict and control populations with ever-increasing efficacy. Then of course, there is the often ignored but ever-present shadow of nuclear weapons, the Cold War legacy of mutually assured destruction, and the continually expanding powers afforded by other military technologies.

In this section we look at a couple of specific areas, broadly outlining the issues and proposing some considerations. First we consider how technology affects the tension between social change and social control. Next we discuss how it relates to the global ecological situation. Finally, we make some suggestions for more general approaches for how to change attitudes and improve understanding of technology. We briefly propose some ways to think about technology in relation to other social forces in order to make more effective strategies for change.

Transhumanism

This is the movement supporting the idea that humans can and should radically transform themselves through the use of technology into what is sometimes called a 'posthuman' condition (although the term 'posthumanism' has differing meanings). This might be, for example, greatly extending human lifespan or enhancing human physical or mental capabilities. Technologies that could be used towards transhuman ends include genetic manipulation, cryonics and increasing integration between humans, computers and artificial intelligence. Transhumanism is sometimes associated with the so called 'tech singularity' (see below), where humans

merge with rapid, exponentially 'advancing' technology.
There are obvious serious ethical concerns with the aim of 'surpassing' or 'improving' the human condition. These are common themes to many works of science fiction, perhaps most famously explored in Brave New World by Aldous Huxley. Huxley presents a dystopian future in which humans are categorised according to an intelligence-based social hierarchy. Those at the bottom of the ladder are kept docile and subservient, facilitating their exploitation, while those at the top enjoy greater freedoms and luxury.

As well as issues around social inequality, ethical objections to transhumanism include those stemming from concerns around ableism. If transhumanism seeks to improve humans by enhancing their abilities, what does this say about those with disabilities? Do they need 'improving'? Is being more able, better? Some critics of transhumanism say it has parallels with eugenics in seeking to create 'superior' humans.

Although we are continually altering ourselves through technology, trying to deliberately change from being humans to something 'better' has profound ethical and other philosophical implications. This is especially true given the continuing conundrum of defining and understanding the human condition, of considering what it means to be human.

Social Change vs. Social Control

As discussed above, technologies are becoming increasingly powerful and widespread in controlling populations [101]. Technology also forms part of the strategic terrain in the struggle between those seeking to change societies and those trying to preserve the status quo.

So how can technology be best utilised to help bring about the radical social change required to address the various ecological and social crises we are faced with? For example, how can the advances in

communication technologies increase the power of movements for change? How can they be used to increase awareness of inequality, environmental destruction etc., to spread ideas and build desire for change and belief in its possibility? How can these technologies be designed and used in a way which enables those struggling for change rather than those that seek to repress or control them? And how can these technologies remain tools instead of being seen as solutions in themselves?

Many corporate communication technologies are used by social movements to communicate and organise, and often the very same tools are used to surveil and repress them [102]. In the uprisings in Egypt during the Arab Spring, Facebook was used to organise protests and spread messages of dissent. But when the new military regime took power, it also proved an invaluable tool in tracing the participants and networks of organisers, leading to arrests, imprisonment and execution.

Further examples can be seen in the the 2018-19 wave of uprisings, sometimes called a "global rebellion against neoliberalism" [103]. They continued to be characterised by the use of mainstream social media platforms, sometimes with great success, although tactics and strategies on both sides had evolved [104].

In Hong Kong in 2019-20 a variety of anti-surveillance measures were used, including umbrellas to protect against facial recognition technologies and destruction of "smart city' lamp posts, suspected of housing surveillance sensors [105] [106]. The increased use of internet blackouts by authorities in many countries was countered by using satellite internet or waiting until the blackout had ended to spread information. In other examples governments chose to leave communications channels functioning so they could be monitored. In many cases end-to-end encryption on commercial apps such as

Whatsapp, Signal or Telegram were used by protesters which in turn were targeted by hacks by governments seeking to quell protests. This is an example of the common cycles of counter-strategies that emerge around the use of new technologies in protest movements.

Such dynamics were also played out along the lines of spreading information and misinformation. In Chile, mobile phones were used to document and highlight acts of repression and brutality [107], also a powerful tactic used in the Black Lives Matter protests of 2020. In Iraq, Iran and China, states deployed 'electronic armies' and bots to discredit movements and spread misinformation, which also provoked counter-measures [108].

Aside from communication technologies there is an ever expanding arsenal of physical repression technologies ('tear' gasses, sound weapons, heat weapons, smart water, smelly water, tasers, baton rounds and other 'less lethal' weapons, drones equipped with 'crowd control' weapons, etc.) which are also met with evolving response strategies from protesters [109].

In many cases, social movements are able to adopt and utilise technologies faster than state institutions are able to respond. By staying ahead of the game they can out-manoeuvre those seeking to control them. When the authorities catch up, movements can often adapt, only using particular modes or methods of communication while they remain effective.

In terms of the technologies used, there are often secure alternatives to corporate-controlled and state compromised communication tools, but there is a difficulty in convincing people to use them. The stranglehold that corporations have over information networks is hard to escape from. However, the situation could improve with a change in attitudes to privacy, personal data and digital freedoms.

If the digital world is treated as another terrain of struggle and effective strategies adopted, it could shift the balance of power towards those who seek liberatory change rather than those seeking to control and exploit [110].

Helping foster relationships of trust and mutual understanding between those who develop alternative communications technologies and the movements that use them also helps break the state/corporate dominance. The more those with expertise are embedded within the community of users, the more relationships are built and skills and knowledge spread. This also helps ensure that technologies are usable and relevant to the specific needs of the community.

Below we further discuss the ways in which attitudes, framings and strategies related to technology can support those struggling for radical social change.

Geo-engineering

Geo-engineering is a way of seeking to reverse climate change by large scale intervention in the Earth's climate. The solutions put forward usually involve trying to reflect solar radiation back into space or remove and store carbon dioxide from emission sources or the atmosphere. There are a variety of proposed techniques for both, including spraying sea water or other particles into the air, producing and burying charcoal, capturing carbon dioxide emissions from power plants, painting rooves and other surfaces white and even putting mirrors in space.

There are unresolved scientific and economic questions over the viability of geo-engineering approaches and serious concerns over possible, potentially devastating, unintended consequences (see 'technofixes' below). There are also criticisms that it diverts attention away from efforts to

mitigate climate change by reducing emissions and changing the underlying political and economic systems creating the problem.

On top of all this, there are fundamental ethical and political issues over the use of geo-engineering, for example how to get consent for planetary-scale interventions that will affect everyone and their potential to reinforce unjust power relations and inequality [111]. Some forms of geo-engineering could be viable, for example large-scale afforestation (planting new forests), however only if carried out under very specific conditions that fully account for social, ecological, political and cultural contexts and consequences [112].

Technology and Ecology

There are two fairly distinct and competing views on the relationship between technologies and ecological crises such as climate change, although there is variation in the focus and framing of each.

One involves an acceptance that the immensity and imminence of ecological crises means there is no hope of making fundamental societal changes in time. Instead, it suggests people should harness the power of technology as it exists within the current capitalist, statist framework to find technological fixes or solutions to ecological crises (e.g. developing and using genetic engineering and geo-engineering, mining asteroids to overcome resources constraints, even populating other planets).

Accelerationism and ecomodernism are both attitudes which fall within this kind of approach. Some also suggest that similar technological solutions can be used to undermine capitalist exploitation at the same time (e.g. using automation to free people from the chains of wage labour).

However, this represents a dangerous 'technofix' mentality, where people rely on technology to provide solutions to all manner of problems, even when such technologist thinking helped create them in the first place.

Technofixes

Using 'simple' technological interventions to solve complex problems. Part of the problem with this approach is that it tends to narrow focus on the problem, meaning that the wider systemic context is ignored [113]. This can result in unintended consequences, resolving the problem in one area only for it to pop up in another. Although perhaps not a use of 'technology' per se, the introduction of cane toads in Australia is a classic example. Intended as a way of controlling native cane beetles, cane toad populations exploded resulting in severe disruption of Australia's sensitive ecology. The use of DDT as a pesticide is another example, resulting in widespread harm to wildlife and human health before eventually being banned.

The prevalence of techno-optimism and the lack of critical perspectives on technology in society means that such approaches are extremely common. As a result, those who are minded to remedy environmental problems often end up proposing technological solutions without realising the dangers of over-reliance on technologies. Technofixes are also popular with politicians and corporations as they provide easy quick 'fixes' that can be sold as solutions, diverting attention from systemic approaches.

Beyond ecology, there are countless examples of technofixes being applied to social problems. They suffer from a similar lack of systemic perspective and frequently result in further unintended consequences [114]. For example 'iatrogenic' medical practices which cure one problem only to create another, or tear gas inflaming crowds and leading to riots.

The controlling and dominating attitude to nature, that sees it as something to exploit for human ends, is a root cause of global ecological crises [115]. It fails to recognise how we are part of nature and the ecosystems that we rely on for survival, creating an illusion of independence. Of course nature is not all cute and cuddly, but in attempting to dominate it and bend it to their will, humans end up harming themselves. That's not to say that humans can't seek to flourish as part of wider nature. But to do so requires a reciprocal rather than instrumental relationship, one that recognises nature's inherent value.

The dominant modern conception of technology is based on an anthropocentric perspective. As a result, relying on technological solutions to environmental problems further entrenches the same kind of thinking that contributed to our current predicaments. If you go around believing yourself superior to nature, then sooner or later it will come back to bite you in the arse, figuratively -or in the case of some trophy hunters- literally (and indeed, poetically).

A technofix approach also risks creating an unending chain of technological 'solutions' leading to further problems requiring more technology to solve them. The greater the focus on technical solutions, the more it risks technology becoming the end rather than the means.

Alternatives share an approach of constraining certain technologies and attempting to undermine and subvert the growth paradigm instead of accelerating it. The degrowth movement for example seeks to end growth-based economics and replace it with a form of ecological economics that prioritises well-being for all and ecological sustainability.

Opposing technological accelerationalism or critiquing a technofix mentality doesn't mean being 'anti-technology'. Technology (in the

broad sense) can still be something to be celebrated and enjoyed, an expression of creativity and a powerful tool at our disposal. But it must be de-constructed and re-imagined so that it no longer embodies ideologies based on domination and exploitation, of humans and nature. It must also remain a tool and not an aim in and of itself, the means must not become the end.

GM and Synthetic Life

Genetic modification (GM) or engineering is the direct manipulation of an organism's genes. It involves transferring a piece of DNA from one organism to another in order to achieve certain desired characteristics. Synthetic biology involves designing and building life forms, or parts of them, including the construction of new genes, instead of just taking them from existing organisms (although it still relies on and replicates 'natural' processes).

There are many ethical, ecological and political issues raised by genetic modification and synthetic life and there has been widespread opposition to and protests against the introduction of the technologies around the world. The role of patents over life and life-saving technologies has been a significant source of contention, particularly in how they control access and centralise control. Other objections include those based on the risk of contamination through uncontrolled proliferation of GM organisms, the commodification and ownership of lifeforms or DNA, and the increased dominance of industrialised agriculture or corporate power in general.

Attitudes to Technology

Spreading a critical understanding of technology is a crucial part of challenging and transforming the role that it plays in society.

To summarise what has been covered in the previous sections, we highlight the following as key areas where the current dominant attitude towards technology can be contested and alternative critical approaches cultivated:

Questioning progress. Challenging the common association of technological advancement with human progress. Critiquing the ideas of civilisation and progress more broadly. Learning from other cultures, traditions and systems of knowledge that have been erased or ignored.

Humans and nature. Start from an understanding of humans being part of nature, not separate from or superior to it. Then seek ways to use technology that encourage harmonious relationships with nature instead of attempting to dominate it.

Mutual shaping. Understanding technology and society being in dynamic relationship with one another. Not viewing technology as just the most efficient means to achieve an end, nor as an end in itself, but as reflecting many ends and considerations and being part of wider culture.

Taking control. Not viewing technological development as being uni-directional or evolving under it's own volition. Seeing the direction of technology as a 'garden of forking paths' with choices to be made. Taking control of technology away from capitalism and states and promoting democratic participation, where technology is a 'commons' for all to share.

Neither good, bad nor neutral. Not seeing technology as inherently good or bad, but recognising that it is imbued with politics and values. Understanding technologies as embodying underlying ideologies and ways of understanding the world.

Reimagining technology. Mixing ideas such conviviality, cyborgism, appropriate technology, free/libre, hacker culture. Ensuring technologies are empowering for minority groups instead of reinforcing inequality and identity-based oppression. Utilising creativity and experimentation in creating new technological realities.

Some questions for reflection on changing attitudes to technology

- How can the techno-optimist narrative be challenged and replaced by a more nuanced critical view of technology, one that understands the complexities of technology and how it is inseparable from society and our relationship with nature? For example in popular culture, in works of fiction and art, in political discourse. Under this nuanced view, what would technology be used for and what would be its limits?

- How can existing critical perspectives on technology be amplified and spread?

- How can critiques of capitalism, and domination of people and non-human nature be incorporated in critiques of technology?

- Are there ways to promote appealing, exciting attitudes? Ones that encourage an imaginative exploration of the possibilities technology allows without falling into the trap of relying on it entirely, viewing it as the solution to all our problems or being an end in itself.

- What can be learned from previous or existing struggles around technology (privacy activism, 'sustainable' energy, campaigns against military technologies, anti-GM campaigns, tech industry unionisation)? And how can these lessons be shared most effectively?

Models

As well as changing attitudes to technology, models of how it functions and interacts with other aspects of society can aid transformation of political and economic systems.

The idea of socio-technical assemblages can help in this regard. It recognises that a given system or assemblage consists of multiple aspects, which include people, behaviours, technological artefacts and systems, trends in technological usage, communications infrastructure, attitudes to technology etc. This helps in two ways. Firstly it moves away from the constrictive framings of technological determinism vs social constructivism. Instead it helps illuminate the complex real-world interactions and feedbacks between people and technologies, allowing for an exploration of the merged/hybrid socio-technical world. It also breaks down the primitivist/techno-optimism dichotomy and encourages the exploration of how ideas such as appropriate, free/libre and convivial technology can interact with social movements and real-world political scenarios.

With critical attitudes and contexualised understanding of the functioning of technology, effective strategies can be formulated.

Strategies

At the time of writing, the Covid-19 pandemic, itself partly a consequence of our exploitative relationship with nature, is having huge impacts on economics, technology and society. In the context of unfolding ecological catastrophe, much greater, seismic changes are ahead of us.

As the reality of these ecological crises become apparent it seems that much of current technological infrastructure will soon be unsustainable.

But this also presents opportunities for salvage, reconstruction, re-purposing and re-invention. Hacker culture has the potential to help guide through these changes in the technological landscape, with its focus on creativity, play and subversion.

Change is certain, but what form of change takes place is still to be determined. Social movements seeking to direct change towards liberatory, equal, ecological societies can form strategies incorporating critical approaches to technology. Communication technologies can be used to form alliances based on affinity and to exploit and spread moments of rupture.

If technology is viewed as an integral part of the shifting social, ecological and political contexts, attitudes to and uses of technology can play a part in changing those contexts. Ideas like hackerism and cyborg alliances, conviviality and degrowth can help form strategies including desertion and sabotage, disruption and subversion, experimentation and reconfiguration.

Some questions to consider on technological strategies:

- What strategies can be employed to avoid being monitored, modelled and incorporated within cybernetic systems of control? How can this be balanced against the need to communicate and effectively organise at scale?

- How can strategies on technology be developed and shared without them being undermined by authorities knowing about them? Can principles and strategic approaches be openly discussed and still remain effective? How would such principles and approaches be affected by local contexts?

- How can lessons learned around the use of technologies be best communicated between struggles across geographies and timescales? Are there general principles to follow in situations of asymmetrical power (as with guerrilla warfare)? How can these principles be effectively and democratically applied by protest movements?

- Under an assemblage view of technology, how can the reduction of people to mere cogs in the socio-technical apparatus be avoided (as with cybernetics and technocracy)? How can the effects of technological artefacts be incorporated in assemblages without treating them as if they had the same kind of agency as people?

- How can technologies that are creating ecological collapse be effectively opposed? How can techno-optimist or technofix approaches to ecological struggles be critiqued and countered?

- How can the development, use and effectiveness of technologies of social control be limited and reversed? How can their normalisation be prevented? How can people take back control of their data and information? How can attitudes to privacy and digital freedom be changed?

- How can the transition from corporate/state control of technology to a technological 'commons' be brought about? What are the steps along the way? How can gains be made permanent to ensure that control isn't clawed back? What features would define such a technological commons?

The Future

So how might we use technology in imagined future societies? And how might technology be used to get there?

Sci-fi

Science fiction provides a powerful way to explore the possibilities and implications of new technologies. Speculative fiction, which overlaps with science fiction, describes possible alternative worlds, how things could have been. For example, from the more traditional sci-fi realm: What if faster than light space travel were possible? But also, imagining what reproductive technologies look like in a future feminist society, or a scenario where social media bots secretly collaborated to overthrow their Silicon Valley masters. Producers of speculative and science fiction have used imagination and creativity to delve into future worlds that technology could bring about. From dark dystopian premonitions to shining visions full of possibility and hope, all kinds of directions have been described, explored and reflected upon.

"the boundary between science fiction and social reality is an optical illusion" Donna Haraway [116]

Artificial Intelligence

Machines (usually computers) carrying out tasks requiring 'intelligence'. 'Hard' artificial intelligence is the idea that sufficiently sophisticated computers could actually think or become conscious, whereas 'soft' artificial intelligence describes computer's ability to simulate thinking. If hard artificial intelligence is proved correct, creating artificial consciousness or 'life' would have enormous implications for society: ethically, culturally and politically. This is something that has been explored in numerous works of science fiction (see 'singularity' box). Machine learning is a branch of artificial intelligence based on 'teaching' computers or systems to learn from experience, where systems learn from data and improve based on what they learn, rather than being explicitly

programmed. For example, self-driving cars could 'learn' to drive by studying human drivers and their reactions to various situations and environments. Even if hard artificial intelligence proves to be wrong, the implications of machine learning and the application of artificial intelligence are profound. The increased power to measure, model, replicate and predict human behaviour has huge implications in terms of culture, automation and social control [117].

Some writers have introduced ideas that have a had a direct influence on those developing technologies today. For example, Asimov's three laws of robotics were introduced and explored in his writing to consider the ethical implications of robots and artificial intelligence. His work has influenced researchers in the field in developing their own principles and the ethics of artificial intelligence is now an active and important area of research, especially as automated cars and weapon systems are becoming more widely used (although debating ethics with an automated weapon systems may prove to be somewhat one-sided).

The darker side of technological possibility has been extensively described in science fiction. Authors such as Aldous Huxley, George Orwell, Philip K. Dick and Margaret Atwood have detailed dystopian worlds where nightmarish technological scenarios are played out.

"If science fiction is the mythology of modern technology, then its myth is tragic" - Ursula Le Guin [118]

Two excellent examples often referred to as 'utopian' sci-fi or speculative fiction, are Ursula Le Guin's 'The Dispossessed' [119] and Marge Piercy's 'Woman on the Edge of Time' [120]. Both consider possibilities of how future societies might function and the role that technology could play in them, but with a healthy dose of gritty realism.

"Science fiction frees you to go anyplace and examine anything." Octavia E. Butler [121]

Tech Singularity

The technological singularity is the idea that at some point in the future technology will advance extremely quickly and uncontrollably, perhaps representing a new phase of life on earth. The term 'singularity' here means something that increases towards infinity in a finite amount of time, in this case, technological sophistication. For example, if true artificial intelligence (AI, see above) were created, it is proposed that it could then improve itself more and more rapidly, far surpassing human intelligence and become unimaginably advanced. Such a tech singularity is treated as fanciful, implausible or absurd by many experts, but it remains popular in online tech communities and has some notable and powerful supporters (such as billionaire-buffoon Elon Musk). Some fear that it could result in human extermination (a common theme in many works of science fiction). There is even a cult-like following of the idea, with those who say a thought experiment known as 'Roskos Basilisk' means human society should focus on attempting to appease a coming tech singularity kind of deity. We, for one, welcome our future robot overlords ;)

Science fiction can help us envision possible futures and in doing so allow us to navigate the changing landscape ahead, a way of the guiding us through the unknowable.

"Science fiction doesn't predict the future – because the future isn't predictable, it's contestable. Science fiction signposts allegedly inevitable things that we do not need to accept, let alone excuse."
- Cory Doctorow [122]

Solar Punk

Solar punk is both sub-genre of science fiction and social and cultural movement. It has its roots in radical environmentalism and is a counter to the trend of pessimism and apocalyptic fatalism inspired by the threats of ecological catastrophe and social collapse. Its name derives from cyberpunk, a dystopian sci-fi genre, and steampunk, a retrofuturist subgenre which features Victorian fashion and technology, particularly steam power. Solar punk retains elements of the punk attitude and aesthetic but with a more positive vision of the future. It also seeks to avoid naive optimism, and instead explores the possibilities of post-capitalist near-future worlds utilising renewable energy and organised in decentralised, horizontal communities. Its aesthetic includes influences from Art Nouveau and Afrofuturism, and it celebrates hybrid cultures, craft and a DIY attitude. It looks to reconnect humans to nature and blends low and high tech together. As well as imagining futures, solar punk is about how to realise them, an attempt subvert, challenge and replace the existing economic and social systems causing ecological collapse and social inequality and domination.

Future Revisited

As well as speculative and science fiction, perhaps learning and inspiration can be found in ideas that have been around for much longer: indigenous knowledge systems, and worldviews and systems of thought from other cultures that have been overshadowed or deliberately undermined by colonialism and the predominance of modern 'scientific-Western' thinking.

What role did or does 'technology' or crafts play in these cultures?

What systems and practices formed around their use of tools and how might we learn from them in shaping future technological relationships?

How can it be ensured that indigenous and other cultural knowledge is approached respectfully? How can meaningful relationships be established that don't recreate colonial practices, where other knowledge systems are just treated as another resource for colonialists to extract and consume?

Final Words

Maybe we shouldn't be trying to find an answer to the question of what role technology should play in a utopian society. Society is a continual process of change, there is no end goal, just better directions.

That's not to say we shouldn't imagine, desire and provoke. Putting forward creative visions of the future can be a powerful way to inspire and direct us, to challenge what is currently considered possible or inevitable.

But instead of trying to finally resolve the question of technology, or creating a blueprint for a how it would operate in the future, we could see it as part of our multidimensional world. It can't be separated from the contexts in which it exists, but it can be used to change them. It is both a fundamental part of the terrain in which we find ourselves and a tool in the process of movement.

We can view technology not just as a simple means to achieve a specific end (or worse, an end in itself) but as creative practice imbued with cultural and ethical considerations, with a plurality of ends, with beauty.

Technology is ultimately bound up in how we relate to each other and the world around us, how it manifests is a reflection of our way of understanding existence.

"Each new hour holds new chances for new beginnings....The horizon leans forward, Offering you space to place new steps of change."

Maya Angelou [123]

References

We of course wouldn't encourage their use, but there are various 'naughty' ways of accessing electronic books and academic papers for free on the internet. Those wishing to investigate such practices further could look up: z-lib , b-ok , booksc or libgen. The Anarchist Library (theanarchistlibrary.org) also has a lot of useful texts.

1.See the Intro Essay in MacKenzie, Donald A., and Judy Wajcman. *The Social Shaping of Technology: how the refrigerator got its hum*. Milton Keynes Philadelphia: Open University Press, 1985. ISBN 978- 0335150274

2. For an extremely detailed explanation of the word's origins, see Schatzberg, Eric. *Technology : critical history of a concept.* Chicago London: The University of Chicago Press, 2018. ISBN 978-0226583976

3. Arthur, W B. *The Nature of Technology: What it Is and How it Evolves*. New York: Free Press, 2009. ISBN 978- 1416544050

4. For such a history, see **Schatzberg 2018**

5. Ibid

6. Immanuel Kant "An Answer to the Question: What is Enlightenment?" (Was ist Äufklarung?) 1784 Available at: <http://web.mnstate.edu/gracyk/courses/web%20publishing/KantOnElightenment.htm> [Accessed 5 Nov 2020].

7. Federici, Silvia. *Caliban and the Witch*. New York London: Autonomedia Pluto, distributor, 2004. Print. ISBN 978-1570270598

8. Cattunar, B. *Gender Oppression In The Enlightenment Era.* 1st ed. [ebook] HSNSW, 2014. Available at: <http://www.hsnsw.asn.au/articles/WomenOfTheEnlightenment.pdf> [Accessed 5 Nov 2020].

9. For example see: O'Brien, Karen. *Women and Enlightenment in Eighteenth-Century Britain*. Cambridge: Cambridge University Press, 2009. ISBN: 9780521774277

10. Wollstonecraft, Mary. *A Vindication of the Rights of Woman* (1792). Available at: <http://www.gutenberg.org/ebooks/3420> [Accessed 5 Nov 2020].

11. Shelley, Mary W., James Kinsley, and M. K. Joseph. *Frankenstein: or, The Modern Prometheus*. Oxford New York: Oxford University Press, 1980. Print. ISBN 978-0199537167

12. Schatzberg 2018

13. Ibid

14. Oldenziel, Ruth. *Making Technology Masculine: Men, Women and Modern Machines in America, 1870-1945.* Amsterdam: Amsterdam University Press, 1999. Print. ISBN 978-9053563816

15. Carson, Rachel, Linda J. Lear, and Edward O. Wilson. *Silent Spring.* Boston: Houghton Mifflin Company, 2002. Print. ISBN 978-0618249060

16. Bacon, Francis. *Novum Organum* (1620)

17. Quote from: Merchant, Carolyn. *The Death of Nature: Women, Ecology, and the Scientific Revolution*. New York: Harper & Row, 1989. Print. pp. 168-172. ISBN 978-0062505958

18. Remaining quotes from: Fideler, David R. *Restoring the Soul of the World: Our Living Bond with Nature's Intelligence.* Chapter 8, "In the Name of Utility: The Exploitation of Nature and the Decline of Pleasure." Rochester, Vermont: Inner Traditions, 2014. Print

19. Quote from the Columbia Broadcasting System's television series "C.B.S. Reports" - "The Silent Spring of Rachel Carson." On April 3, 1963. According to <https://www.rachelcarson.org/mRachelCarson.aspx> [Accessed 5 Nov 2020]

20. **Merchant 1989**

21. Merchant, Carolyn. *Reinventing Eden: The Fate of Nature in Western Culture.* New York, NY: Taylor and Francis, 2013. Print. ISBN 978-0415644259

22. Foster, John Bellamy *"Marx's Theory of Metabolic Rift"*. American Journal of Sociology. 105 (2): 366–405. 1999. doi:10.1086/210315.

23. Read more here: Matthew Gindin. *What Is Metabolic Rift?* Aug 3, 2018
<https://medium.com/@MatthewZGindin/what-is-metabolic-rift-632452a00860> [Accessed 5 Nov 2020] and here: Elizabeth Terzakis. *Marx and Nature*

Why we need Marx now more than ever. International Socialist Review Issue #109:
<https://isreview.org/issue/109/marx-and-nature>
[Accessed 5 Nov 2020]

24. Quote taken from **Schatzberg 2018**: K. Marx, Capital, 3rd ed., 1:352n2; K. Marx, Capital (1976), 1:493; Marx and Engels, Werke, 23:392n89.

25. Bookchin, Murray (published under pseudonym Lewis Herber). *Towards a Liberatory Technology.* Anarchos, no. 2 (Spring 1968) and No. 3 (Spring 1969)

26. Truscello, Michael; Gordon, Uri. *Whose Streets? Anarchism, Technology and the Petromodern State.* Anarchist Studies. 21.1 2013 ISSN 0967 3393 <https://www.lwbooks.co.uk/anarchist-studies/21-1/whose-streets-anarchism-technology-and-petromodern-state> [Accessed 5 Nov 2020].

27. Out of the Woods. *Murray Bookchin's Libertarian Technics.* Libcom.org 2014
<https://libcom.org/blog/murray-bookchins-libertarian-technics-11032014>
[Accessed 5 Nov 2020]

28. Shapin, S. *History of Science and its Sociological Reconstructions.* History of Science, 20(3), 157–211. (1982). https://doi.org/10.1177/007327538202000301

29. Haraway, D. Situated Knowledges: *The Science Question in Feminism and the Privilege of Partial Perspective.* Feminist Studies, 14(3), 575. (1988). https://doi.org/10.2307/3178066

30. Whitt, Laurelyn. S*cience, Colonialism, and Indigenous Peoples: The Cultural Politics of Law and Knowledge.* Cambridge New York, NY: Cambridge University Press, 2009. Print. ISBN 978-1107675070

31. Lynn White, jr. *Medieval Technology and Social Change. New York: Oxford University Press. 1962. Pp. ix, 194, 10 plates. (1962).* The American Historical Review. https://doi.org/10.1086/ahr/68.1.93

32. Winner, Langdon. *Do Artifacts Have Politics?* in Daedalus, Vol. 109, No. 1, Winter 1980. Reprinted in *The Social Shaping of Technology,* edited by Donald A. MacKenzie and Judy Wajcman. London: Open University Press, 1985; second edition 1999

33. Winner, Langdon. T*he Whale and the Reactor: A Search for Limits in an Age of High Technology.* Chicago: University of Chicago Press, 1989. Print. ISBN 978-0226902111

34. Joseph Weizenbaum, quoted in McCorduck, Pamela. *Machines Who Think: A Personal Inquiry Into the History and Prospects of Artificial Intelligence.* Natick, Mass: A.K. Peters, 2004. Print. pp.356, 374–376 ISBN 978-1568812052

35. Bradley, Arthur. *Originary Technicity: The Theory of Technology from Marx to Derrida.* Houndmills, Basingstoke, Hampshire New York: Palgrave Macmillan, 2011. Print. ISBN: 978-0230576926

36. Bruland, Tine. *Industrial Conflict as a Source of Technical Innovation: The Development of the Automatic Spinning Mule.* Essay in **MacKenzie and Wajcman 1985**

37. Hickel, Jason. *The Divide: A Brief Guide to Global Inequality and its Solutions.* London: Windmill Books, 2018. Print. ISBN 978-1786090034

38. Quote from Milwaukee Art Museum website <https://mam.org/collection/archives/brooks/> [Accessed 5 Nov 2020]

39. Marcuse, Herbert. *One-Dimensional Man:Studies in the Ideology of Advanced Industrial Society.* London: Routledge, 1991. Print. ISBN: 978-0-415-07429-2. (text available online here: <https://www.marcuse.org/herbert/pubs/64onedim/odmcontents.html> [Accessed 5 Nov 2020])

40. Ellul, Jacques. *The Technological Society.* New York: Vintage Books, 1964. Print. ISBN: 978-0394703909

41. Quote from: Fasching, Darrell J. *The Thought of Jacques Ellul: A Systematic Exposition.* New York: E. Mellen Press, 1981. Print. pp.17. ISBN: 978-0889469617

42. Intro Essay in **MacKenzie and Wajcman 1985**

43. Deleuze, Gilles, Félix Guattari, and Michel Foucault. *Anti-Oedipus: Capitalism and Schizophrenia.* New York: Penguin, 2009. Print. ISBN: 978-0143105824

44. Deleuze, Gilles, and Félix Guattari. *A Thousand Plateaus: Capitalism and Schizophrenia*. Minneapolis: University of Minnesota Press, 1987. Print. ISBN: 978-0816614028

45. Huxley, Aldous. *Ends and Means: An Inquiry into the Nature of Ideals.* New Brunswick, N.J: Transaction Publishers, 2012. Print. ISBN: 978-1412847445

46. Haraway, Donna. *A Cyborg Manifesto*. Socialist Review, 1985. (Full text available online here: <https://sites.evergreen.edu/politicalshakespeares/wp-content/uploads/sites/226/2015/12/Haraway-Cyborg-Manifesto-2.pdf> [Accessed 5 Nov 2020])

47. Tiqqun, *The Cybernetic Hypothesis,* <http://cybernet.jottit.com>[Accessed 5 Nov 2020]

48. Georges Boulanger. *Dossier on Cybernetics: Utopia or Science of Tomorrow in the World Today, 1968.* (Quote from The Cybernetic Hypothesis [47])

49. For examples of technologies not adopted see:
-Intro Essay in **MacKenzie and Wajcman 1985**
-Edgerton, David. *The Shock of the Old: Technology and Global History since 1900.* Oxford New York: Oxford University Press, 2007. Print. ISBN: 978-0199832613
-Morison, Elting E. *Men, Machines, and Modern Times.* Cambridge, Mass: M.I.T. Press, 1966. Print. ISBN: 9780262630184

50. Quote from interview: *Margaret Atwood on books: "Push comes to shove, they're great insulating material".* Salon.com. Sep 2013 <https://www.salon.com/2013/09/08/margaret_atwood_on_books_push_comes_to_shove_they%E2%80%99re_great_insulating_material> [Accessed 5 Nov 2020])

51. Drexler, K E. *Engines of Creat*ion. Garden City, N.Y: Anchor Press/Doubleday, 1986. Print. ISBN: *978-0385199735*

52. Collingridge, David. *The Social Control of Technology.* New York: St. Martin's Press, 1980. Print. *ISBN: 978-0312731687*

53. Noble, David F. *Progress without People: New Technology, Unemployment, and the Message of Resistance.* Toronto, Ont. Between the Lines, 1995. Print. p63. ISBN: 978-1896357003

54. For more on this, there is the classic text by Marx on the use of innovations in industrial machinery to protect capitalists' interests and to control and suppress the labour force: Marx, *The Machine versus the worker.* For a more recent exploration of capitalist influence on technology see: Noble, David F. *America by Design: Science, Technology, and the Rise of Corporate Capitalism.* Oxford: Oxford University Press, 1979. Print. ISBN: 978-0195026184

55. crimethinc.com *The Internet as New Enclosure.* <https://crimethinc.com/2013/06/10/the-internet-as-new-enclosure> [Accessed 5 Nov 2020]

56. Return Fire. *Caught in the Net. Return Fire vol. 4.* Autumn 2016 (Available at Anarchist Library <https://theanarchistlibrary.org/library/return-fire-vol-4-supplement-caught-in-the-net?v=1501280195> [Accessed 5 Nov 2020])

57. *Data Justice and COVID-19: Global Perspectives.* London: Meatspace Press, 2020. Print. (also available in digital format from <https://shop.meatspacepress.com/product/data-justice-and-covid-19-global-perspectives> [Accessed 5 Nov 2020])

58. For more on this and other readings related to the Covid- 19 pandemic, see: <https://corporatewatch.org/understanding-coronacapitalism> [Accessed 5 Nov 2020]

59. Gordon, Uri. *Anarchism and the Politics of Technology.* WorkingUSA 12(3):489 - 503. Sep 2009. doi 10.1111/j.1743-4580.2009.00250.x (available at <http://theanarchistlibrary.org/library/uri-gordon-anarchism-and-the-politics-of-technology> [Accessed 5 Nov 2020])

60. Endnotes. *Romantic Fiction* <https://endnotes.org.uk/other_texts/en/endnotes-romantic-fiction> [Accessed 5 Nov 2020]

61. Mumford, Lewis. *The Myth of the Machine: Technics and Human Development.* New York: Harcourt, Brace Jovanovich, 1967. Print. ISBN 978-0151639755

62. Mumford, Lewis. *The Pentagon of Power.* New York: Harcourt Brace Jovanovich, 1974. Print. ISBN: 978-0156716109

63. ***Gordon, 2009***

64. Schneier, Bruce. *Power in the Age of the Feudal Internet.* Collaboratory.de , October 2013. <http://en.collaboratory.de/w/Power_in_the_Age_of_the_Feudal_Internet> [Accessed 5 Nov 2020]

65. Moore, John. *A Primitivist Primer. (referring to a quote from Fifth Estate 1979. Text available at <https://theanarchistlibrary.org/library/john-moore-a-primitivist-primer>* [Accessed 5 Nov 2020])

66. Perlman, Freddy. *Against History, Against Leviathan.* Black & Red, 1983. Print. ISBN 978-0686877134

67. Zerzan, John. *Elements of Refusal.* Columbia MO: Columbia Alternative Library, 1999. Print. ISBN 978-1890532017

68. Zerzan, John. *Future Primitive and Other Essays.* Brooklyn, NY Columbia, MO: Autonomedia Anarchy, a Journal of Desire Armed, 1994. Print. ISBN 978-1570270000

69. Fifth Estate, quoted in ***Moore, A Primitivist Primer.***

70. Binfield, Kevin. *Writings of the Luddites.* Baltimore: Johns Hopkins University Press, 2004. Print. pp. 210. ISBN 978-1421416960 (from a key Luddite letter written in March 1812)

71. Biagini, Cédric. *Les Luddites en France: Résistance à l'Industrialisation et à l'Informatisation.* Montreuil: L'Echappée, 2010. Print. ISBN 978-2915830309

72. Bookchin, Murray. The Ecology of Freedom: *The Emergence and Dissolution of Hierarchy*. Oakland, CA: AK Press, 2005. Print. pp.264. ISBN 978-1904859260

73. Truscello, Gordon. 2013

74. Out of the Woods. *Murray Bookchin's Libertarian Technics.* Libcom.org March 2014. <https://libcom.org/blog/murray-bookchins-libertarian-technics-11032014#footnote5_i7z2xxj> [Accessed 5 Nov 2020])

75. Benjamin, Ruha. *Race after Technology: Abolitionist Tools for the New Jim Code.* Cambridge, UK Medford, MA: Polity, 2019. Print. ISBN 978-1-509-52643-7

76. Nelson, Alondra, Thuy L. Tu, and Alicia H. Hines. *Technicolor: Race, Technology, and Everyday Life.* New York: New York University Press, 2001. Print. ISBN 978-0814736043

77. Winner, 1980

78. Doffman, Zak. *China Is Using Facial Recognition To Track Ethnic Minorities, Even In Beijing.* www.forbes.com. May 2019 <https://www.forbes.com/sites/zakdoffman/2019/05/03/china-new-data-breach-exposes-facial-recognition-and-ethnicity-tracking-in-beijing/#4296a77e34a7> [Accessed 5 Nov 2020]

79. Benjamin 2019

80. Neil, Cathy. *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy.* New York: Crown, 2016. Print. ISBN 978-0553418811

81. Womack, Ytasha. *Afrofuturism: The World of Black Sci-Fi and Fantasy Culture.* Chicago: Lawrence Hill Books, an imprint of Chicago Review Press, 2013. Print. ISBN 978-1613747964

82. Thomas, Sheree R. *Dark Matter: A Century of Speculative Fiction from the African Diaspora.* New York: Warner Books, 2000. Print. ISBN: 978-0446525831

83. Wajcman, J. (2009). *Feminist Theories of Technology.* Cambridge Journal of Economics, 34(1), 143–152. https://doi.org/10.1093/cje/ben057

84. Oldenziel 1999

85. Harding, S. *The Science Question in Feminism.* New York, Cornell University Press, 1986. Print

86. Cockburn, Cynthia. *Caught in the Wheels: The High Cost of Being a Female Cog in the Male Machinery of Engineering.* Marxism Today, 1983. Print. Pp16 -20

87. Cockburn, Cynthia. *The Material of Male Power.* Feminist Review, 9(1), 41–58. (1981) https://doi.org/10.1057/fr.1981.19

88. Haraway, 1985

89. Some of these themes are elaborated on in: Haraway, Donna J. *Staying with the Trouble: Making Kin in the Chthulucene.* Durham: Duke University Press, 2016. Print. ISBN 978-0-8223-6224-1

90. Schumacher, E. F. *Small is Beautiful: Economics as if People Mattered: 25 years later ... with commentaries.* Point Roberts, Wash: Hartley & Marks Publishers, 1999. Print. 1973. ISBN 978-0061997761

91. Clark, John P. *The Anarchist Moment: Reflections on Culture, Nature, and Power.* Montréal: Black Rose Books, 1984. Print. pp. 197

92. Stallman, Richard. *FLOSS and FOSS.* www.gnu.org . Nov 2016. <https://www.gnu.org/philosophy/floss-and-foss.en.html>[Accessed 5 Nov 2020]

93. *Technological Sovereignty, Vol. 2.* <https://sobtec.gitbooks.io/sobtec2/content/en> [Accessed 5 Nov 2020]
94. Illich, Ivan. *Tools for Conviviality.* London: Calder and Boyars, 1973. Print. ISBN 978-0714509730

95. All quotes in this section from **Illich, 1973**

96. Weber, J. (n.d.). *From Science and Technology to Feminist Technoscience.* In Handbook of Gender and Women's Studies (pp. 397–414). SAGE Publications Ltd. https://doi.org/10.4135/9781848608023.n23

97. Wajcman, Judy. *TechnoFeminism.* Cambridge Malden, MA: Polity, 2004. Print. ISBN 978-0745630441

98. Layne, Linda L., Sharra L. Vostral, and Kate Boyer. *Feminist Technology.* Urbana: University of Illinois Press, 2010. Print. ISBNs: 978-0252077203 (In "Introduction" pp 1 -35)

99. Ibid (Chapter 2: Johnson, Deborah G. (2010). *"Sorting out the question of feminist technology")*

100. *Feminist Principles of the Internet - Version 2.0.* APC.org. Aug 2016 <https://www.apc.org/en/pubs/feminist-principles-internet-version-20> [Accessed 5 Nov 2020]

101. Marx, G. T. (2015). *Technology and Social Control.* In International Encyclopedia of the Social & Behavioral Sciences (pp. 117–124). Elsevier. https://doi.org/10.1016/b978-0-08-097086-8.85052-7

102. Gerbaudo, Paolo. *Tweets and the Streets: Social Media and Contemporary Activism.* London: Pluto Press, 2012. Print. ISBN: 978-0745332482

103. Ehrenreich, Ben. *Welcome to the Global Rebellion Against Neoliberalism.* The nation.com Nov 2019. <https://www.thenation.com/article/archive/global-rebellions-inequality> [Accessed 5 Nov 2020]

104. Dyer-Witheford, Nick; Brenes Reyes, Jaime; and Liu, Michelle. *Intotheblackbox.com.* June 2020 <http://www.intotheblackbox.com/articoli/riot-logistics/#_ftnref43> [Accessed 5 Nov 2020]

105. J. Bray, Jessica & T. Quinn. *Optics and Fluidity: Evading Surveillance in Hong Kong.* Platypus: The CASTAC Blog, 2 Oct. 2019 <http://blog.castac.org/2019/10/optics-and-fluidity-evading-surveillance-in-hong-kong> [Accessed 5 Nov 2020]

106. *Tactics and Methods Surrounding the 2019–20 Hong Kong Protests - Technology.* Wikipedia.org <https://en.wikipedia.org/wiki/Tactics_and_methods_surrounding_the_2019%E2%80%9320_Hong_Kong_protests#Technology> [Accessed 5 Nov 2020]

107. Haynes, N & Campbell, B. *Before They Erase It: Memory and the Social Media Archive.* Platypus: The CASTAC Blog, 12 Nov. 2019. <http://blog.castac.org/2019/11/before-they-erase-it-memory-and-the-social-media-archive> [Accessed 5 Nov 2020]

108. Michelle, Chan. *From Hong Kong to the NBA, how China is losing the media war.* nikkei.com. Oct 2019. <https://asia.nikkei.com/Spotlight/The-Big-Story/From-Hong-Kong-to-the-NBA-how-China-is-losing-the-media-war> [Accessed 5 Nov 2020]

109. For some recent examples see: *Tools and Tactics in the Portland Protests.* Crimethinc.com Aug 2020. <https://crimethinc.com/2020/08/03/tools-and-tactics-in-the-portland-protests-from-leaf-blowers-and-umbrellas-to-lasers-bubbles-and-balloons> [Accessed 5 Nov 2020] and *Tactics and methods surrounding the 2019–20 Hong Kong protests* (ref 106 above)

110. Karatzogianni, Athina. *Firebrand Waves of Digital Activism 1994-2014: The Rise and Spread of Hacktivism and Cyberconflict.* Houndmills, Basingstoke Hampshire New York, NY: Palgrave Macmillan, 2015. Print. ISBN 978-0230242463

111. Stephens, J. C., & Surprise, K. (2020). *The Hidden Injustices of Advancing Solar Geoengineering Research.* Global Sustainability, 3. https://doi.org/10.1017/sus.2019.28

112. Muraca, B., & Neuber, F. (2018). *Viable and Convivial Technologies: Considerations on Climate Engineering from a Degrowth Perspective.* Journal of Cleaner Production, 197, 1810–1822. https://doi.org/10.1016/j.jclepro.2017.04.159

113. Corporate Watch. *Techno-fixes: A Critical Guide to Climate Change Technologies.* 2008 <https://corporatewatch.org/wp-content/uploads/2017/09/Technofixes.pdf> [accessed 8 Sep 2020]

114. Marx 2015

115. Plumwood, Val. Environmental Culture: The Ecological Crisis of Reason. London New York: Routledge, 2002. Print. ISBN 9780415178785

116. Haraway 1985

117. For some discussions around the ethics of Artificial Intelligence see the outputs from the *'Artificial Intelligence: how little has to go wrong?'* conference 2018.
Available here: *<https://www.sgr.org.uk/events/artificial-intelligence-how-little-has-go-wrong>* [Accessed 5 Nov 2020]

118. Guin, Ursula K. The Carrier Bag Theory of Fiction. 1986. Available here: <http://theanarchistlibrary.org/library/ursula-k-le-guin-the-carrier-bag-theory-of-fiction> [Accessed 5 Nov 2020]

119. Guin, Ursula K. *The Dispossessed: An Ambiguous Utopia.* New York: Harper & Row, 1974. Print. ISBN 978-0061054884

120. Piercy, Marge. *Woman on the Edge of Time.* New York: Alfred A. Knopf, 1976. Print. ISBN: 978-0449210826

121. Although the quote is widely attributed to Octavia Butler, we couldn't actually find the source. Perhaps she didn't say it, but we liked it, so we included it :)

122. Doctorow, Cory. *Technology is making the world more unequal. Only technology can fix this.* theguardian.com, May 2017 <https://www.theguardian.com/inequality/2017/may/31/technology-is-making-the-world-more-unequal-only-technology-can-fix-this-cory-doctorow> [Accessed 5 Nov 2020]

123. Angelou, Maya. *On the Pulse of Morning.* 1993

Technology is everywhere. Its influence on our lives is enormous. But how does it function? How does it affect us? Who does it serve? Can it support radical social change towards free and equal societies living in harmony with nature? Are humans fated to wind up as pets for hyper-intelligent robot hamsters?

These are -mainly- important questions. However, the dominant view is that technology is apolitical and inevitable, that it represents human progress, making our lives easier, more fulfilling, or just 'better'. Let's dig a little deeper.

We are at a unique moment in human history – an ecological precipice, perhaps a social tipping point. Whatever path we take, unravelling technology and the dilemmas it presents will give us a clearer view of the horizon ahead of us.

This book is a brief introduction to the politics and philosophy of technology - a simple guide to how interacts with society and the world around us. We hope you find it useful.

CW

978-1-907738-27-2