

Science, Technology, and the Human Domination of Nature

The term 'domination' is frequently used to characterise human relations with nature, but there are various views on what 'domination' really means in this context. Some argue, like Marcuse, that modern science inevitably leads us to the 'domination of nature'. However other thinkers, such as William Leiss, take the view that although modern science is implicated in humanity's domination of nature, this is essentially an avoidable accident of history. Furthermore, Leiss argues that the term '*human* domination of nature' is essentially meaningless for it is not possible to think of a unified human project. Is there an essential connection between the characteristics of the modern scientific method and an exploitative relationship of 'domination' of nature by human beings, as Marcuse suggests? Or is, as Leiss argues, this relationship merely contingent?

To answer these questions I will begin with a critique of Leiss's analysis of the terms 'mastery' and 'domination'. Following Husserl, I will trace the roots of 'mastery' in the development of the modern scientific methods of Bacon and Galileo. I will then discuss Heidegger's understanding of the essence of technology, its relationship to modern science and effect on humanity's attitude towards nature. Finally, I will return to the points raised by Marcuse regarding the intrinsic tendency of modern science towards domination and control of nature, and examine his thesis in relation to Leiss's main arguments.

Francis Bacon (1561 – 1626) was a pivotal figure in the emergence of a recognisably modern scientific method, and was explicit in framing scientific knowledge as power. He described the pursuit of this knowledge through experimentation as ‘entrapment’, even ‘torture’ of nature to reveal ‘her’ secrets, for the benefit of humanity.

‘I am come in very truth leading you nature with all her children to bind her to your service and make her your slave.’

(Bacon, *The Masculine Birth of Time*, quoted in Leiss, 1972:55)

Since Bacon’s era, ‘mastery,’ ‘domination,’ ‘conquest’ and ‘power’ are terms often used to describe the human/nature relationship. However, the meaning of the phrase ‘domination of nature’ is imprecise, and a more exact understanding of what the term might mean will be a necessary starting point for this discussion.

Leiss claims that ‘the notion of a common domination of the human race over nature is nonsensical’ (Leiss, 1972:123) Why so? He begins by pointing out that ‘domination’ and ‘mastery’ are often considered interchangeable terms, but identifies a clear distinction between them by seeing ‘domination’ as essentially political, requiring the conscious subordination of one side to another. Thus we cannot speak of unified human project of domination over nature, for domination can only be meaningfully understood within an inter-human context. He substantiates this claim with reference to Hegel’s discussion of the superior self-knowledge required of the slave, who must continually gauge the master’s needs. However interesting Hegel’s point

is, it does not establish that domination can *only* be understood in the context of human relations (Leiss, 1972:122). Neither is Leiss's differentiation between 'domination' and 'mastery' borne out by an etymological analysis, for 'domination' has its roots in the Latin *domare*, 'to tame,' and *dominatus*, 'to be master of'.

The second reason Leiss gives for rejecting the idea of a universal 'human domination of nature' is that there are no universal human projects of domination over nature (1972:123). Science and technology certainly feature in inter-human struggles, but according to Leiss, the lack of a unified human project of domination over nature makes the term so generic as to be meaningless. However, it could be argued that humanity's universal project has been to avoid suffering and death by manipulating the natural environment to sustain our families and ourselves. Thus agriculture in its various forms could be construed as a common project, if we expand our understanding of cultivation to include the habitat management of so-called 'hunter-gatherers', and the low-key maintenance of plant resources by forest dwellers. These forms of cultivation are only now beginning to become visible to western eyes attuned to more intensive forms of agriculture. (Posey, 1985:139-158)

Leiss is more comfortable with the term 'mastery' of nature, which he accedes has resulted in widespread ecological damage (1972:119). He acknowledges a basis for a case against science here, but again he is at pains to be precise in his definition of what is meant by 'mastery'. Firstly he seeks to establish a differentiation between *technological* mastery and *scientific* mastery. Technology is essentially instrumental and

pragmatic, thus technological mastery can be understood as 'mastery-as-control'. This Leiss distinguishes from 'mastery-as-faithful-interpretation' which he associates with science. This merely happens to sometimes produce results which lend themselves to instrumental technological ends. These may sometimes be used by some humans to impose domination on nature, and other humans. The problem lies not in science itself, as Leiss sees it, but in the socio-economic sphere. Science, as a neutral project of 'mastery-as-faithful-interpretation,' has the potential to make positive contributions. Where human mastery of nature is troublesome, is, according to Leiss, down to a lack of mastery over *human* nature, which is by implication intrinsically flawed.

Eco-feminists such as Val Plumwood have also placed the term 'mastery' under scrutiny (1993:19), rejecting the master model altogether as irredeemably dualistic. (1993:35) Plumwood defines dualism as 'the construction of a devalued and sharply defined sphere of otherness' (1993:41) which, through a process of 'backgrounding' systematically denies dependency on the subordinated 'other' and forces both parties into equally distorted roles of 'master' and 'slave'. The master denies dependence on the slave whose labour sustains his livelihood; a dependence both hated and feared as a subtle challenge to dominance, thus leading to further repression. Plumwood identifies this dualism in inter-human relationships of gender, race and colonisation, as well as human/nature relations. This dualism is intrinsically hierarchical for 'dualisms are not just free-floating systems of ideas, they are closely associated with domination' (1993:41) and she traces the structure of dualism through the entire western conceptual system. Human/nature dualism is, according

to Plumwood, a post-enlightenment development of a tenacious, interrelated web of dualisms including subject/object, productive/reproductive, rationality/animality, male/female, and civilised/primitive.

However, Plumwood points out that not every distinction need be a dualism. What is particular to dualism is the manner in which it gives cultural expression to hierarchical power imbalance, separation, radical exclusion, opposition and domination, naturalised in culture as if it were part of the nature of beings. By contextualising the terms 'mastery' and 'domination' within a framework of wider cultural relationships of power, exclusion and exploitation, Plumwood identifies a link between the domination of some humans by other humans, and the domination of nature. Both are seen as cultural manifestations of the Western dualistic concept structure. Therefore I would argue that the separation Leiss attempts to establish between exclusively inter-human 'domination' on the one hand, and 'mastery' which *can* include nature on the other, is a false one, as one cannot separate relations of power over human beings (women, indigenous peoples) from relations of power over nature. Indeed the two are inseparable. The domination of nature *is* political.

However, this cannot be a question of straightforward domination, for natural disasters, disease and climate change resist such 'conquest,' and remind us of the acute vulnerability of our technological society. Just as the 'master' denies his dependence on the 'slave', so our technological society is unable to acknowledge our ultimate dependence on nature.

Leiss offers an alternative reading of 'mastery' as 'faithful interpretation', which may be understood as mastery of the kind a craftsman might display, and which he associates with science. (1972:119) 'Mastery-as-control', in Leiss' view, pertains to technology, which is intrinsically pragmatic and instrumental. However, new technologies which seek a less coercive and exploitative way of working within nature's limits, such as 'biomimicry' in design (Benyus, 2002), or the permaculture approach to designing for sustainable human dwelling, (Holmgren, 2002) as well as the low-impact agriculture mentioned earlier, could equally be understood as 'mastery-as-faithful-interpretation'. Such mastery might more accurately be described as 'skilful technique', aspiring towards the grace and economy displayed by natural forms and systems. Indeed, it could be argued that this attentive skill has been co-opted into the dualistic 'master' narrative, for there is no obvious correlation between 'mastery' and 'skill' other than the master's power to make a claim on it.

I would therefore argue that neither Leiss's separation of the political domination of humans by other humans from a supposedly apolitical mastery of nature, nor his distinction between 'mastery-as-control' and 'mastery-as-faithful-interpretation' by which means he seeks to prosecute technology and acquit science, hold up to scrutiny.

Another cornerstone of Leiss' thesis is the neutrality of technology as instrument. He readily accedes that humanity faces major problems which are the results of our

failure to use the power of science and technology wisely, and that science and technology cannot easily be separated, for technology is not just straightforward application of science. However, Leiss argues that while modern science may be implicated in the disastrous consequences of technology's industrial and agricultural manifestations, these are consequences of other social factors, rather than an intrinsic characteristic of science itself (1972:118).

Leiss's claim that 'pure' science can be understood as 'faithful interpretation' will now be examined in the light of arguments put forward by Husserl and Heidegger. Both these thinkers claim to identify intrinsic characteristics of modern science implicating it as 'mastery-as-control', and argue that technology is essentially shaped by science, rather than its neutrally pragmatic application to ends that have been shaped by separate socio-economic factors.

Husserl, in 'The Crisis of European Sciences and Transcendental Phenomenology' argues that science is in a state of deep crisis. In 1937 this must surely have been a surprising claim, although arguably less so in the light of our current situation seventy years later. Husserl's criticisms are rooted in a critique of Positivism's conviction that scientific knowledge is self-sufficient, directly accessible to the senses, and needs no further philosophical or metaphysical account. In spite of science and technology's spectacular successes, Husserl argued that the separation of science from philosophy was disastrous. The dream of the Enlightenment was of a 'universal science' that would serve social and cultural life, a full flowering of human reason which would

enable us to understand both ourselves *and* the world we inhabit. Husserl argued that the exclusion of human nature and wider cultural concerns from scientific research confined it to the ‘carefully circumscribed portions of nature which are the objects of its enquiries’ and by excluding wider human concerns such as values, ethics, and social goals, effectively ‘decapitated’ it. (Husserl, 1970:9)

He identifies the ‘mathematisation of nature’ as the fundamental feature of modern science underlying this trend, as set out in Galileo’s “The Assayer”

‘Philosophy is written in this vast book, which continuously lies before our eyes (I mean the universe). But it cannot be understood unless you have first learned to understand the language and recognise the characters in which it is written. It is written in the language of mathematics, and the characters are triangles, circles, and other geometrical figures.’

Galileo, *The Assayer* (1623/2008: 181)

While respecting Galileo’s spectacular scientific achievements Husserl draws out the underlying illusion. Mathematical physics, he argues, both ‘reveals and conceals’, and he articulates the ‘strangeness’ of this way of thinking about nature (1937:37). Galileo was an opponent of the Aristotelean, qualitative view of science which dominated his times. His work was based on that of Archimedes, who had developed mathematical understanding of natural phenomena such as buoyancy. Galileo correctly understood that the mathematical physics of Archimedes opened the possibility of describing and predicting phenomena in purely mathematical terms. What was truly revolutionary about Galileo’s approach however, was the idea that

the mathematical approach was superior because *that is how nature is*. Husserl doesn't suggest that the mathematical approach is invalid, but he challenges the underlying claim that nature is itself mathematical.

In order to more clearly understand the nature of this illusion Husserl outlines the stages in the process of 'mathematisation', beginning with the 'geometrisation' of nature conceived as an 'infinite and yet self-enclosed world of ideal objects as a field of study' (1937:26). Composed of pure, exactly measurable objects, 'geo-metry' as literally 'Earth-measurement' originated in land surveying for mapmaking (1937:28, 49). 'Pure' geometry therefore began as an instrument developed for the measurement, control and appropriation of territory. But of course, the map is famously not the territory, and a geometrical model of nature, however exact its calculations, can only be an approximation. What was strange and revolutionary about Galileo's claim, according to Husserl, was the notion that this exactness was within nature, and was merely revealed by mathematical physics.

Husserl argued that as we experience the 'life-world' as it is given to our senses, we are not passive receptors but are actively shaping our perception through the ideas we hold. We are not consciously aware of this 'garb of ideas', (1937:51) *through* which we see, as if wearing tinted spectacles. Thus, the mathematisation of nature, which began with Galileo, inserts itself into our perceptual experience (1937:49-50). Then, through a second stage of 'technisation,' these geometrical shapes become further abstracted as numbers and formulae.

It would seem that our direct sensory experience of nature would resist such abstractions, and indeed as the 'forgotten meaning-fundament of natural science' (Husserl, 1937:48) must come before abstraction is possible. Galileo's *coup de grace*, as Husserl saw it, was the mathematisation of sense qualities, with the doctrine of 'primary' and 'secondary' qualities. The 'primary' qualities of nature are those qualities we cannot imagine a natural object as lacking, such as its size, shape, location in time and space, and motion, all of which are quantifiable and measurable. We can however imagine a natural object as lacking colour, sound, scent, or taste. Galileo concludes that these qualities, which became known as 'secondary' qualities, are not real, and not located in the object itself, but in the perceiving subject in whom the object provokes a sensory response. With this move the world of everyday experience becomes a world of illusion. The doctrine of primary and secondary qualities sweeps aside the world that meets our senses, and substitutes for it a world of mathematical abstractions shaped by formulae.

And so we move from an Aristotelean, qualitative science which seeks to *describe* nature and is couched in terms of wonder, to a mathematised nature which can be measured, calculated, predicted and thus *controlled*. Furthermore, just as 'pure' geometry can trace its origin to cartography and militarism, Galileo's research into the behaviour of small objects in motion, and the trajectories of projectiles, was directly influenced by his patrons' interest in accurately predicting the path of cannonballs. (Galileo and Finocchio, 2008) As with the Baconian project to extract maximum benefit for humanity from a reluctant 'slave' nature, the rationale for the

Galilean mathematisation of nature lay in the prediction and control of natural phenomena for human, instrumental ends. Scientific research, it seems, has never been 'pure'. The mathematisation of nature, as understood by Husserl, would seem therefore to refute Leiss's claim that science is a neutral 'mastery-as-faithful-interpretation', with technology its pragmatic application to socio-economic ends, but that an ethos of 'mastery-as-control', originating in pragmatic projects to predict and control nature, territory *and* other humans, infuses both science and technology and shapes the ends to which both are put.

What then of the relationship between science and technology? Husserl's student Heidegger also argues that it is a misconception to think of technology as a neutral means to an end, but that technology has far reaching effects on our understanding of nature and of our relation to it.

In 'The Question Concerning Technology', first published in 1954, Heidegger asks what is the *essence* of technology? Is it a neutral means to an end, or a powerful, yet still obedient, manifestation of the human drive to remake and shape the world? These two readings of technology, the instrumental and the anthropological, are both, he says, factually *correct*, but neither is *true*. (1978:4) In order to find what he calls the 'essence' of technology he begins by unravelling the notion of instrumentality to reveal its complexities. Instrumental means effect ends, and desired ends demand new means. Heidegger points out that we have come to understand a cause as 'that which brings something about', (1978:9) but this was in

earlier thought just one kind of cause among four, namely: material, formal, final and *efficiens*. A silver chalice is brought into presencing by the silver (material cause), the idea of ‘chaliceness’ (formal), the rite of communion (final) as well as the skill of the silversmith (efficient) and owes its existence to all of these. In the instrumental view causality has been oversimplified into a unilinear ‘efficient cause’ only. Heidegger goes further still, to ask why stop at four? He implies a somewhat karmic web of interdependent reciprocal cause-effect-causes, describing causality as allowing ‘what is not yet present to arrive into presencing,’ a ‘bringing-forth’ which the Greeks termed *poiesis*. (1978:10) If *poiesis* can be understood as the bringing forth by the artisan, *physis* is the spontaneous bringing forth of natural entities which sprout, grow and blossom. This growing or making involves a bringing forth out of concealment into unconcealment – a revealing, or *aletheia*. To the Greeks this word meant revealing in the sense of truth, and here we encounter truth as more than mere factual correctness.

This unravelling of the threads of a complex causality which allows the presencing of that which is not yet present, demonstrates that the instrumental view of technology is an oversimplification. Heidegger says ‘every bringing forth is grounded in revealing’. Technology, as an instrument of manufacture, is no mere means, but a ‘way of revealing’ (1978:12). And technology is a very particular mode of revealing; it is an inquisitorial ‘challenging-forth’ (1978:13-14], which treats nature as nothing more than a storehouse or ‘standing-reserve’ (1978:15-19). Technology makes nature serve our every whim, on tap at any time, present or absent according to our desire; we no longer have to accommodate ourselves to the dark when night falls,

for the flick of a switch allows us to instantly tap into a standing reserve of ancient sunshine stored as fossil fuel.

Heidegger's 'questioning concerning technology' is in search of the metaphysical essence of technology, by which he seems to mean something of technology which endures beyond the various aspects of the technological apparatus. He suggests this essence may be understood as 'Enframing' (Gestell). The essence of technology is a system, a framework of 'ordering revealing' in constant need of an unlimited supply of labour, energy, material, and ideas. This Enframing is a 'setting in order', and like nature, we too must fit our lives into this order, regulating our time, emotions, and energies, from our first schoolday onwards. Psychologists and antidepressants are as necessary to this ordering as engineers and economists (1978:15-19).

The 'ordering revealing' occasioned by technology differs from the blossoming forth of *physis*, and the skilful bringing forth of the artisan which the Greeks termed *techne*, for it carries the sense of challenging forth, of extraction. Technology and *techne* both locate the impetus for revealing outside the thing itself, but *techne* is attuned to the self-revealing of *physis*, as when a craftsman works with the grain of the wood, whereas the interrogatory searchlight of technology requires no such sensitivity. A comparison of industrial-scale agribusiness with organic farming methods serves to illustrate the qualitative difference between a hubristic technological 'mastery-as-control' and an attentive 'mastery-as-faithful-interpretation,' more akin to the skilful technique of *techne*.

Technology is therefore no neutral instrument, but completes the agenda instigated by the scientific philosophies of Bacon and Galileo, and can be understood as a direct descendant of the entrapment of nature we saw 'vexed' into revealing 'her' secrets in the scientific experiment. The technological world in which we find ourselves is thus disguised, arranged into an aggregate of raw materials, in two piles: 'resources' (human and natural), or 'waste' (ditto).

The work of Herbert Marcuse can be understood as a synthesis of the ideas of Husserl and Heidegger with those of Marx. In 'One-Dimensional Man' he develops the implications Husserl saw in the mathematisation of nature, and on the sense of totalitarianism implicit in Heidegger's understanding of the 'Enframing' essence of technology. Marcuse sets out his stall with the following claim:

'A comfortable, smooth, reasonable, democratic unfreedom prevails in advanced industrial civilisation, a token of technical progress.' (2008: 1)

He agrees with Husserl and Heidegger that technology is not a neutral instrument but a system of domination, the means by which modern industrial society contains change without the use of force. His notion of 'one-dimensionality' is the bland totalitarianism of the shopping mall, the dulled satiation of 'false' needs (to shop, to be entertained), in which alternatives become literally unthinkable. Resistance and protest is co-opted, absorbed into the mainstream and sold back to us as escapism, entertainment or the latest thing in 'cool'.

Marcuse accedes that nature may yet be an antidote, a reprieve from the constant getting and spending of the 'free' economy (from which no-one is really free), and reads the struggle to protect natural areas from encroachment as essentially political. However this contradiction is fragile, as conservation areas are packaged and sold back to us by the tourism industry. Yet nature as an 'area of contradiction' stubbornly persists, as proven by volcanic ash clouds effortlessly grounding holiday-makers, and finally, inevitably, inescapably, in spite of all the efforts of modern scientific medicine, and all our culture's denials, by our inability to escape mortality.

Marcuse argues that modern science plays a central role in 'one-dimensional' thought. The western philosophical tradition was characterised, from at least Plato onwards, by a tension between the Ideal and the actual, where the Ideal was more real than the world of everyday experience. Furthermore the Ideal (for example, Plato's ideal 'Republic') was something to which the actual aspired. This set up an essentially ethical dialectic between what *is* and what *ought to be*, which Marcuse characterises as 'two-dimensional' thought (2008:125). This he contrasts with 'one-dimensional' thought, rooted in modern scientific thinking which has no place for the Ideal as norm. In modern science, the ideal is reduced to a mathematical structure. There is no tension between Ideal and actual. Mathematised nature is just what *is*. Values, as subjective and unreal, are separated from objective facts, and thus science from ethics (2008:146-7). Nature perceived 'objectively' becomes seen in value-free terms, shaped by a mathematical physics which from its outset is rooted in the prediction and control of nature. This neutral value-free approach is one which we

value because of its instrumental usefulness. This, as we have also seen in the arguments of Husserl and Heidegger, is in itself a value.

Galilean science created an illusion of objective truth – a supposedly neutral, disinterested viewpoint which is intrinsically instrumental – Marcuse terms this the ‘technological a priori.’ (2008:158) ‘The principles of modern science were a priori structured in such a way that they could serve as conceptual instruments for a universe of self-propelling, productive control’ (2008:158) Therefore a convincing case is made that ‘science, by virtue of its own methods and concepts has projected and promoted a universe in which the domination of nature has remained linked to the domination of man’. (2008:166)

We saw that Leiss’s attempt to establish a distinction between ‘domination’ and ‘mastery’ did not stand up to detailed scrutiny, and that in the light of an eco-feminist reading of dualism, ‘mastery’ of nature is not apolitical, for as an expression of a wider web hierarchical dualisms it cannot be differentiated from ‘mastery’ of some humans by other humans. Furthermore, Leiss’s attempt to distinguish a ‘pure’ science of ‘mastery-as-faithful-interpretation’ from an instrumental, technological ‘mastery-as-control’ is undermined by Husserl’s uncovering of the roots of the mathematisation of nature. Mathematical physics, according to Husserl, is a project rooted in the pragmatic desire to predict and control nature, territory, and other humans. Neither is technology exclusively ‘mastery-as-control’, for some sustainable and indigenous ‘technologies’ could be construed as ‘faithful interpretation’.

Heidegger identifies a totalitarian 'Enframing' as the essence of modern, industrial technology, which is a direct consequence of the modern scientific method outlined by Bacon. Marcuse brings this to a conclusion which finds us in a blandly totalitarian system that controls not only nature, but our very thoughts. For Marcuse then, the human domination of nature, in its fullest expression, becomes the domination of human nature. Marcuse concedes that, although advanced industrial society thus seems capable of containing change, there are tendencies which may rupture this, but he considered these less dominant and ultimately impotent (2008: x1).

However, within the master narrative, the inherent contradiction Plumwood identifies, of the master's denial of his ultimate dependence on the slave, may be the source of his own undoing. We have, as Bacon suggested, made nature our slave, and many would argue that our industrial technology is working her to death. A master who works a slave to death can always capture another slave, but when humanity as 'master' of nature pursues this enslavement to the point of destruction, the 'Enframing' of technological-industrial society can only collapse with it. That we do not and cannot control the totalitarian technological-industrial society we live in does not mean it will continue indefinitely, as Marcuse implies, rather that we will not be able to dictate the nature, pace and timing of the changes which will take place once the 'standing-reserves' become too depleted to sustain the exponential growth on which it ultimately depends.

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