Deleuze and Technology

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Abstract

Although Gilles Deleuze never explicitly developed what might be considered a 'philosophy of technology', this article nonetheless attempts to outline the rudiments of a Deleuzian approach to technology by proposing a series of interrelated concepts: (1) prosthesis (technological artefacts are externalised organs); (2) proto-technicity, or originary technicity (but this technicity already exists in Nature, all the way down, and precedes any 'theory'); (3) exodarwinism (the fact that evolutionary time has bifurcated, and technology evolves in a faster and accelerating time scale); (4) de-specialisation or de-differentiation (what conditions the externalisation of organs is their deterritorialisation); (5) motricity (the link between the brain and the hand/mouth is primarily one of movement); (6) inscription, or graphism (the link between mouth and hand takes place through phonetic writing, when the hand reproduces speech in graphic inscriptions); (7) maker's knowledge (we know the organisations of matter found in nature through the organisations of matter that we ourselves have created); and finally, (8) totipotence (like a stem cell, the body is capable of externalising an almost unlimited number of forms and functions; it is itself an abstract and the source of abstractions).

Keywords: Deleuze, Simondon, Serres, Ruyer, Leroi-Gourhan, technology, prosthetics, original technicity, inscription, maker's knowledge

Although Gilles Deleuze never explicitly developed what might be considered a 'philosophy of technology', he was strongly influenced by thinkers such as André Leroi-Gourhan, Raymond Ruyer and Gilbert Simondon, all of whom provided profound analyses of the nature

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of technicity. Moreover, works such as *Capitalism and Schizophrenia* were grounded in a precise concept of 'machinism'. In what follows, I would like to offer some Deleuzian reflections on the nature of technology, and more specifically on the nature of the relationship between technology and thought. Deleuze famously defined philosophy as the creation of concepts, and I would propose, in a tentative manner, several concepts that, taken together, may help lay out the rudiments of a Deleuzian philosophy of technology: prosthetics, proto-technicity, exodarwinism, de-specialisation, motricity, inscription, maker's knowledge and totipotence.

I. Prosthetics

Speaking in general terms, technologies are 'prosthetic', so to speak – that is, they are extensions of the body or externalisations of bodily organs. The German thinker Ernst Kapp, in his 1877 book *Principles of a Philosophy of Technology*, seems to have been the first to propound this idea of technical objects as 'organ projections'.[1] I can pound a stake into the ground with my fist, but I do a much better job if I use a hammer, which mimics my forearm and fist. In place of the arm, technology substitutes an external artefact that resembles the arm: with a hammer in our hands, my flesh and bones become wood and iron, like an exoskeleton. Similarly, the wheel externalises the quasi-spherical articulations of our hips, knees and ankles; clothing externalises the skin; a baby's bottle externalises its mother's breast; a kitchen stove is an extension of the stomach, and so on. We've even managed to mimic the organs of other species: aeroplanes mimic the wings of birds; scuba equipment mimics the gills of fish, albeit with different means. Technology is an apparatus that has been extracted from the body, like a ship leaving port. This, it seems to me, is the basic point from which one has to start: technology is primarily corporeal, it is derived from the body. As such, technology marks a first 'threshold' of life. As Marshall McLuhan put it, technologies are 'the extensions of man' (McLuhan 2003). Or, in Bernard Stiegler's words, 'as a "process of externalization", technics is the pursuit of life by means other than life' (Stiegler 1998: 17).

Scientific instruments, for instance, constitute a vast 'sensorium' spread out in a space that constitutes an externalised prosthetic body: telescopic eyes (like the Hubble telescope, or its successor, the Webb telescope) that magnify and record light on film; radio dishes as vast ears that listen to the heavenly noise; seismographs like vast fingers and nerve endings that sense the slightest tremor in the ground, or colliders that allow us to register the effects of particle collisions, as in the discovery of the Higgs boson. What is sometimes called the 'scientific revolution' took place in part because of our ability to extend our senses in such technical artefacts.[2]

II. Proto-technicity

However, one must immediately modify this concept of prosthetics in two directions. On the one hand, the concept of prosthetics tends to presume the initial integrity of the body, which secondarily extends itself spatially. But in fact, the body itself must be comprehended in terms of its natural technicity. As Marx put it, in a famous text, the greatness of Darwin was that he 'directed attention to the history of *natural technology*, that is, the formation of the organs of plants and animals' (Marx 1990: 493n4). In his book *Climbing Mount Probable*, Richard Dawkins has an intriguing chapter, aptly titled 'The Forty-Fold Path to Enlightenment', that analyses the fact that eyes – which Dawkins calls 'a remote sensing technology' – have evolved no fewer than forty times in the animal kingdom in accordance with nine distinct principles (Dawkins 1996, 138–9). From this viewpoint, not only eyes, but eggs, exoskeletons, feathers, hair, hooves, nails, teeth, the shells of turtles and the scales of anteaters are all forms of what we might call proto-technicity, or 'originary technicity'.[3] Deleuze and Guattari call it 'machinism' (see Sauvagnargues 2016).

The idea of proto-technicity was perhaps developed most convincingly by the French philosopher Raymond Ruyer (see Ruyer 1946: 42–51; 2016:17–22). Consider a unicellular animal such as an amoeba. As Bergson noted, it can digest food, even though it does not have digestive organs such as a stomach or intestines: it is able to react in intelligible ways to its environment, even though it has neither a nervous system nor any sensory organs; we could thus say that it thinks, even though it lacks a brain (Bergson 1920: 7). In other words, even though it lacks a brain, a nervous system or a stomach, an amoeba can think, can digest food and can move about intelligibly in its environment. Ruyer's conclusion is that *bodily organs are themselves technical artefacts* (Ruyer 1938). I do not necessarily need a hammer to pound a stake into the ground, but I can do a better job if I have one. Similarly, organisms do not need a stomach to digest, or a brain to think or a nervous system to interact with the environment, but they digest and interact better if they have specialised organs fulfilling these functions. In other words, if tools are externalised projections of our organs, we would equally have to say that our bodily organs – stomachs, lungs, kidneys, brains – are themselves technologies that have been created by the organism itself in the course of evolution. In Deleuze's terminology, the egg is a body without organs, and organs are artefacts that are created by the egg in the course of embryogenesis. This is why, in a provocative turn of phrase, Ruyer sometimes calls the embryo our 'primary consciousness', since an embryo has a 'knowledge' that is far vaster than the knowledge our brains have. An embryo easily and routinely creates numerous organs (brain, heart, stomach, lungs, kidneys) that the human brain is now trying to recreate artificially (artificial hearts, dialysis machines that replace the functioning of kidneys, 'artificial intelligence'). But the embryo, our 'primary consciousness', creates these organs with a perfection that the brain, our 'secondary consciousness', can scarcely replicate (Ruyer 2016: 45–67).

Nietzsche had already suggested that the most perfected form of knowledge we possess is knowledge that has been literally 'incorporated' – it has been corporealised, it has become part of the body (Nietzsche 1974: 169–71, §110). This is the kind of knowledge a pianist has of a piece of music, or a basketball player has of his game: the knowledge is incorporated into their body as a motor habit ('muscle memory'). Students today are generally proficient typists, and typing obviously requires a knowledge of the layout of the computer keyboard. But if students are asked to identify the two letters to the left and right of, say, the letter 'C' on their keyboard, few of them are able to answer. The knowledge has been incorporated into their body and has largely disappeared from consciousness. This is the kind of perfected 'primary' knowledge that an embryo possesses, as opposed to the more limited 'secondary' knowledge possessed by consciousness. Indeed, consciousness most usually intervenes when we lack knowledge – when we have to consciously look at the keyboard or double-check a musical score. The kind of incorporated knowledge we have when we play an instrument or play a sport is close to the kind of perfected corporeal knowledge that an embryo has, where the conscious self-awareness of a brain does not intervene at all.

Technicity and life interpenetrate each other. If technology is an externalisation of the body, we must also say that bodily organs are themselves technologies. There is a technicity that reaches all the way down to the reproductive capacities of smallest bacteria, and it is conceptually misleading to separate the two. Mutation and selection are two mechanisms of this natural technology. One might ask if the ancient ruins of long-vanished civilisations or even modern junkyards filled with the carcasses of rusting automobiles are all that different from the fossilised remains of the Cambrian period that are found in the Burgess Shales in the Canadian Rockies, about which Stephen Jay Gould wrote his superb book called *Wonderful Life?* (Gould 1990)? As Michel Serres has remarked, they are all cemeteries of externalised techniques – fossil remains, ancient ruins, modern junkyards (Serres 2020: 148)

III. Exodarwinism

The concept of prosthetics must also be modified in a second direction. A cigarette lighter, for instance, can hardly be seen as an organ projection. Rather, what characterises technical artefacts is that these 'externalised organs' are detachable, removable; they become separated from the body, and as such, they have the advantage of mobility. A lion's fur, for instance, forces it to rather quickly halt a chase when it becomes overheated; but when fur is externalised in a coat, it can be put on and off at will, according to quickly changing conditions of hot and cold. An important consequence follows from this detachability. Having been detached from the body, technical objects enter into their own evolutionary history – a trajectory that Serres has called an 'exodarwinism' (Serres 2019: 28). Evolution bifurcates: biological evolution produces organisms, with their own proto-technicity; but these organisms then produce technical artefacts that interconnect with each other in complex networks to produce a new body with its own moving tissue – a body for which Kevin Kelly has aptly coined the term *technium* (Kelly 2010: 11).

The evolution of this new externalised body not only moves at a faster pace than normal evolution, but it is moving at an increasingly accelerated pace. Indeed, it is this other evolutionary time people are referring to when they talk about the fast pace of modern life (Gleick 2000). One would be tempted to say that each of us now lives in two bodies and participates in two evolutionary temporalities: our organic body, which is sculpted by an extremely slow-moving evolutionary process; and the second technological body (the technium) that we have created around ourselves, which is formed, more rapidly, by exodarwinism. And of course, this second body begins to react back upon the first, producing all the complexities of what we call the new 'bio-technologies', and the theme of the cyborg.

IV. De-specialisation

But this raises a delicate question: other species create and use technology – spiders weave webs, beavers build dams, birds make nests – but without entering into this 'exodarwinian' time. Their techniques seem largely tied to their genetic makeup. What is it that has allowed the artefacts produced by the human species to become detached from its organic body, such that its extended body is now spread over the entire planet? Deleuze's answer: deterritorialisation. In evolutionary theory, the bodies of living beings are transformed through two processes, mutation and selection, which allow an organism to specialise in such a way that it can better exploit the resources of its particular ecological niche. But the human species, somewhat paradoxically, has been partly disengaged from this schema: whereas other species tend to be 'genetic automatons', largely following their genetic programming, humans have been, as it were, de-programmed or de-specialised, de-speciated. How did this happen?

If we follow the theses of André Leroi-Gourhan, the answer to this question must be found in the body, and in the *upright position* that the body assumed in the (first) evolutionary process (Leroi-Gourhan 1993). As humans assumed the upright position, their front paws gradually lost their faculty of locomotion, but in the process evolution invented the hand, which became what Aristotle called 'a tool of tools', a kind of generalised tool (Aristotle 1957: book 3, part 8). At the same time, the mouth largely lost its capacity for prehension, which was taken over by the hand, but in the process it gained the capacity for speech. In other words, the hand and the mouth went through a process of 'de-territorialisation': in the upright position, they are literally removed from the earth or the ground (the *terre*, in French). Put differently, far from being animals that are well adapted to their environment, humans are 'champions of inadaptation" (Serres 2018: 41). Because we are not adapted to any *particular* environment, we can adapt to almost *any* environment. And the fact is that evolution takes place *only* through inadaptation, since species that are already perfectly adapted to their environment, such as jellyfish, have hardly changed since the Cambrian period, and have no reason to change (Serres 2019: 33).

Put differently, we might say that, through deterritorialisation, the human body has become a generality, not unlike the algebraic variable x, which can take on any and all values because it has no value in itself. Or, to use an image suggested by Michel Serres: it is like a stem cell, capable of giving rise to any cell type or a complete embryo (Serres 2018:48).

Embryologists have coined a term to describe this state of a stem cell: '*totipotence*', which can be contrasted with the term 'omnipotence' often used to describe God. Stem cells are not omnipotent, they are not all-powerful; but they are totipotent, they have the power of taking on an almost indefinite number of forms and functions. Thus, whereas other species fill their niche to perfection, human have been able to leave their local niche and to open themselves onto a global space. We have been able to do this because of the de-specialisation or de-differentiation of our own organs, which has allowed us to create extended organs in the externalised body of the *technium*.

V. Motricity

This brings us to a fifth concept: motricity. It is one thing to say the human body has been deterritorialised and de-specialised, and that this is a condition of our technicity. But what about the brain? Do we also not have to say that the fabrication of technical artefacts is a sign of superior human intelligence? At bottom, is it not true that we humans are able to build aeroplanes and computers because, to put it bluntly, we are the smartest creatures on the planet? Whatever the deterritorialised status of our bodies, it is not the brain that really counts? The answer to all these questions is: no. Leroi-Gourhan, for instance, strongly critiqued brain-centred versions of evolution, like that of Teilhard de Chardin, which interpreted evolution as a movement towards an expanded consciousness. The determining factor of human evolution, he argued, was not intelligence, but locomotion (Leroi-Gourhan 1993: 26). In other words, what has driven human evolution is not the brain, but a more modest body part, the foot, since it was modifications in the foot that allowed humans to assume the upright position. It is true that the upright position also allowed for the expansion of the skull, which gave human bigger brains, since a vertical spine can support a heavier cranium than a horizontal spine. But this was an *effect* of the evolutionary process and not its *cause*.

But why then would a bigger brain matter? If animals, compared to plants, have more developed nervous systems, it is because animals have to move about in their environment in order to feed and survive, whereas plants can remain largely immobile, since chlorophyll allows them to 'feed' directly from the sun. In animals, the nervous system is thus the interface between the organism and its environment, or more exactly, between the organism's sensory organs, which provide input from the environment, and its locomotor apparatuses, which allow it to *act*.[4]

Motricity is important for thinking about technicity, in turn, for several reasons. First, in the movement towards the upright position, the brain became bigger at exactly the same time that the hand and face became deterritorialised. As Leroi-Gourhan insisted, the triple 'liberation' of the brain, the hand and the mouth was *one and the same phenomenon*. A considerable amount of brain activity is oriented towards coordinating the muscles in the hand and the face, which lie at the origin of both technicity (produced by the movement of the hand) and speech (produced by the movement of the mouth). This is why Leroi-Gourhan himself, in his early two-volume masterpiece *Evolution and Techniques*, analysed technical artefacts not as externalised organs (as Ernst Kapp did), but rather as an externalisation of our *sensory-motor movements*, such as prehension (grasping, turning, sawing) and percussion (striking, pounding) (Leroi-Gourhan 1971, 1973). This is also why Deleuze (and others) can speak about a *movement that is proper to thought*, since thinking takes place through both language and technicity.[5]

Second, if tools are externalised organs, it follows that our brains have also been externalised and become part of the *technium*. The great anthropologist Jack Goody wrote extensively about what he called the 'technologies of the intellect', that is, technologies that have externalised our intellects (Goody 1977, 1986, 1987, 2000). The most important example of a technology of the intellect is writing, which is a highly complex technology that requires a surface to write on (stone, vellum, parchment, paper) and an instrument to do the writing (chisel, pen, pencil). In other words, writing, like speech, is a complicated motor skill, though speech and writing are very different from each other. Speech is a motor technique of the mouth, which children learn fairly quickly; phonetic writing is a technique for transferring speech into spatialised drawings using the hand and requires years of training (Havelock 1963; Ong 1982). Writing brought about a profound transformation in the hand–mouth relation, which would be modified again with the advent of computers.

Indeed, as a technology of the intellect, one might consider the computer from the viewpoint of three 'faculties' of the mind that classical philosophers often identified: memory, imagination and reason. The memory in a computer is a million times more powerful than one's own memory, and can be accessed anytime ('Let's google it'). Its imagination is equally enormous, nourished by millions of icons and images. (Compare this to the fact that the only images a typical medieval peasant in Europe might have seen during their life were probably the stained glass windows and paintings at their local parish church or cathedral.) Computers even have a faculty of reason, since their programs can solve numerous problems that we could never have solved on our own. (For many mathematicians, having a computer is much more important that having a formal axiomatic.) It is as if our heads – our brains and our minds – have been externalised in front of us in an objectified cognitive box, which we can now tuck away and carry around with us in our backpacks, just as our forearm and fist are objectified in a hammer.

VI. Inscription

The idea that writing constitutes a 'technology of the intellect' implies a sixth concept, *graphism*, or what amounts to the same thing, inscription, to use Deleuze and Guattari's vocabulary in *Anti-Oedipus*.[6] Inscription is a broad category that includes not only writing and symbolisation, but also drawing and 'art', as well as markings inscribed on the body (tattoos, piercings, circumcisions). We often forget that learning how to write is learning how to draw, albeit in a particular manner. We also forget that writing is itself a technology whose effects have arguably been more far-reaching than almost any other technology. Bergson noted that the immediate advantages humans may derive from a new technical artefact 'is a slight matter compared with the *new ideas* and *new feelings* that the invention may give rise to in every direction', and this is certainly true of writing (Bergson 1911: 183). Above all, writing is an externalisation of memory. In so-called oral cultures, poems like the *Iliad* and the *Odyssey* had to be formulaically memorised, and any knowledge that existed had to be retained in the mind. Hence the respect shown to elders, who were literally living libraries, living repositories of knowledge, knowledge that could simply disappear when the person died.[7] But once knowledge was written down and externalised, it could be stored in books and libraries, or even in computer chips, and was available for consultation anytime. The move from 'pre-history' to 'history' is marked by the advent of writing. (This is why the burning of the library in Alexandria was one of the great catastrophes of the ancient world – it destroyed a considerable portion of the collective memory of the human species.) Philosophy itself was made possible by writing, as evidenced by the confrontation between Plato, who championed writing, and Socrates, who refused writing and praised living speech, and in this sense still belonged to the old Homeric culture. Writing also produced entirely new forms of religion – what we call 'religions of the Book'

(Judaism, Christianity, Islam), oriented around the interpretation of texts, and thus utterly focused on the technology of writing. They are *technological religions*. Oral religions, by contrast, tended to be oriented around the voice.

VII. Maker's Knowledge

The idea that our intellects have been externalised as much as our bodies takes us to a seventh concept, maker's knowledge, which deals with the nature of the relationship between technology and thought. The Greeks famously distinguished between *epistêmê* (knowledge) and *technê* (know-how or craftsmanship), and it is well known that Plato elevated *epistêmê* over *technê*. In some famous passages in the *Republic* and elsewhere, Plato claimed that the user of a flute, for instance, knows the flute better than the maker of the flute, and the person who knows the Idea of the flute has a better knowledge than either the user or the maker (Plato 1992: 597b, 601c). Some have seen in Plato's texts a kind of elitism: a slave who fabricated things could not be allowed to be the possessor of a science superior to that of the master who used them (Farrington 1969: 106–14). For Plato, the highest knowledge is given to those who contemplate the intelligible form of Ideas, and not those who actively fabricate things. Epistemology (the contemplative knowledge of the user or the beholder) won out over technology (the active knowledge of the maker).

In emphasising language over technicity, Plato set the tone for much subsequent philosophy. In contemporary analytic philosophy, there is a similar appeal to 'propositional knowledge', the presupposition that knowledge is primarily expressed in propositions.[8] In the continental tradition, the early Foucault emphasised what he called 'discursive formations', as if thought was shaped primarily by discourse; Lacan similarly stressed the role of what he called the 'symbolic'. In all these cases, in differing ways, there remains an implicit deprecation of knowledge that comes through *making* – in other words, technology – a denigration of *knowing-how* in favour of *knowing-that*, to use a terminology formulated by Gilbert Ryle (Ryle 1949: 25–61).

It was not until the sixteenth century that the status of 'maker's knowledge' started to be reconsidered and rejuvenated within philosophical discourse, notably in works such as Hobbes's *Leviathan* and Vico's *The New Science* (see Hintikka 1974: 80–97; Perez-Ramos 1988). In the intervening period, to be sure, the knowledge of 'makers' – metallurgists, brewers, sailors, potters, brewers, and so on – had never disappeared and indeed had proliferated (Connor 2005). But the Renaissance had engendered a philosophical restoration of the rights of maker's knowledge, and it was Vico who provided the most succinct summary of the tradition in a famous phrase: '*verum et factum convertuntur*', 'the true and the made are interchangeable'.[9] In other words, *we truly understand only what we can make*. Maker's knowledge is a kind of knowledge *per causas*: makers have superior knowledge of the products of their creation because they caused it to come into being. We can say we truly understand flight, for instance, because we have learned how to make planes. Knowing is a kind of making, and there is a reciprocal relation between cognition and construction.

For both Hobbes and Vico, curiously, the two paradigms of maker's knowledge were mathematics and the state, since both are made by humans and thus are demonstrable.[10] Vico's 'new science' was the science of society and its history: we can understand society because we have made it ourselves, whereas we cannot truly understand Nature because it was made by God.[11] Hobbes, in the opening of *Leviathan*, presented the state as 'an artificial man', a kind of 'automata' fabricated by humans, and thus knowable by them (Hobbes 1988: 7). We cannot have a maker's knowledge of natural objects, since we did not make them; we find them 'ready-made', a brute fact that is simply 'given'. Though Kant never used the term, his transcendental project can be seen as a continuation of the maker's knowledge tradition. 'Reason', he wrote, 'has insight only into that which it produces after a plan of its own [. . .] We can know *a priori* of things only what we ourselves put into them' (Kant 1929: Bxiii, Bxviii).

Maker's knowledge has an obvious connection to what might be called *actor's knowledge*, since making is an action. Kant had already defined desire as 'a faculty which by means of its representations is the *cause* of the actuality of the objects of those representations' (Kant 1952: Intro §3, 16, n1, as cited in Deleuze and Guattari 1977: 25). More generally, this was the basis of Kant's distinction between theoretical reason and practical reason: 'Practical reason is concerned not with objects in order to *know* them, but with its own capacity to *make them real* – which does require knowledge of them', but a particular kind of knowledge that is neither theoretical nor conceptual but causal (Kant 1993: 93). For Aquinas, similarly, practical knowledge is 'the *cause* of what it understands', whereas 'speculative' knowledge 'is *derived* from the objects known' (Aquinas 1920: Ia IIae, Q3, art. S, obj. 1). Elizabeth Anscombe's *Intention* is the *locus classicus* in considering intentional action as a form of maker's knowledge (Anscombe 2000: 87).

Though they never use the phrase, to my knowledge, Deleuze and Guattari's work can be similarly situated in the maker's knowledge tradition – a tradition that, in Deleuze's language, poses the question of *genesis*. *Anti-Oedipus*, in a Vico-esque manner, is an attempt to rewrite Kant's *Critique of Practical Reason* (desire is productive) by replacing the transcendent Ideas that constitute Kant's postulates (World, God, Self) with purely immanent syntheses (connection, disjunction, and conjunction) that serve as principles for the production of social formations (Deleuze and Guattari 1977: 75). Even in the 'theoretical' domain, they define philosophy as the activity of *fabricating* concepts (Deleuze and Guattari 1994: 2), and insist that the proper question to be posed about a concept is not 'What does it mean?' but rather 'How does it work?' (Deleuze and Guattari 1977: 109).

This brief detour through the history of philosophy should nonetheless make clear the importance of the maker's knowledge tradition in analysing the nature of technology. Vico's claim – that we can have a maker's knowledge of history and society but not nature – can sound strange to modern ears, since we now seem to have a better understanding of nature than society, given the advances in the natural sciences, and the workings of politics and the economy can still seem something of a mystery. But this is the point at which technology intervenes. As Barry Cooper notes, 'modern technology can do in the realm of nature what Vico thought could be done only in the realm of history' (Cooper 1991: 146). To be sure, Vico thought nature was susceptible to a mathematical treatment because mathematics is constructed by us and thus demonstrable. Similarly, an experiment, though not necessarily a creation, can provide us with knowledge because it allows us to artificially reassemble, recreate and record the processes of nature. In remaking nature, we come to know the 'workings' of nature. Nonetheless, despite the justified emphasis on mathematics and experimentation in characterisations of science, the role of what we might call 'technical schemata' in our knowledge of nature is often overlooked.

The fact is that we tend to think nature, to know nature, through our technologies. Consider the following. It is often said that, in the modern world, there have been three ages of machines: mechanical machines, like levers, pulleys, watches and automata; energetic or thermodynamic machines, like the steam engines and electrical motors that powered what Toynbee was the first to call 'the industrial revolution'; and finally, informational machines like computers and smart phones, which define the 'information age' we are in the midst of. Each of these machines has been used as a model to interpret nature as a whole, or objects within nature. In the seventeenth century, the idea of mechanism arose from an analogy with the watch: the world is like a watch, with internal mechanisms that explain its functioning; animals, according to Descartes and LeMettrie, were themselves nothing but pieces of machinery; and just as a watch needs a watchmaker, the deists argued, so the world needs a creator. The same happened in the nineteenth century, when the world was interpreted in energetic terms: because of entropy, the world was going to end 'not with a bang but a whimper' (Eliot 1991: 82). Today, many people appeal to the computer as a model for the mind: the brain is the hardware, and the mind is the software, running different programs in different modules.

Even before the 'age of machines', in the Latin Middle Ages, it was not the computer or the watch but rather the book that functioned as an analogy for Nature. Nature was a book in which one could read 'the stenography of God's omniscient hand', and for Galileo, that language of Nature turned out to be mathematics.[12] In antiquity, Heraclitus similarly appealed to the bow and the lyre as models of a universe that harnessed two forms of energy, potential and kinetic, tension and release ('we pull on the string, and either an arrow or a tone is released') (Rothenberg 1993: 3, 111). Other ancient thinkers appealed to the potter's wheel, the lathe and the spindle to conjure the concept of a spinning, perfect, harmonious university: an eternal circle (Rothenberg 1993: 112–14).

These supposed 'analogies' might initially seem to follow an impossibly distorted logic. We invent a technology – books, watches, computers – and then we project it onto Nature and say, 'Nature itself is like one of our machines!' Nature is like a book, the universe is like a watch, the mind is like a computer. But Nature is not a book, any more than the universe is a watch. Such thought processes seem to be perversely anthropomorphic, analogy run amok, not unlike theology: just as we create gods in the image of humans, so we create Nature in the image of our technologies. One might go a step further: just as the Enlightenment saw the notion of God as a human product, modelled on human attributes, perhaps we need a second Enlightenment that would see our notion of Nature (sometimes, at least) as an equally human product, modelled on human technologies.

But this initial reaction becomes less tenable when one considers two impressive counter-examples, namely, Darwin and Einstein. The first chapter of Darwin's 1859 *On the Origin of Species* is entitled 'Variation under Domestication', in which Darwin analyses the ways in which agriculturalists and stockbreeders had long been breeding animals and grafting plants in order to select and encourage certain traits. Darwin presented his own theory as a projection of this *artificial selection* of traits undertaken by breeders into nature itself: a *natural selection* (Darwin 2009: 17–48). Like many others, Darwin used a human technology to interpret nature. Similarly, Einstein's 1905 paper on special relativity begins with a reflection on the relation between two pieces of technology: a moving train and a ticking clock ('If I say: "That train arrives here at 7 o'clock", I mean something like this: "The pointing of the small hand of my watch to 7 and the arrival of the train are simultaneous events."') (Einstein 1905). Although Einstein was not imposing a technical model on Nature, the theory of relativity would have been impossible to even think in a world without clocks (Galison 2003: 221–93; Canales 2015: 620–45). Two of the most important developments in the sciences – evolution and relativity – were dependent for their formulation on previously developed technologies.

How then are we to understand the maker's knowledge that is contained in these technical artefacts? We usually tend to think of the production of a technical artefact as the 'application of a theory', as when an architect designs a house and contractors build it. But in the broadest sense it is the reverse that is true: from an evolutionary viewpoint, as we have seen, it is technology that long preceded 'theory'. Moreover, we often presume that the creation of a technical artefact requires a 'mental image' in the mind of its maker, a model or representation of the object to be produced, an Idea – this is precisely the *hylomorphic schema* that Gilbert Simondon famously critiqued (Simondon 2020: 21–54). But as Gary Tomlinson has shown, in analysing the prehistoric 'biface', it was the tool *itself* that was the means of transmitting the 'operational sequences' of its own production, without requiring a self-conscious intentionality behind it (Tomlinson 2015: 51–88). Bertrand Gille proposed the term 'technemes' to indicate the knowledge that is thereby transmitted from master to apprentice (Gille 1986: 1144). But we can see why we would comprehend nature through our technologies. It is not that we comprehend nature through an 'analogy' between natural objects and technical artefacts, or that technologies provide with 'metaphors' for understanding nature. Analogy and metaphor are still primarily linguistic operations. Rather, natural objects are organisations of matter, and tools and machines are the ways in which we have learned to organise matter. Since we have a maker's knowledge of our own machines, and what we might call their 'technical schemata', we use that knowledge to comprehend the organisations of matter that we find in nature. In other words, it is our maker's knowledge of technical artefacts that gives us a knowledge of nature itself. Technologies, in short, are forms of knowledge: we know not only through what we can say (propositional knowledge); we also know through what we can make, what we 'can do'.

VIII. Totipotence

I would like to conclude, very speculatively, by returning to a concept we have already mentioned, namely, *totipotence*. Following Serres, we used the term as a way of describing the de-specialisation of human organs such as the hands, which, like stem cells, are capable of taking on an almost indefinite number of functions. In *Difference and Repetition*, Deleuze spoke of white light, which virtually contains all colours, or white noise, which virtually contains all sounds. In a similar vein, one might speak of the body without organs (the egg) as a white stem cell that virtually contains in itself all the organs and functions it is capable of externalising. But this brings us to a final speculative question: If technologies are externalisations of the body, is the human body also capable of externalising its totipotence? In other words, is abstraction itself born from our own bodies?

The initial answer would seem to be 'yes'. Why did we once put fences around pastures and meadows except to create artificial empty white spaces in which we could raise our domesticated animals and plants? The diversity of cultures on the planet presupposes this very gesture (the very term 'culture' is derived from 'cultivation'). The same is true in economics, for what is a coin, a piece of money, except a white promise: we can exchange it for a night on the town, a meal with friends, a book to curl up with. If money is equivalent to everything, it is because, in and of itself, it is worth nothing; it is a pure abstraction. Do there exist cognitive white objects? A famous fragment of Anaximander identified the origin of geometry as what he called *apeiron*, an indefinite with no limits, in other words, a purely formal and white space that rather quickly received the name of the Earth or Geo, which geometry measured and mastered. In algebra, as we have already noted, the variable x can take on all values because it has none in and of itself.

Indeed, one could say that metaphysics is itself the domain of de-differentiated concepts. For instance, the concept of matter is a *hyle* without specification; but when matter in the form of wood, stone, metal, crystal, molecule, atom, particle or quark, then the generic concept of matter becomes useless. The white concept of space has a translucid content, innocent of all the things of the world; but when it has Euclidean space, or projective space, or a topological space that multiplies its dimensions, then we no longer say anything about space in general, and it disappears from our preoccupations. Similarly, desire and love are white concepts, since we always desire a particular thing, and fall in love with a particular person. This is how metaphysics used to work: it was de-differentiated. It speaks of matter before we have molecules or crystals; it speaks of the individual before we have either Peter, Paul or Mary; it speaks of consciousness before it becomes the 'consciousness of something' (Serres 2018: 66). But if this class of white concepts is made possible by the totipotence of our own bodies, then we could take the further step and follow Deleuze in affirming that 'the abstract is lived experience. I would almost say that once you have reached lived experience, you reach the most fully living core of the abstract [. . .] You can live nothing but the abstract and nobody has lived anything else but the abstract'.[13]

We have presented eight concepts as a preliminary manner of approaching Deleuze's philosophy of technology: (1) *prosthesis* (technological artefacts are externalised organs); (2) *proto-technicity*, or originary technicity (but this technicity already exists in Nature, all the way down, and precedes any 'theory'); (3) *exodarwinism* (the fact that evolutionary time has bifurcated, and technology evolves in a faster and accelerating time scale); (4) *de-specialisation* or de-differentiation (what conditions the externalisation of organs is their deterritorialisation); (5) *motricity* (the link between the brain and the hand/mouth is primarily one of movement); (6) *inscription*, or graphism (the link between mouth and hand takes place through phonetic writing, when the hand reproduces speech in graphic inscriptions); (7) *maker's knowledge* (we know the organisations of matter found in nature through the organisations of matter that we ourselves have created); and finally, (8) *totipotence* (like a stem cell, the body is capable of externalising an almost unlimited number of forms and functions; it is itself an abstraction and is the source of abstractions). Far from being complete or systematic, these concepts are components of an assemblage that inevitably remains open and dynamic.

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Notes

1. Kapp 2018. In France, Kapp's work influenced the work of Alfred Espinas (Espinas 1897). Arnold Gehlen would later add to Kapp's notion of organ projection the principles of organic relief (*Organentlastung*), organic substitution or replacement (*Organersatzes*) and organic strengthening or improvement (*Organüberbeitung*). See Gehlen 2003.
2. On the role of instruments in science, see Galison 2003.
3. The term 'originary technicity' seems to have been initially coined by Jacques Derrida and developed by Bernard Stiegler. See Bradley 2011.
4. Bergson 1911: 133–9. Oliver Sacks, in his book *Musicophilia: Tales of Music and the Brain* (Sacks 2007), notes that anatomists can tell that a person is a pianist by examining their MRI brain scans, since the motor sequences required to play the piano are complex and the pathways can be seen in their brain imaging (p. 94).
5. See Deleuze 2024, seminar of 10 November 1981: 'There is a speed proper to thought, there is a movement proper to thought, there is a duration proper to thought.'
6. See Deleuze and Guattari 1977: 142: 'Society is not first of all a milieu for exchange where the essential would be to circulate or to cause to circulate, but rather a socius of *inscription* where the essential thing is to mark and to be marked.'
7. On the techniques of orality in Homeric verse, see Lord 1960 and Parry 1987. On techniques of memorisation, see Yates 1966.
8. An extreme version of such 'intellectualism' can be found in the article by Jason Stanley and Timothy Williamson entitled 'Knowing How' (Stanley and Williamson 2001), which argues that all knowing-how is reducible to knowing-that (presumably an embryo that 'knows how' to produce an organ must be in possession of propositional knowledge). For a rejoinder, see Alva Noë's 'Against Intellectualism' (Noë 2005).
9. See Vico 1988: 45: 'For the Latins, *verum* (the true) and factum (what is made) are interchangeable, or to use the customary language of the Schools, they are convertible.' For analysis, Berlin 2000: 30–41.
10. See Hobbes 1839: 184, as cited in Hintikka 1974: 82: 'The science of every subject is derived from a precognition of the causes, generation, and construction of the same; and consequently, where the causes are known, there is place for demonstration, but not where the causes are to seek for. Geometry therefore is demonstrable, for the lines and figures from which we reason are drawn and described by ourselves; and civil philosophy is demonstrable, because we make the commonwealth ourselves. But because of natural bodies we know not the construction, but seek it from the effects, there lies no demonstration of what the causes be we seek for, but only of what they may be.'
11. Isaiah Berlin (Berlin 2000) notes that Vico's distinction would reappear in nineteenth-century Germany in the difference between the *Naturwissenschaften* (natural sciences) and the *Geistwissenshaften* (human sciences), each with their characteristic way of knowing: *Erklären* (explanation) and *Verstehen* (interpretation).
12. This famous phrase is from Robert Boyle's book *The Usefulness of Natural Philosophy* (Boyle 1772, vol. 2: 6), referring to the practice of shorthand, then much in vogue. For Boyle, 'living things were "texts" whose interpretation called for "penetrating indagations" directed toward the discovery of their "unobvious properties"' (Harrison 2015: 78).
13. Deleuze 2024: seminars of 14 March 1978 and 21 March 1978.

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