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# More than Machines

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The Restless Clock: A History of the Centuries-Long Argument over What Makes Living Things Tick
by Jessica Riskin.
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When you consider the difference between a human being and a machine, you start with some idea about what it is to be a human being and what it is to be a machine. Some people now celebrate the technological advances that can make it hard to tell the difference; others view that difficulty with anxiety. They are concerned when machines do what we want to do; and they have species-self-doubt when machines do things that once defined what it was to be uniquely human. The worst worry is that the machines will refuse our orders, that they may acquire a will of their own, and want free agency.

You start out with some matter-of-fact presumptions about what each sort of entity really is. If you're reading this piece, you're almost certainly a person, and you assume that its other readers are too. You might be reading it on a machine, just as I wrote it on a machine, and it was typeset on a machine. I didn't have a problem knowing that my laptop was a machine, but I'd be hard put to define human beings and machines such that the definitions of each were distinct, clear, up to date with the latest technological advances, and would pass muster with the artificial intelligence experts and cognitive psychologists who theorise about these things for a living.

Some time ago, it was confidently said that people uniquely have 'intelligence', or 'rationality', or that they possess 'language', or that they have 'feelings', or even that they can 'adapt flexibly to changing situations', while machines have none of these competences. These days, I can't be the only one who sometimes feels a bit unsure about these distinctions. I have a cheap chess-playing programme that usually beats me; I know that IBM's Deep Blue beat Gary Kasparov and that DeepMind's AlphaGo beat the human Go master.* Sometimes I get angry at my car's satnav device: she seems to me a little too prissy and self-satisfied, and thinks she knows best how to get around my own town. (I don't think of her as stupid, just as having an agenda of her own.)

These things have a deep history, and Jessica Riskin's wide-ranging, witty and astonishingly learned book aims to recover it. People in the past thought in radically different ways from the way we do now about what it is to be a human being and a machine, and none of these past sensibilities was uncontested in its own time. In any period from at least the late Middle Ages

through to the 19th century, arguments about the properties of humans and machines were invariably drawn into discussions about animals and about divine agency. Each entity of the tetrad (humans, machines, animals and God) was considered relationally: to know the properties of any one was to imply something about the properties of the others. In the 17th century, for example, to be human was to be a little lower than the angels but – because of God's intentions and creative acts – much higher than the beasts. New tendencies in 17th-century philosophy and science pictured nature, animals and human bodies as divinely designed machines, though there was conflict over whether anything in nature could be explained in mechanical terms, whether only some things were machine-like, or whether 'mechanical nature' was just a metaphorical way of speaking.

These days, we're not much concerned about the human-animal distinction. Most people accept that human beings are animals and, following Darwin, many natural and social scientists are increasingly drawn to thinking about human cognitive and emotional behaviour in terms of our pre-human, or proto-human, evolutionary ancestors. But animals are not as pertinent to modern human experience as they once were; we don't hang around them as we did in our pre-industrial, pre-urban past. Beasts tend to get drawn into these discussions mainly when we're prompted to consider how, and whether, we should treat them 'humanely'. In moral and practical discussions, we may wonder whether caged hens are unhappy, whether lobsters suffer when they're dumped into boiling water, or how clever our pet dog is. In philosophical debates over whether you can explain mental states in terms of material substrates, it's been asked 'What is it like to be a bat?' – though Thomas Nagel's famous essay of 1974 wasn't really about the consciousness or sensory world of bats but about the consciousness and sensibilities of reductionist philosophers. (Nagel's answer: we don't know, and we certainly aren't on the way to knowing when we invoke objective facts about the bat's neural make-up. What it's like to be a bat is a feature of the bat's unique subjectivity, not of its nervous system.) Apart from these sorts of considerations, the human-animal thing is yesterday's problem. So too, for many, is the God-human thing. That question hasn't quite gone away – as Richard Dawkins and the New Atheists would like it to – but you don't get published in philosophy or neurophysiology journals by invoking our unique relationship to a Creator God as a way of accounting for our mental and vital properties. The human-machine problem continues to occupy us very much. And the greatest contribution of Riskin's sweeping survey is to put a question about what people have historically thought machines were, such that we and the animals were either like or unlike clocks, pumps and other sorts of mechanical artefact.

The book starts with medieval ideas about machines and animals; it goes on to discuss the mechanical philosophies of the Scientific Revolution; the automata crazes of the Enlightenment; the tensions in 18th and 19th-century life science over design, organisation, organic change and embryological development; and it finishes with discussions of cybernetics, robots and artificial intelligence. The scope and ambition are hugely impressive. But the book is really about nothing so coherent as intelligence (human, animal or mechanical), though we now have enough problems even saying what that is. It's about something Riskin calls agency. What is agency such that we can say what sorts of entities have it? It's a notion she is content to leave rough around the edges, perhaps prudently, perhaps frustratingly. 'By "agency",' she writes, 'I mean an intrinsic capacity to act in the world, to do things in a way that is neither predetermined nor random. Its opposite is passivity.' 'Agency' resembles consciousness, but not very closely: 'I mean simply something like consciousness but more basic, more rudimentary … A thing cannot be conscious without having agency,

but it can have agency without being conscious.' So, in Riskin's fruitfully idiosyncratic usage, the heliotropic response of sunflowers is evidence of agency; and maybe so too are the flow of water from higher to lower levels, the elasticity of coiled springs, and the drift of the compass needle to the North. The movement of one billiard ball when struck by another doesn't appear to involve agency, for it depends entirely on the extrinsic cause of the first ball's movement, with the contacted ball reacting, so to speak, mechanically.

The story Riskin tells is about how some people once thought of machines as having agency, and how we came to think otherwise. In early modern science, the solar system was understood as a machine, the bodies of animals and human beings as machines, and the ultimate constituents of nature as micro-machines – corpuscles defined only by their size, shape, arrangement and states of motion. However, Riskin shows that this story about a pervasive conceptual shift to the mechanisation of nature covers profound disagreement about how to understand machines and how knowledge of machines might be metaphorically or substantively extended to understand animate beings. Riskin maps those divisions onto the fundamental religious cleavages in post-Reformation culture. The Catholic Church was the main patron of the 'great bustling population' of automata that 'thronged the landscape of late medieval and early modern Europe' and were 'familiar features of daily life'. There were mechanical Christs on the cross, bowing, shaking and rolling their eyes in agony; the crowing mechanical rooster on top of the great Clock of the Three Kings in Strasbourg Cathedral; angelic automata, carrying saintly souls to their reward; and a mechanical Assumption of the Virgin – Mary blissfully hoisted up to heaven by an 'endless screw'. Pre-Reformation Catholicism had no problem with such mechanical icons for, Riskin says, the Catholic world 'held no sharp distinction between the material and the spiritual, earthly and divine … The icons were mechanical but neither passive nor rote.' They were, she writes, 'inspirited statues: they were mechanical *and* divine.'

Protestants hated this sort of thing. Such automata were judged to be engineered idols, sacred scams, defrauding the credulous. The iconoclasts despised them because, in Riskin's view, Protestantism insisted on a radically different cosmological relationship between matter and spirit. Matter was, for them, 'brute and stupid', incapable of self-movement, self-organisation or any inherent disposition to act. 'Machinery' in Protestant thought, Riskin says, 'could not represent divinity other than deceitfully. One could no longer know a thing to be mechanical and simultaneously believe it to be divine,' or even to be animate. And if indeed nature was just inert stuff, and if the divide between matter and spirit was absolute, then there was nothing else these church automata could be but yet more sorry examples of Papist hocus-pocus.

Riskin exaggerates the extent to which automata were around every corner in the late Middle Ages and early modern period, though she is quite right to point to their symbolic significance for both scientific and religious thought. And it isn't clear that Protestants were unanimously appalled by the idea of inspirited matter. The radical English Protestant sects – Diggers, Ranters, Seekers and the like – applauded by Christopher Hill in *The World Turned Upside Down* (1972) challenged ecclesiastical hierarchies by maintaining that all matter was endued with spirit, that God was present in the fabric of nature, even that God and nature were one. No need for an external spiritual deity to animate the world; no need for priestly intermediaries between man and God. It's true that Boyle and Newton asserted that matter was inactive and inanimate, and that they invoked the mechanical metaphor to show nature's utter dependency on God as the Master Agent and sole source of activity and design. Yet their

work also populated the world with an array of ‘active principles’, and neither was confident that vital phenomena could be sufficiently accounted for in solely mechanical and material terms. Matter might be ‘brute and stupid’, but there were turns of phrase in Newton’s work that made it difficult to see how the activity of the natural world could be sufficiently accounted for by the theory of inert matter. Newton, indeed, had serious problems explaining how it might be that gravitational attraction was not ‘an essential and inherent’ property of matter, and he chose to express his first law – of inertial motion – by referring to an ‘innate force of matter … by which every body … endeavours to preserve its present state’.

Riskin’s reading of the Catholic René Descartes is a superb contribution to understanding what this great ‘dualist’ meant when he drew attention to automata – he’d evidently seen some of them – and imagined the human body as ‘a statue, an earthen machine’. Descartes insisted that animals were machines through and through and that human beings too were mechanical, with the exception of their immaterial soul. Yet Riskin reminds us that these animal-machines were understood to be wholly alive: ‘Rather than to reduce life to mechanism, he meant to elevate mechanism to explain life, never to explain it away.’

Agency was more plausibly ascribed to some sorts of machines than others. The machines that especially impressed Descartes were complex hydraulic devices, where a single motive power – the flow of water – resulted in many different effects. These automata included hydraulically powered grottos which, unlike clocks, could display responsiveness to human presence – a responsiveness similar to that of living bodies, which, in Cartesian thought, were similarly moved by ‘animal spirits’ flowing through hollow nerves. (In the 13th and 14th centuries, French aristocrats constructed parks full of ‘frolicsome engines’ that spouted water at visitors when they came near – ‘eight pipes for wetting ladies from below’ and three for pasting them with flour.) Fluids like water, Riskin says, appeared to Descartes and others to offer ‘a material basis for agency’: they ‘pursue equilibria, climb siphons, exhibit a kind of purposefulness’. Hydraulic automata *seemed* lifelike – that was their point – but, for Descartes, machines *were* lifelike: they lacked reason and a soul, but they were thought to possess other vital attributes. And this seeming-agency retained something of its hold on the imagination even as 17th-century moderns made sport of Aristotelian explanations of elements ‘seeking their natural place’. Old explanatory habits were hard to break, even if one wanted very much to break them.

So animals were machines, but Descartes maintained a range of views of what capacities these machines possessed. He may well have been in an early modern minority in maintaining that animals possessed neither thought nor language. (Montaigne contended that some beasts had both these capacities, and even perhaps reflective consciousness. He wondered what it was like to be a cat, but he also wondered what it was like for a cat to wonder what it was like to be a human being.) Descartes, Riskin writes, was in fact ‘equivocal’ about the sentience of beast-machines. On some occasions, he claimed that animals only seemed to have emotions; on others, he granted dogs, horses, monkeys and magpies a range of emotions, including hope, fear and joy, none of which, of course, required thought. The Cartesian animal-machine wasn’t just alive; it was also, in some versions, a sensible and a feeling thing.

There were later Cartesians who enthusiastically dispensed with these nuances about the faculties of mechanical life, and there were critics who pushed back against the conception of animals as machines and, more fundamentally, against the radical separation of matter from

activity and spirit, which was one of the core principles of 17th-century 'brute mechanism'. In the early 18th century, the German polymath Gottfried Wilhelm Leibniz invited readers to imagine a machine that could think, a kind of thought-factory big enough for you to walk into and look around. What you'd see were the sorts of gears and wheels and screws and levers that could be observed in a flour mill but, Leibniz said, 'never anything to explain a perception'. In an echo of Nagel's account of bat-ness, Riskin sums up the lesson Leibniz meant to draw from the thought experiment: 'You would understand consciousness no better than before entering the mill of the mind. Looking at the machinery, the pushing and pulling, the moving parts, the thing you would be led to understand was that perception and consciousness were not that.' These resided 'not in the operation of the mechanism but in its very substance'. Sentience and purposeful agency were not apart from matter; they belonged essentially to matter.

It was in this connection that Leibniz drew attention to aspects of clockwork. 'In German,' he wrote (he was writing in French), 'the name for the balance of a clock is *Unruhe* – that is to say *disquiet*' (or restlessness). Clocks, he said, were like human bodies in their states of constant agitation, the mutual responsiveness of their parts, their intrinsic tendencies to certain types of motion. His point in talking about clocks wasn't to show the ultimate dependence of their activity on external sources, but to argue that machinery had a self-moving capacity, that it wasn't merely an inanimate metaphor for animate things but was itself animate. Every bit of nature was mechanical, he insisted, down to its smallest components, but these bits were 'full of life' – though you still have the problem of saying what sentience is at a micro-level. While other critics of 'brute mechanism' objected that 'living creatures were more than machines', Leibniz countered (in Riskin's nice formulation) 'that *machines* were more than machines'.

THE ARGUMENT from design, proving the existence and wisdom of God from the evidence of nature, goes back to the medieval period, but it enjoyed a surge in cultural popularity in the 17th and 18th centuries, and it was articulated through practical understandings of machines and machine-makers. You come across a watch lying in the road; you take it apart and appreciate its intricate contrivance and the superb adaptation of complex structure to function. It is a human artefact and you know, of course, that there are intelligent human watchmakers. Now repeat this exercise with a natural thing, like the eye of a fly. The intricacy of contrivance is even more impressive – as Nature is everywhere superior to Art – but here there is, of course, no human designer. That is proof of Intelligent Design, of the existence of a Designer God, and of his supreme intelligence. Nature does not organise itself; it does not move itself; it has no intrinsic ends or purposes. It needs external animation.

The design argument distilled sensibilities concerning the nature of machines and the nature of Nature. It was a resource useful for thinking about mechanical contrivance, about natural things that bore comparison with mechanical contrivances, and about the total reliance of 'brute and stupid' nature on divine agency. It belonged both to natural science and to theology. Darwin encountered the argument from design as a student at Cambridge; he was enormously impressed by its power; and he set about destroying it. By the time he began to propose natural selection as a replacement for Intelligent Design as the major agent of organic change, the design argument was already intellectually battered and bruised. Naturalists and philosophers – including La Mettrie, Maupertuis, Hume, Kant and Lamarck – had rejected it for a range of reasons. Why must we infer design from order? Why couldn't life

just be an effect of organisation? And why couldn't organisation, even changes in organised forms, over immense periods of time, just *happen*? By 1800, Riskin says, 'a living being in scientific, philosophical and literary understanding had become, in essence, an agent.' Animate creatures, including human beings, were machines, but they were not designed machines. Darwin, it's well known, did not invent the idea of species change, and Riskin reconsiders the prehistory of Darwinian evolution in terms of long-standing debates over mechanism, theories of matter and the legitimacy of the design argument.

The 18th-century career of what's called vitalism – the attribution to living things of inherent powers of self-animation and self-organisation – was not a regrettable detour from the high road of scientific materialism; much about it was, instead, an attempt to rid philosophy and science of the idea of a designing deity. Riskin administers a dose of historical realism to present-day evolutionists – notably Richard Dawkins – who choose to dismiss, ignore or repair Darwin's own 'Lamarckian' views of the limits of natural selection: his stress on the importance of use and disuse, and of species variability flowing 'from the indirect and direct action of the conditions of life'. To the extent that Darwin shared a sensibility with Lamarck on such matters, 'he did so,' Riskin writes, 'not out of a failure of nerve or an inability to carry his own revolution all the way, but on the contrary because he too sought a rigorously naturalist theory and was determined to avoid the mechanist solution of externalising purpose and agency to a supernatural god.'

From the late 17th century, and on into the Enlightenment and early 19th century, metaphysical disputes over matter and agency were charged up by new and vastly improved automata, machines that offered a more powerful challenge to ideas about capacities presumed to belong uniquely to human beings. There was a mechanical flute player, not a music-box but a statue that actually blew air into the instrument, just as human musicians did; there was the Mechanical Turk, which played chess very well and went on a European Grand Tour, to immense acclaim and some scepticism; in the early 1770s, there was the famous Jaquet-Droz mechanical female organist (superbly interpreted in Adelheid Voskuhl's *Androids in the Enlightenment*);† there was a Mechanical Duck, which took in food and excreted it from the other end; and there were credible plans by a French engineer called Le Cat to turn Descartes's imagined 'human statues' into reality – automata-humans that would breathe, circulate blood, digest food and secrete vital fluids, and would have all the organs appropriate for these functions, 'heart, lungs, liver and bladder, and God forgive us, all that follows from it'. What were the defining attributes of human beings that allowed some people to conclude that the gap between machines and humans had finally been bridged, and what were the grounds for insisting that human beings had properties and competences machines could never possess? Learned opinion was divided about whether the machines and their performances were genuine: for every believer, there were sceptics who thought that, as with the religious icons of the past, some deception was going on: the human-like mechanical performances must have been produced by secreted human agents.

Some 18th and 19th-century sceptics accepted that a 'chess-playing' automaton could 'play' chess, but only predictably, with a limited repertoire of pre-programmed moves. True play required the player to respond flexibly to an indefinitely large number of situations. 'No one move,' Edgar Allan Poe wrote in 1836, 'necessarily follows upon any other': chess was both a matter of heroic rational calculation and a matter of judgment and situational adaptation. No machine could possess either of those capacities, still less both of them. That was a hard Cartesian sensibility, but others pointed out that softer criteria could be used to draw the line

between the human and the mechanical. Speech, for example, might be a matter of having thoughts to express, or it might be to do with having the appropriate organs to form air-streams into intelligible sounds. In order to build a talking automaton, the mechanic would have to understand, as Riskin puts it, 'what goes on in the larynx and glottis … the action of the tongue, its folds, its movements, its varied and imperceptible rubbings', and so on. No human being had that sort of understanding and no mechanic had the ability to make things out of flesh and blood. Yet La Musicienne, the organ-playing machine, caused a sensation by virtue of her apparent ability to express emotion and her evident ability to elicit emotion. She produced music as humans would. Her fingers pressed the keys; her chest rose and fell as she apparently breathed; she bowed gracefully; she was visibly moved by the music she performed, and her audience was moved in turn. A critic who had not seen her defied 'all the machinists on earth to make an artificial face that expresses the passions, because to express the passions of the soul, one must have a soul', but many people who flocked to see her thought he was wrong.

So one sort of defining human capacity was high rational intelligence, but another was, as it were, the opposite. The Mechanical Turk had his unbelievers, but there were many more who didn't accept that the Mechanical Duck could actually perform such low vital functions as eating, digesting and defecating. (The duck's designer candidly admitted that what it accomplished wasn't 'perfect digestion', though he maintained that its processes were 'copied from Nature', the food digested 'as in real Animals, by Dissolution', taking place in a 'Chymical Elaboratory'.) People who were swept away by chess and organ-playing automata drew the line at mechanical digestion and excretion. A new sort of challenge had been posed. The traditional questions were whether only human beings could think, or speak, or have and express emotions. The bottom line now was whether machines could shit.

The chess-playing Turk was eventually exposed as a fraud, but there remained some – like Charles Babbage, who conceived the Difference and Analytical Engines in the 1820s and 1830s – who, even if they accepted that there was human agency behind the Turk, reckoned that the thing was nevertheless possible, indeed that 'every game of skill' (including those, like chess, which were regarded as paradigms of rational calculation), was 'susceptible of being played by an automaton'. Mechanical calculators were not new in the 19th century, but as they became more plausible and, especially, as mechanical devices replaced human labour that had once seemed to demand intelligence, a Cartesian sensibility was, Riskin writes, turned on its head, 'demoting calculation from a paradigm of intelligence to the antithesis of intelligence'. Machines might now do things that once justified attractive rates of pay for human agents. The metaphysical human-machine problem then became a central problem in political economy and in political action. The Czech word *robotnik* traditionally designated a serf, a forced labourer; in Karel Čapek's science fiction in the 1920s, the robot was an artificially intelligent agent concocted out of moulded protoplasm; now robots manufacture both cars and unemployed workers. Robots already supplement both humans and cuddly animals in providing emotional support for the aged and unwell – and, given the political realities of healthcare, they will surely assume ever greater importance. Where's the intelligence in all that? Who, or what, is an agent?

These questions are metaphysical, but they are also theological, and no historian of ideas or politics should disregard them. *The Restless Clock* establishes that thinking about machines, animals and matter belongs centrally to the history of religion and to all the things that follow from religion. Riskin shows in her concluding chapter that our thinking about these subjects has always had a conversational character. What counts as agency, intelligence, consciousness and the state of being human is constantly changing in response to cultural and technological realities. Machines can now do things that were once thought possible only for humans; the human beings who now think and act *with* machines are different beings, with different powers; and, while God is now not much mentioned among advanced thinkers, there is no lack of visionary futurologists who imagine a state in which we will become as gods – immortal, immaterial, our minds fittingly uploaded to the Cloud from their fleshly confines.

Yet there is a sense in which little of this matters. For a long time, scientists and philosophers have maintained that natural laws and technical artefacts are what they are regardless of the metaphysics they are supposedly 'founded on'. On this view you can build much the same watch whether or not you think its springs have sentience, and the inverse-square law of gravitation remains the same whether or not you think that the capacity of attraction belongs essentially to matter. Neither do metaphysical ideas about the capacities of animals, machines and the human mind matter much to our everyday interactions with one another and with the material world. When Descartes advanced the idea that animals were wholly mechanical, some of his acolytes took that notion more unreservedly than he did. In the 1670s, the Cartesian Father Nicolas Malebranche understood Descartes to be saying that animals were devoid of sensation and feeling, so when a pregnant dog was playing around at Malebranche's feet, he viciously kicked it in the guts, which astounded and upset his companions. Malebranche, however, blandly assured them that the animal felt nothing; its howling was just a mechanical reflex. Descartes himself had a pet dog, named Monsieur Grat (Mr Scratch). The philosopher greatly valued the dog's company on walks; he evidently treated him with affection and, some say, he even talked with him. That's the sort of thing people do, whatever their metaphysical position on agency and sentience, just as I yell at my PC (he's called Bill), which is a machine, and who annoys me very much.

## Footnotes

* Paul Taylor wrote about AlphaGo and machine learning in the *LRB* of 11 August.

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† Chicago, 294 pp., £20.50, March 2015, 978 0 226 03416 4.