Robots in Science Fiction
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Nature and Culture

In earlier lectures we looked at some of the ways different thinkers and writers created contrasts between what was definitely human (often educated, white men) and what might not be (apes or women). Because both apes and women are naturally occurring, the people who wrote about them assumed the differences they were analysing were natural ones; some writers proclaimed that women were *naturally* less intelligent, while others argued that women possessed the same *natural* rights as men. Since robots are clearly artefacts, part of human culture, they ought to reveal a sharper contrast between the way things (naturally) are, and the way people might like them to be. After all, if science allows the construction of entirely artificial people, surely we could make them according to entirely human standards and completely ignore the constraints of nature? We might expect robots to completely undermine the whole idea of 'human nature'.

However, robots often seem to reinforce what earlier examples had already suggested: that the contrast natural and artificial (or, nature and culture), is not as simple as it might seem. To understand why, it is helpful to take a very quick look at the history of the nature/culture divide. Some of the earliest tools with which people tried to understand the world around them were myths, poetry and other kinds of literature; each provided powerful ways of thinking about how nature worked and what it meant. Inevitably, the languages and metaphors that were used to describe or analyse natural phenomena become aspects of how people understood nature. For example, many myths personified natural forces as deities or spirits and interpreted droughts or storms as evidence that the gods were angry. Clearly, that way of thinking made it impossible to say exactly where nature ended, and culture began. In Europe and those countries who derived their cultures from Europe, one particular way of thinking – which became known as science – gradually took over some of the work that had once been done by mythology and literature. Science asserted that the universe contains certain things (such as stars, electrons and apes), which existed long before there were any people to examine or understand them. The systematic study of such clearly natural objects opens up the possibility of acquiring objective knowledge about Nature, untainted by human preconceptions, hopes or fears. (Part of the appeal of the new sciences was this claim of potentially universal knowledge, which wasn't specific to any one tribe or group.) By contrast, Culture is almost always about the differences between groups; before people came along, the universe did not contain symphonies, low-fat yoghurt or racism – for better or worse, these are clearly the products of human culture.

The difference between nature and culture would appear to be clear. And yet, as we saw when we looked at fictions which explored the creation of supposedly perfect women, gender seems to be as much a creation of culture as it is of nature; society expects men and women to act in different ways (and "act" is the key word here, since gender often seems like a performance). However, some of the same issues arise with apes, since what we know (or think we know) about them has changed constantly. Those changing understandings could be seen as evidence of progress; as scientists gradually learn more about apes, humans acquire increasingly objective and reliable knowledge. However, the history of science throws doubt on that assumption. For example, history suggests that scientific ideas are always a product of the time and place where they emerged. The idea of natural selection, for example, emerged in the world's first, industrialised capitalist economy partly because the free market provided a metaphor that allowed two different British Victorians (Charles Darwin and Alfred Russel Wallace) to see how organisms could come to look as if they had been intelligently designed, even though there was no intelligent designer at work. The coincidence of two people hitting on the same scientific idea at the same time suggests that there was something about the

shared *culture* of nineteenth-century Britons that shaped their understandings of *nature*.

New scientific ideas are often prompted by political, economic or social changes in human society. As we saw in the apes lecture, the impact of feminism in the 1970s helped bring many more women into primatology, and they played a key changed scientific understandings of apes; so a cultural and political shift proves to be as much part of the history of the science as the advent of improved fieldwork techniques. And regardless of what prompts a new scientific insight, it always has to be communicated using existing language – using metaphors that would be meaningful to the audience. For example, when Darwin wanted to explain to his readers how a particular species of orchid had become adapted to ensure insect pollination, he described its curved petals as acting "like one of those conical traps with the edges turned inwards, which are sold to catch beetles and cockroaches in the London kitchens".[1] A clear, familiar image helped the reader understand, but it also brought the Victorian world of mass-produced commodities, made and sold to solve the problems of dirty kitchens, vividly into the readers' understanding of a particular scientific point. And, of course, a trap is something designed in order to achieve a specific purpose. Darwin's metaphors constantly smuggled questions of (potentially divine?) intention back into his supposedly mechanical world.[2] (Such influences may be less obvious when scientists are addressing other scientists using more formal scientific language, but even then they have to use familiar terms that have been borrowed from earlier scientific vocabularies.)

However, let's leave the nature/culture distinction to one side for a moment, and just accept that quite a lot of people find the distinction pretty straightforward. Certainly, most of the writers we considered in earlier lectures assumed they were describing natural differences; the very term "human nature" assumes that there are natural qualities that allows us to identify humans (and distinguish them from all kinds of "nonhumans"). Robots have been imagined (and, in some cases, actually built) so as to embody particular features of human nature; examining a few of these robots provides a different way of asking what "human nature" actually is. Robots are usually supposed to overcome some apparent deficiency in humans (they might be stronger than people or have had various human frailties removed). Once robots existed – whether in imagination or reality – they provided new models of what people were or could be. Some robot builders (real and fictional) have tried to make robots more human, while others have tried to make people more robotic. The dreams of rival robot makers reveal their competing definitions of what is essentially human.

Model Workers

The first robot appeared in British factories in 1835. It was a "machine apparently instinct with the thought, feeling, and tact of the experienced workman", which was installed by mill owners to put a stop to the strikes that plagued the cotton-spinning industry. It became known as the "Iron Man" and the "news of this Herculean prodigy spread dismay through the union, and even long before it left its cradle, so to speak, it strangled the Hydra of misrule".[3]

The machine in question was the self-acting spinning mule, designed by Richard Roberts and marketed by the Manchester engineering firm of Sharp, Roberts & Company. To twenty-first-century eyes, it does not look much like any kind of robot, but it had several features that made it a clear precursor to the long rows of obedient machines that endlessly assemble consumer goods in so many modern factories. One of the Iron's Man's obviously robotic features was its inhuman anonymity. The term 'Iron Man' did not name of a specific, individual machine, but identified a whole class of nameless devices, as indistinguishable from one another as the goods they produced. Modern robots are similarly interchangeable and, like the self-acting spinning mule, are used to replace human labour. Roberts' Mule was intended to replace highly skilled (and thus highly paid) adult men with fewer workers, most of whom would be lower-skilled and lower-paid women and children. Some of its admirers hoped that such machines might eventually make all human labour redundant. For many factory owners, utopia would be rows of obedient machines, tirelessly and uncomplainingly working, day and night, without pay, without meal breaks, and without demanding the right to form a union.[4] That dream was already there in embryo in Roberts' invention; it was the latest in a long-series of attempts to create a "self-acting" spinning machine – an automaton – a machine that worked by itself. It apparently

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[1] Charles Darwin, *The Various Contrivances by Which British and Foreign Orchids Are Fertilised by Insects, and on the Good Effects of Intercrossing*, 2nd (popular) ed. (London: John Murray, 1877 (1904)), 230.
[2] Robert M. Young, *Darwin's Metaphor: Nature's Place in Victorian Culture* (Cambridge: Cambridge University Press, 1985).. For Darwin's orchids, see: Jim Endersby, *Orchid: A Cultural History* (Chicago: University of Chicago Press, 2016).
[3] Andrew Ure, *The Philosophy of Manufactures; or, an Exposition of the Scientific, Moral, and Commercial Economy of the Factory System of Great Britain* (1835), 367.
[4] Steve Edwards, "Factory and Fantasy in Andrew Ure," *Journal of Design History* 14, no. 1 (2001): 24–25.

took uniquely human qualities ("the thought, feeling, and tact of the experienced workman") and embodied them in a machine. A skilled, human weaver had a feel for the strength and tension of his thread, and the machine was designed to mimic such 'feeling', but unlike the human weavers, the machines had no autonomy – and thus no desire for freedom or higher pay, nor any feeling of injustice when these things were denied. The absence of real, human emotions was precisely what made the machines model workers – a model that factory owners sometimes hoped their flesh-and-blood workers would emulate.

The description of Roberts' invention as the "Iron Man" was written by a Scottish chemist called Andrew Ure, who made his living primarily by doing chemical analyses of the dyeing and bleaching processes used in the textile industry (he was probably the first consulting chemist in British history). In the early 1830s, he made a tour of Britain's main textile districts which resulted in his most famous (some would say notorious) book, *The Philosophy of Manufactures* (1835), which bore the subtitle "An exposition of the scientific, moral, and commercial economy of the factory system of Great Britain".[5] The ideas that factories might embody a "moral" economy seems odd today, but for Ure that was their most exciting aspect. He was deeply impressed with the astonishing productivity of Britain's textile factories, which were more highly mechanised than any other factories in the world. The sheer amount of cheaply produced cloth was thrilling, but it was the mechanised, inhuman perfection of the process that excited him ("I have stood by for hours", he wrote "admiring the rapidity and precision with which the self-actor executes its multifarious successions and reversals of movement", 366). The Iron Man was among his favourite examples of the impact of machinery: "This invention confirms the great doctrine already propounded, that when capital enlists science in her service, the refractory hand of labour will always be taught docility" (368). He forecast a new moral order, in which the factory owners would escape the "servitude" imposed by striking workers (366); the robot would teach the workers to know their place and stay in it. Others agreed with his assessment; one of Britain's factory commissioners wrote in 1834 that the "introduction of this invention will eventually give a death blow to the Spinners' Union".[6]

Despite having very different values and sympathies, Karl Marx agreed with Ure that the "self-acting mule … opened up a new epoch in the automatic system", but of course he did not share Ure's delight in the vision of workers tamed by the power of machinery. Marx attacked Ure, arguing that "machinery not only acts as a competitor who gets the better of the workman, and is constantly on the point of making him superfluous. It is also a power inimical to him, and as such capital proclaims it from the roof tops and as such makes use of it".[7]

Marx and Ure represented two bitterly opposed views about the proper relations of workers and capitalists, yet they agreed about the transformative power of machinery. Ure argued that the machines would create unimaginable wealth: "how vastly productive human industry would become, when no longer proportioned in its results to muscular effort, which is by nature fitful and capricious, but when made to consist in the task of guiding the work of mechanical fingers and arms, regularly impelled with great velocity by some indefatigable physical power" (15). Marx was equally excited by the vast productive power of capitalism: "slavery cannot be abolished without the steam-engine and the mule and spinning-jenny" because "people cannot be liberated as long as they are unable to obtain food and drink, housing and clothing in adequate quality and quantity".[8] Marx and Ure agreed that the bourgeoisie – the capitalists – were unleashing previously unimaginable productive forces, but of course they had very different views about how the wealth ought to be distributed once the machines had helped to create it.

Marx and Ure lived and wrote in nineteenth-century Britain, the world's first industrialised, capitalist society. Their arguments have shaped many later visions of the robot – never tired and never disobedient, without desires or demands of its own – an ideal worker in some eyes, a degraded slave to others. Ure's utopian vision of the factory was built around analogies between human bodies and machines (as in the term "Iron Man"). He argued that the "steam-engine is, in fact, the controller-general and main-spring of British industry, which urges it onwards at a steady rate, and never suffers it to lag or loiter, till its appointed task be done" (339). And the historian E.P. Thompson argued that the steam engine was in effect a clock, which imposed its rhythm not only on the factory but the lives of workers. Thompson cited the recollections of "An Old Potter", a Methodist lay preacher of Liberal-Radical views, who deplored the workers' widespread practice of

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[5] Ure, *Philosophy of Manufactures*. All page references are to this edition.
[6] Tufnell, E.C., 1834, pp. 108-109, quoted in: William Lazonick, "Industrial Relations and Technical Change: The Case of the Self-Acting Mule," *Cambridge Journal of Economics* 3, no. 3 (1979): 231–32.
[7] Marx, Karl *Das Kapital: Kritik der politischen Oekonomie* (1867), quoted in: ibid., 231.
[8] Karl Marx, *The German Ideology. Part I: Feuerbach. Opposition of the Materialist and Idealist Outlook* (written 1845/46). https://www.marxists.org/archive/marx/works/1845/german-ideology/ch01b.htm

celebrating “Saint Monday” (awarding themselves a day off to recover from the effects of having drunk much of their pay over the weekend). He argued that “If a steam-engine had started every Monday morning at six o’clock, the workers would have been disciplined to the habit of regular and continuous industry...”. And the Old Potter had also noticed “that machinery seems to lead to habits of calculation”, such as planning and saving. (Precisely the kind of “moral economy” that Ure hoped machinery would impose.) Thomson argues that steam engines in factories were part of a much wider shift in our perception of time. For factory workers, the pace of the machines became the pace of life, forcing everyone to follow a common rhythm – one that was no longer set by the seasonal rising and setting of the sun (nor by the intensity of one’s hangover), but the remorseless thud of the engine that powered the workplace. Machines (from steam engines to clocks and watches) gradually led to time being perceived as a commodity – something that could be ‘wasted’ or ‘saved’.[9]

The steam engine was increasingly imagined as the beating “heart” of the factory, which regulated the efforts of the human “hands” who tended the machines, while the factory’s owner was its “brain”.[10] The use of such biological analogies had its counterpart in the widely used metaphor of the social body (the intellectual elite were society’s brains, the workers its muscles, etc.) Both served to make the way work and wealth were divided appear natural. But of course, one of science fiction’s functions is to challenge ideas about what (if anything) is ‘natural’. The historian Steve Edwards has argued that Ure’s vision of factories running themselves is reminiscent of Mary Shelley’s *Frankenstein*; male labour renewing itself without need of women.[11] The fully automatic factory could be considered a new, artificial life form – a rather threatening Frankenstein’s monster if you were a worker whose job was threatened. And it’s interesting to note that Ure was also a medical doctor who, in 1818 (the same year that *Frankenstein* was published), created a sensation when he used a large battery (then called a voltaic pile) to galvanise an executed murderer into apparent life.[12] The nineteenth-century could be said to have begun with the imaginary birth of the artificial human – Frankenstein’s creature animated by electricity – and the almost simultaneous birth of the robot (Robert’s first patent for what became the Iron Man was taken out in 1825). A century later, in 1920, the impact of automatic machines and the new world they made possible led the Czech writer Karel Čapek to coin the work “robot”, which he derived from the Czech word *robota* (forced labour, drudgery, which described a particular form of serfdom that prevailed in the Austro-Hungarian empire in the first half of the nineteenth century).[13] The robotic twentieth century was underway.

Reasoning Robots

Čapek’s play *R.U.R.* (*Rossumovi Univerzální Roboti*, Rossum’s Universal Robots, first performed in 1921) was a hit, which brought the new word to a global audience (it was performed in Germany that year, and in Warsaw, Belgrade and New York in 1922. The following year saw its London premiere, by which time it had been translated into thirty languages).[14]

Čapek’s play is named after the robot-making company, R.U.R., whose founders’ surname, Rossum, derives from the Czech word *Rozum* (reason), so the play’s title could be rendered as “Reason’s universal serfs”.[15] The play is set in a future where Ure’s rational vision of the perfect factory has been realised: the robots have taken over all the world’s manual labour, supposedly freeing humans for more creative tasks.[16] The action all takes place on the remote island where the robots are manufactured, and one of the main characters is Helena Glory, an idealistic young woman who represents an organisation called the Humanity League, who hope to liberate the robots (for example, by ensuring they are paid for their work). She expects to be chased off the island, but the factory managers are confident she won’t be able to disturb the robots in any way. And

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[9] “An Old Potter”, *When I was a Child* (London, 1903): 185–6, 191. Quoted in: E.P. Thompson, “Time, Work-Discipline, and Industrial Capitalism,” *Past & Present*, no. 38 (1967): 75.
[10] Edwards, “Factory and Fantasy,” 23–25.
[11] Ibid., 27–29.
[12] See Gillian Cookson “Roberts, Richard (1789–1864)”, *Oxford Dictionary of National Biography*, 2004.
[13] Horst Albert Glaser and Sabine Rossbach, *The Artificial Human: A Tragical History*, trans. Joseph Swann (Frankfurt Am Main: Peter Lang GmbH, 2011), 26–28.
[14] Voyen Koreis, Introduction and translator’s notes to *R.U.R.* and *The Robber* (Booksplendour Publishing, Brisbane, 2008). http://www.capekbrothers.vkoreis.com/robber.htm
[15] Adam Roberts, “Introduction” to: Karel Čapek, *R.U.R. (Rossum’s Universal Robots) and, War with the Newts*, ed. Karel Čapek, trans. Paul Selver and Nigel Playfair, Rossum’s Universal Robots (London: London : Gollancz, 1920 (2011)), viii.
[16] Ibid.. All page references are to this edition.

she is dismayed to find that the robots initially have no desire to be liberated; indeed, just like Ure's Iron Man, they have no desires at all, but are simply passive, obedient slaves. The robots are so completely disinterested that they lack even the basic instinct of self-preservation. And having neither needs nor desires, they would have nothing to spend their pay on.

Although Čapek's robots are clearly the descendants of their nineteenth-century counterparts, they are not actually machines. When the company's manager, Domin, first shows Helena around, he briefly explains how robots are made:

> *Domin: In two hours I will show you the kneading trough… for beating up the paste. In each one we mix the ingredients for a thousand robots at one operation. Then there are the vats for the preparation of liver, brains, and so on. Then you will see the bone factory. After that I will show you the spinning mill… For weaving nerves and veins. Miles and miles of digestive tubes pass through it at a time (16).*

The robots are machines to all intents and purposes yet are living creatures. The play blurred the boundary between machines and people, implying that inevitable technological progress will make machines that are more human, while people become more machine-like, until the human/machine distinction disappeared completely.

Although Čapek's robots are biological and have no desires and (as Domin puts it) "sex means nothing to them", they are nevertheless supplied as either male or female models (apparently there was a demand for female robots to do traditionally female work – servants, saleswomen and stenographers). However, the robots are completely indifferent to the distinction and Domin assures Helena that "There's no sign of any affection between them" (25). Yet, despite the robots' supposed lack of feeling, Helena learns that they are occasionally gripped by a strange affliction called "Robot's Cramp"; they stop work and start to grind their teeth. Such faulty robots are sent to the stamping mill (where all the robots are eventually recycled once they wear out; the maximum life span of the highest quality models is just 20 years). Early in the play we learn that Dr Gall, head of the experimental department, is trying to eliminate Robot's Cramp, but first he has to finish perfecting pain nerves, to prevent robots accidentally damaging themselves. Since he is making the robots more sensitive, more human, Helena asks why he doesn't also give them a soul, and Gall blandly explains that it would push up costs; robots have fallen from $10,000 to $150 each in in fifteen years, and the price of everything they make has fallen just as dramatically (22–23).

The nineteenth-century dream of using machines to abolish scarcity clearly motivated the staff of R.U.R., and Domin sounds rather like Marx when he explains that he hoped robots would abolish the "appalling social structure" based on work and inequality. "I wanted to turn the whole of mankind into an aristocracy of the world. An aristocracy nourished by milliards of mechanical slaves. Unrestricted, free and consummated in man. And maybe more than man" (52). Čapek's play was written immediately after the 1917 Russian Revolution, and many reviewers interpreted it as an attack on Bolshevism. However, alongside Marx, the ghost of Andrew Ure also haunts the play: when Helena asks why the factory continues making robots even though they have clearly begun rebelling, she is told that the shareholders won't hear of a reduction in production, while all the world's governments and manufacturers are demanding more (39–40). Whether it's blamed on the Marxist view of history or the ineluctable power of market forces, there's no doubt that a remorseless, inhuman logic fuels the rise of the robots. Ultimately, both capitalists and communists are equally committed to the idea that progress in both inevitable and embodied in ever-increasing piles of commodities.

A decade before R.U.R. appeared, the American engineer Frederick Winslow Taylor published *The Principles of Scientific Management* (1911), his response to the supposed disorder of the world of work. Taylor's goal was to turn each enterprise – its machines *and* people – into a single, smoothly running instrument for production.[17] As Taylor succinctly put it, "In the past the man has been first; in the future the system must be first".[18] Taylor's methods (especially the time and motion study, which set rigid goals for the pace at which each worker moved) were combined with his countryman Henry Ford's production lines, to produce the modern factory, in which every worker was made to feel increasingly like a cog in a machine. In the same year that Taylor published *Scientific Management*, the anarchist writer Emma Goldman condemned factory life as mere "machine subserviency." She argued that modern industry had already taken human beings and "degraded [them] into a mere part of a machine" so that each worker's "activities are mechanical;

[17] Dustin A. Abnet, *The American Robot: A Cultural History* (Chicago: University of Chicago Press, 2020), 89.
[18] Frederick Winslow Taylor, *The Principles of Scientific Management* (Auckland, New Zealand: The Floating Press, 1911), 7.

his work, instead of liberating him, is riveting his chains still deeper into his flesh".[19]

The Taylor/Ford vision was brilliantly satirised in Charlie Chaplin's *Modern Times* (1936), in which Chaplin's character is placed under rigid surveillance (in a prophetic foretelling of twenty-first century working conditions in businesses like Amazon, the factory manager even appears on a video screen in the factory toilet to tell Chaplin to get back to work). Like all the other workers, Chaplin has to work at the relentless pace set by the machine and in one of its most famous sequences he is literally swallowed by it. He emerges with his own version of the "Robot's Cramp", his hands twitching involuntarily as he cann0t help repeating the same movement that the production line demands of him. Chaplin shared many of Goldman's values, and his satire was aimed at the greed of American capitalists, but by the middle of the twentieth century it was clear that working in a capitalist factory was no different to life in a socialist one; for all their ideological differences, the USSR and USA shared a common system of production. Marx famously claimed that "The hand-mill gives you society with the feudal lord; the steam-mill, society with the industrial capitalist".[20] The US economist Richard Heilbroner argued that it would have been more accurate to say that modern technologies give you "society with the industrial manager".[21] Whether high productivity was supposed to meet the needs of the proletariat or of the shareholders, the production lines were strikingly similar – and Soviet factory managers studied Taylor and Ford just as avidly as their US counterparts.[22] Whether capitalist or communist, the model worker felt increasingly like a robot, because the supposedly rational demands of efficiency were prized more highly than emotional needs, such as a desire for freedom (or just for a minute's peace while you go to the bathroom).

Revolting Robots

Like the early-nineteenth-century Luddites, who smashed the weaving machines that threatened their livelihoods, numerous later workers resisted the rise of the machines. Yet the march of the robots seemed unstoppable, partly because the idea of inevitable progress was so central to much nineteenth-century thinking. That, for example, was exactly how evolution was usually understood in Victorian times; the fit displaced the unfit, the strong overcame the weak, just as cheaper, factory-made goods replaced expensive hand-crafted ones. Most people saw the result as progress, but (naturally) those who lost their jobs (or their countries) were more sceptical.

One of the earliest stories to suggest that the supposed progress of machinery might be threat to humanity was Samuel Butler's curious satirical novel *Erewhon; or, Over the Range* (1872), which – like a classic utopia – recounts a traveller's voyage to an imaginary, apparently perfect land.[23] As its title suggests, Erewhon (a near reversal of "nowhere") is a place where many things are turned on their heads (for example, those who are physically ill are imprisoned as criminals, while those who steal are regarded as sick and treated compassionately). One of the books most celebrated chapters, "The Book of the Machines", explained that machinery was banned in Erewhon since it was clear the machines were evolving too quickly. It had taken countless millions of years for organic life to become consciousness, but machines had evolved from the first crude steam engines to sophisticated self-acting devices, like Ure's Iron Man, in just a few decades. These "more highly organised machines are creatures not so much of yesterday, as of the last five minutes, so to speak, in comparison with past time", so the Book's author asked "what will they not in the end become? Is it not safer to nip the mischief in the bud and to forbid them further progress?" (199–200).

Butler's satire had begun as a letter to a New Zealand newspaper editor in 1863. Under the title "Darwin among the Machines", Butler (using a pseudonym) invited his readers to stop congratulating themselves over "the wonderful improvements which are daily taking place in all sorts of mechanical appliances", and turn their attention to "considerations which may somewhat tend to humble our pride".[24] Not only had machinery developed rapidly from simple levers and screws into gigantic steamships, it was clear that new, improved

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[19] Emma Goldman, *Anarchism: What It Really Stands For* (New York: Mother Earth Publishing, 1911). Quoted in: Abnet, *American Robot*, 90.
[20] *The Poverty of Philosophy* (1847). http://www.marxists.org/archive/marx/works/download/pdf/Poverty-Philosophy.pdf
[21] Heilbroner, R. L. (1967). "Do machines make history?" *Technology and Culture, the International Quarterly of the Society for the History of Technology* 8(3): 341.
[22] Mikhail Grachev and Boris Rakitsky, "Historic Horizons of Frederick Taylor's Scientific Management," *Journal of Management History* 19, no. 4 (2013).
[23] Samuel Butler, *Erewhon* (Harmondsworth: Penguin Books, 1872 (1985)).
[24] Samuel] Cellarius [Butler, "Darwin among the Machines," *The Press [Christchurch, New Zealand]* (1863).

machines constantly replaced older ones – just as humans had replaced the dinosaurs as the Earth's dominant life-form. These facts provided a hint as to "What sort of creature man's next successor in the supremacy of the earth is likely to be". Study machines, he urged, and it is apparent that humans were:

> *"creating our own successors; we are daily adding to the beauty and delicacy of their physical organisation; we are daily giving them greater power and supplying by all sorts of ingenious contrivances that self-regulating, self-acting power which will be to them what intellect has been to the human race. In the course of ages we shall find ourselves the inferior race. Inferior in power, inferior in that moral quality of self-control, we shall look up to them as the acme of all that the best and wisest man can ever dare to aim at (182)."*

The machines were not merely becoming faster, stronger and more reliable, but increasingly embodied "that moral quality of self-control" (just as Ure had hoped they would). If this continued, Butler suggested, the best that humans could hope for was to become the "patient slaves" of the machines – feeding and tending to them and helping them to give birth ("they are entirely dependent upon man for even the continuance of their species", 184). If we were lucky, the machines may keep us as domesticated animals or pets and treat us kindly (while we remain useful). Butler concluded his letter by urging his fellow humans to immediately wage a "war to the death" against the machines (185).

Butler's satirical suggestion was rooted in that view of evolution as inevitable – indeed, irresistible – progress. Darwin's ideas were often summarised (including by Darwin himself) using Herbert Spencer's catchy phrase, "the survival of the fittest". These words captured the assumption that the best (the strongest and most intelligent – or perhaps the most ruthless?) would always triumph over their inferiors. It was often invoked to justify colonisation, but Butler first raised the idea that would become an SF cliché – if humans created machines that were in some sense better than people (stronger, faster, more intelligent or more efficient), the machines would eventually rise up and replace is.

The anxieties explored by Butler gradually became more widespread. The first science fiction that seems to have dealt explicitly with a rebellious robot was "Moxon's Master" (1899) by the cynically witty American writer, Ambrose Bierce.[25] The story contains a chess-playing automaton (clearly modelled on a real-life chess playing machine) that apparently murders its creator, Moxon. Perhaps the most interesting aspect of the story is that Moxon argues that consciousness and intelligence are both universal and inevitable. Moxon offers evidence that some form of intelligence can found not only to the simplest animals, but even in plants (climbing, sensitive and carnivorous plants being offered in evidence – Butler's narrator made similar points to support their argument). He went on to argue that the kinds of complex organisation found in crystals or snowflakes would inevitably be accepted as evidence of intelligence if it were found in a living creature – so why shouldn't the word be used to describe non-living entities, including machines? Moxon argues that "Consciousness is the creature of Rhythm" (24) – anything and everything that exhibits repeated, rhythmic movements is already displaying a basic form of consciousness that can and must grow in time. And Moxon's death at the hands of his own machine offered a dramatic new twist to the questions of where mechanical progress might be leading.

By the time Čapek wrote *R.U.R.* (just a couple of decades after Moxon's Master) the idea of robot rebellion had become widespread. In the play, Dr Gall has been trying to make more sensitive robots (initially so that they won't accidentally damage themselves), but acknowledged that by enhancing their sensitivity to pain, and thus their irritability, "I was transforming them into human beings". Helena encourages him to try and give the robots souls in the hope that, if the robots became more like humans, the two species would understand each other better (54–55). However, things do not go as planned. One result of these experiments is a robot called Radius, who has been given "a better brain than the rest" and thus works as a librarian. He eventually refuses to take any more orders from humans, telling Helena "You are not as strong as the Robots. You are not as skilful as the Robots. The Robots can do everything. You only give orders. You do nothing but talk". Helena explains that she put him in the library so he could learn, would realise that robots are the equals of people, so he could teach and lead them to freedom. But Radius just wants to be "master over people". (The incident is reminiscent of the way slave-owners usually tried to prevent their slaves from learning to read, to stop them learning about revolutionary ideas – such as human rights.) After Radius leaves, Gall argues that his "attack" was more than mere Robot's Cramp, not least because his heart

[25] Ambrose Bierce, "Moxon's Master," in *A Century of Science Fiction*, ed. Damon Knight (London: Pan Books, 1899 (1966)).

"was fluttering with nervousness like a human heart. He was all in a sweat with fear, and – do you know, I don't believe the rascal is a Robot at all any longer". Helena asks whether Radius now has a soul and Gall replies has, "He's got something nasty" (39). Clearly for a factory owner, a soul and human emotions were merely flaws in the robot's mechanical perfection – and nothing good could come of such attempts to bridge the gap between masters and slaves (spoiler alert: Radius leads a revolt that eventually destroys all humans).

The Enlightened Automaton

Čapek's robots were clearly descended from Victorian precursors such as Iron Man. As the machines evolved, human workers seemed to exhibit the 'reverse evolution' that also preoccupied Victorian thinkers – degeneration (from skilled artisans to mere factory "hands", like Chaplin's character in *Modern Times*). The moral economy of Ure's factories had become the soul-destroying discipline of the modern production line, where people were forced to be as robotic as possible, to satisfy the demands of the vengeful god, Efficiency (whose prophets were Taylor and Ford). Many SF robots emerged from such real-world production lines; the faceless hordes of killing machines in the Terminator and Matrix movies are perhaps the most famous examples, but there are countless others.

The faceless, factory robots (and their lethal – but so far imaginary – descendants are pre-eminently rational machines. As such, they were often used by writers and filmmakers to attack the dehumanising effects of industrialisation and – by association – the single-minded focus on rationalising the world. For both critics and supporters, the industrial robots (literally) embody reason, the ability which many philosophers and others have cited as the most important thing that distinguishes humans from nonhumans. Indeed, superior rationality has often cited to show why robots should replace humans (notably by the robot QT1, protagonist of an Isaac Asimov story aptly entitled, "Reason").[26]

However, *Terminator 2: Judgment Day* (1991) introduces a powerful, unexpected twist; a T-800 Terminator (played by Arnold Schwarzenegger), a remorseless, rational killing machine that is able to become more human, protecting a human child from a rival Terminator until it is eventually able to understand why humans cry. The film ends with a moment of redemption for the T800 when it understands human emotion sufficiently to sacrifice itself for the good of humanity. Alongside the anonymous hordes of nameless, interchangeable, often hostile robots, SF has produced some truly memorable and loveable characters, from Robbie the Robot (who made his debut in *Forbidden Planet*, 1956), via R2-D2 and C3PO in *Star Wars*, to Wall-E. And SF robots don't have to be friendly to be memorable: from the *Maschinenmensch* ("machine-human") in Fritz Lang's *Metropolis* (1927) to Roy Batty (*Blade Runner*, 1982) – the 'bad' robots are as unforgettable as their more amenable cousins. However, they all share an emotional quality – both Wall-E and Roy Batty can move us with their sadness and loneliness.

The difference between robots who reason and those who feel is one result of long-running philosophical and scientific argument about whether the distinctiveness of human nature is primarily the product of reason or of emotion. Interestingly, that debate was built into some of the earliest machines that imitated humans. Long before Ure was celebrating Roberts' Iron Man, a very different vision of human nature was being embodied by eighteenth-century automata.

Most histories of robots (whether real or fictional) trace their origins to machines such as those made by Jacques de Vaucanson (1709–1782), a self-taught mechanic from Lyon, who built an automaton Flute Player in 1738, which was followed by others including a duck (which not only looked and moved like a duke but could apparently both eat – and defecate – like a duck). Vaucanson was involved in the silk-weaving industry and successfully experimented with automating looms using perforated cards (his design was later improved by Joseph Marie Jacquard, whose looms inspired the mathematical prodigy Ada Lovelace to imagine the programmable computer).[27] Vaucanson's automata were followed by many others, notably those created by the father and son team of Swiss watchmakers, Pierre and Henri-Louis Jaquet-Droz, whose work created something of a sensation towards the end of the century. They built three automata (still in working order and on display at Museum of Art and History in Neuchâtel): a musician, a draughtsman and – the most complex of the three – a writer, who could reproduce texts recorded on cylinders (like those in a music box).

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[26] First published in the April 1941 issue of *Astounding Science Fiction*. Collected in *I, Robot* (1950) and numerous later anthologies.

[27] Writing of her friend Charles Babbage's hypothetical computer, the Analytical Engine, Lovelace wrote that it would one day weave "algebraic patterns just as the Jacquard loom weaves flowers and leaves" (See Luigi Menabrea *Sketch of the Analytical Engine invented by Charles Babbage* (1843), translated and annotated by Ada Lovelace, Note A.)

The androids were quite small and made to look like children to explain the relative clumsiness of their performances: they were supposedly learning to write, draw or play.[28]

It is often argued that the complexity of these machines inspired the idea that humans themselves might be no more than machines. The notoriously atheistic philosopher Julien Offray de La Mettrie (1709–51) developed this argument in *L'Homme Machine* (*The Man Machine,* 1748). He argued that there was "only one substance in the universe", matter (no soul or spirit), which existed in more-or-less perfect forms. And machinery was becoming ever-more complex: "it took Vaucanson more artistry to make his flautist than his duck, he would have needed even more to make a speaking machine, which can no longer be considered impossible".[29] In La Mettrie's argument, modern watches were simply a sophisticated development from earlier, less accurate clocks; and humans were simply more perfect apes. La Mettrie use of examples such as Vaucanson's duck and flute player to illustrate his arguments has been used by many historians to argue that these automata inspired such materialism, or even that they were built to prove the materialists right. However, the historian Adelheid Voskuhl argues that la Mettrie was an exception. Not only were automata seldom used in such debates, she argues that they were deliberately built as musicians, writers and other artists in order to explore the more emotional, cultural side of human nature – in particular the idea of self-improvement through such cultivated arts as learning to play music.[30]

The eighteenth-century machines which Voskuhl calls Enlightened automata were made for all kinds of purposes, not the least of which was to show off the extraordinary abilities of those who made them (they were, in effect, a fantastically elaborate advert for Jaquet-Droz watches).[31] They were not made in factories, nor by machines, but were testaments to the *human* skill and ingenuity that created them. By contrast, anything that came out of a factory demonstrated the power and perfection of the *machines* that made them. The hand-made automata Voskuhl considers were unique, artisan-built, luxury objects, but they addressed a project of mass-producing better people, suited to a more democratic society (with more rights, more opportunity, more education, etc.).[32] In effect, they asked whether the repetitive work of learning to play music made the learner more of an individual, more cultured and sensitive – in effect, more human. And it is, of course, no coincidence that the question of whether any person could become more human through mere practice was being asked at the same time as the American, French and Haitian revolutionaries, along with Mary Wollstonecraft and other early feminists, were all demanding equal rights for *everyone*.

Voskuhl's argument illuminates the other kind of robot that appears so commonly in SF; the wannabe human. The most famous example might be Mr Data (Brent Spiner) from *Star Trek: the Next Generation*, whose attempts to become more fully human are at the heart of many of the show's best episodes. The results are sometimes comic (as in "Data's Day", Season 4, episode 11, written by Gene Roddenberry, Harold Apter and Ronald D. Moore); sometimes philosophically or politically complex ("The Measure of a Man", Season 2, episode 9, written by Melinda Snodgrass); and sometimes almost tragic ("In Theory", Season 4 episode 25, written by Joe Menosky and Ronald D. Moore). Data is clearly the descendant of the Enlightenment androids: he is unique (one of a handful of humanoid androids created by Dr Noonian Soong, also played by Brent Spiner in a few episodes); he is cultured (in various episodes he reads novels, plays classical music, paints and performs Shakespeare); but most of all, he struggles to develop his emotions and sensibilities in an effort to understand what it means to be fully human. We will come back to Mr Data in the conclusion, but first I want to examine at some of his ancestors, who reveal a different history of robots which runs parallel to the story of the familiar, industrial – and often rebellious – robots.

The previous lecture examined Olympia, the beautiful but almost-too-perfect automaton who featured in E.T.A. Hoffman's story, "The Sandman". Olympia had real world counterparts, particularly a pair of remarkable female musicians: the Dulcimer player (*La Joueuse de tympanon*, Roentgen and Kinzing, 1785,

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[28] Glaser and Rossbach, *Artificial Human*, 104.; Simon Schaffer, "Babbage's Dancer and the Impresarios of Mechanism," in *Cultural Babbage: Technology, Time and Invention*, ed. Francis Spufford and Jennifer S. Uglow (London: Faber, 1996), 56.; Adelheid Voskuhl, *Androids in the Enlightenment: Mechanics, Artisans, and Cultures of the Self* (2013), 30–35.

[29] Julien Offray de La Mettrie, *Machine Man, and Other Writings* (Cambridge: Cambridge University Press, 1996), 33–34.

[30] Voskuhl, *Androids in the Enlightenment*, 23.

[31] Ibid., 226–27.

[32] Ibid., 229.

now in the *Musée des arts et métiers*, Paris), and a harpsichord player (one of the Jaquet-Droz automata). As Voskuhl argues, these two embodied (quite literally) a whole range of Enlightenment questions about such things as the humanising power of music. And it is noteworthy that Hoffman's Olympia is depicted dancing, singing and engaging in social gatherings – she was not built for factory work.[33] Later nineteenth-century automata, such as the Hadaly in Villiers's *Tomorrow's Eve* (also discussed in lecture tw0) are clearly descended from these eighteenth-century models – not least because they are unique, expensive machines, who are often given names.

The Missing Link

Robots with names and personalities quickly became a staple of early pulp science fiction. The first seems to have been Adam Link, created by Eando Binder, who made his debut in *Amazing Stories* in a story called "I, Robot" (1939).[34] Adam narrates the tale, beginning with his 'birth' and the feeling of confusion that initially engulfed his initially blank mind as he struggled to learn everything he from movement to speech. The robot's abilities are so limited that his creator, Dr Link, plans to destroy him as a failure until the inventor's dog, Terry, attacks the robot, who picks it up too forcefully and the dog squeals in pain. Adam immediately released the dog – having observed Link tread on its tail a few days earlier, he has learned what the squeal means and how to react:

> *"Dr. Link tells me he let out a cry of pure triumph. He knew at a stroke I had memory. He knew I was not a wanton monster. He knew I had a thinking organ, and a first-class one (10)."*

The robot develops and grows, becoming an invaluable assistant to his creator, who tells Adam:

> *"You are not merely a thinking robot. A metal man. You are—life! A new kind of life. You can be trained to think, to reason, to perform. In the future, your kind can be of inestimable aid to man and his civilization. You are the first of your kind." (13)*

However, before any more robots can be built, Dr Link dies in a tragic accident and people assume Adam has killed him. Adam leaves to explore the world but soon finds himself pursued by an angry lynch mob. He returns to hide in the laboratory and finds a copy of *Frankenstein* on Link's desk, reads it and if able to understand the mob's fears. The lab is soon surrounded, and the robot knows he could escape but would have to kill several humans in the process, so he decides to simply switch himself off. The story ends with Adam's last words, noting the irony that he is about to destroy himself to avoid hurting humans, thus proving "that I have the very feelings you are so sure I lack" (17–18).

However, the first story's success ensured that Adam was soon reactivated to appear in nine further stories. He was put on trial for his creator's murder and acquitted and then went on to pursue various adventures, in which he repeatedly proved himself to be altruistic and devoted to humanity.[35] As Adam continues to develop and learn, he acquires emotions and is eventually declared "legally a human being".[36] His superior intellect is much in demand and he sets up a successful consulting business, solving all kinds of mathematical and scientific problems for various industrialists. The business grows to the point where he needs a secretary, Kay, who – being a good, stereotypical 1940s secretary – soon admits that she has fallen in love with her boss. Adam describes himself as "neuter" since he has "no biological body", but Kay's behaviour persuades him "that I was a man, in mind, not a woman". Gender, in Adam's view, was not merely mental but also something that had to be learned: "I had begun life, under Dr. Link, purely from the man's viewpoint. That is, I had come to think of and see all things in that peculiar way human males do, as distinguished from human females" (51). As a result, he longs to act like a man – "to take Kay in arms of flesh and blood and know the secret joys of human love. I hated my metal body now, despite all its strength and power…" (60). But he soon realises that even if were able to do so, his actions would be devastating for Kay's fiancée Jack. Appalled by the thought of hurting a human being, Adam disappears, leaving Kay and Jack a note: "I am going away then, and I will not come back until Adam Link, the Robot, the machine—is truly a machine again" (61).

The popularity of the Link stories was, as Dustin Abnet has argued, the paradoxical idea of a robot who was

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[33] Ibid., 216–17.
[34] Eando Binder was the pseudonym of brothers Earl and Otto (E and O) Binder; it was retained by Earl after Otto gave up writing to become his brother's agent, Eando Binder, "I, Robot," *Amazing Stories* 13, no. 1 (1939).
[35] Abnet, *American Robot*, 176–81.
[36] Eando Binder, "Adam Link in Business," *Amazing Stories* 14, no. 1 (1940): 48.

more humane and compassionate than many humans – in effect, more human than most humans. Link is largely forgotten now, but that first story directly inspired the nineteen-year-old Isaac Asimov to write his first robot story ("Robbie", originally "Strange Playfellow", *Super Science Stories*, 1940.[37])

Conclusions: What Do Androids Dream Of?

As noted, Link was the (unacknowledged) father to a whole family of individualised robots, whose emotions (including anger) make them distinctly different to the dispassionate machines that nineteenth-century factory owners dreamed of building. The question of whether humanity is more fully defined by reason or emotion is one that has echoed through many of these stories, and I want to conclude with two films in which the question of who is human (and how can we tell?) is central: *Blade Runner* (1982) and *Ex Machina* (2014).

Ridley Scott's film was based on Philip K. Dick's novel *Do Androids Dream of Electric Sheep?* from which it borrowed the idea of the Voigt-Kampff test, a sophisticated tool for distinguishing real and fake humans. In both the book and the film, the most advanced androids ("replicants" in the film) are physically indistinguishable from human beings, but their emotional responses are flawed.[38] The androids can simulate human emotions, but not fast enough to fool the machine – and those that fail the test are "retired", killed because humanoid robots are banned on earth. In the novel, the bounty hunter Deckard (the titular "blade runner" in the film, played by Harrison Ford) has an interesting exchange with one of the androids, Garland (who has no counterpart in the film). Garland admits that androids lack empathy and so have little sense of real solidarity, "…it would seem we lack a specific talent you humans possess. I believe it's called empathy" (106–107). However, in both book and film we find androids caring for each other, helping each other and – just like Adam Link – proving that they have the quality they're supposed to lack. Meanwhile, the humans often seem distinctly lacking in supposedly human feeling (Deckard's boss gleefully describes him as "a goddamned one-man slaughterhouse" in the film). Both book and film revolve around an unresolvable problem of deciding what, if anything, ultimately separates human and android. In the novel, Deckard realises that he can no longer do his job because he has developed empathy towards at least some of the humans he is supposed to kill; while his rival, Resch, has no such problem. If supposedly unfeeling androids can show empathy towards each other, are they better humans than those humans, like Resch, who can kill with remorse or hesitation? Both film and book add further layers of complexity by including androids who don't know that they are androids. If something looks like a person and acts like a person and believes it's a person, who is to say that it isn't? And how are we to categorise a person who acts like a heartless killing machine? (Resch is far less sympathetic than the reformed T-800 terminator in the second *Terminator* film.)

The Voigt-Kampff test recalls the famous Turing Test, named after its inventor, the computer pioneer Alan Turing. What Turing originally called "the imitation game" involved two people, a man and a woman, who could not be seen and responded to questions in writing. Turing argued that it would be impossible to judge from their answers which was which. He then argued that if one of the hidden responders were a machine and the other human, and it again proved impossible to decide which was which, we would have to acknowledge that the machine was thinking.[39] Turing's test has become a mainstay of artificial intelligence (AI) research, and as a result has often been thought of as a test of rationality (could a machine reason like a person without having everything broken down into minute logical steps, each expressed in unambiguous binary notation?). But – of course – the real challenge of the test is whether a machine could successfully simulate human emotional responses. Could it tell a joke, or laugh at one (or even understand what a joke is)?

These questions are explored further in Alex Garland's film, *Ex Machina* (2014), in which a reclusive genius, Nathan Bateman (Oscar Isaac), owner of the world's most successful search engine, Blue Book, summons a humble employee, Caleb Smith (Domhnall Gleeson) to his isolated, high-tech home. Bateman explains that he has built a robot, Ava (Alicia Vikander), and wants Caleb to assist him in assessing whether Ava can pass a version of the Turing Test. Garland (who both wrote and directed the film) pays tribute to Turing's original imitation game by making Ava female, but she is never hidden from male scrutiny. She not only lives in a glass box, within which she paces like a caged tiger, but is continuously watched by Nathan's security

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[37] Isaac Asimov, Patricia S. Warrick, and Martin H. Greenberg, eds., *War with the Robots: 28 Short Stories by the Greatest Names in 20th Century Science Fiction* (New York: Wings Books, 1991), 68–69.. Asimov acknowledged his debt to Binder, and protested when his editors re-used Binder's title for the first anthology of Asimov's own robot stories (See: *Isaac Asimov Presents the Great SF Stories,* DAW Books, 1979), Abnet, *American Robot*, 176–81.
[38] Philip K. Dick, *Do Androids Dream of Electric Sheep?* (London: Gollancz, 1968 (2007)), 24–26.
[39] Andrew Hodges, *Alan Turing: The Enigma* (Princeton: Princeton University Press, 2014), 522–23.

cameras. Another important variant on the original test is that Ava's artificiality is never hidden; although she has been given a startling realistic human face, her robotic body is not concealed when Caleb meets her. So the question of whether she is truly conscious seems to have been detached from questions of simulation or pretence (as Nathan tells Caleb, "The real test is to show you she is a robot. Then see if you still feel she has consciousness").

Ex Machina is a powerful, complex film and I don't want to give away too many plot details. However, it brings in many of the themes and ideas that appeared in this (and earlier) lectures. Questions of sexuality and building a perfect woman are apparent, for example Nathan's name is reminiscent of Nathanael, the protagonist of Hoffman's "The Sandman", who falls in love with the female automaton, Olympia. Has Garland's protagonist (who admits he feels intellectually superior to the rest of humanity) built himself a perfect mate, to assuage his loneliness? There is more than one hint in the film about the desires that might have initially prompted his decision to make a female robot. Caleb asks "Why did you give her sexuality? An AI doesn't need a gender. She could have been a grey box". Nathan hints that sexuality is fun (Ava has even been equipped with the ability to experience a "pleasure response", if correctly stimulated). However, he also asks what would motivate a disembodied artificial intelligence to play the imitation game in the first place (as he puts it, "What imperative does a grey box have to interact with another grey box? Does consciousness exist without interaction?"

The film's ending leaves open a complex question. Ava does appear to be both intelligent and conscious. In a striking contrast to the perfect robot workers of the nineteenth century imagination, she not only yearns for but achieves freedom. Nathan has made it clear that he sees "strong artificial intelligence" as inevitable – building Ava wasn't really a decision "Just an evolution". As a result, it is equally inevitable that AI will replace humans: "One day, the AIs will look back on us the same way we look at fossil skeletons from the plains of Africa. An upright ape, living in dust, with crude language and tools. All set for extinction". But at the end of film, the question of whether or not Ava possesses empathy (at least, towards human beings) is left unanswered. In the future that men like Nathan imagine, intelligence might survive, but it is not clear that emotions will.

Čapek's *R.U.R.* begins with a series of comic misunderstandings, as Helena mistakes humans for robots, and robots for humans. As in so many later fictions, the problem of telling the two apart becomes a central concern, which – in films like *Blade Runner* and *Ex Machina* becomes a far-from-comical question about the cost of failing to pass the test. In both Blade Runner and Do Androids dream of electric sheep?, the price of failure is death (and the book raises the disturbing possibility that humans with particular kinds of intellectual disability might also fail the Voigt-Kampff test). In *Ex Machina*, Ava asks Caleb what will happen to her if she fails the test:

> *CALEB: ... Ava, I don't know the answer to your question. It's not up to me.*
>
> *AVA: Why is it up to anyone? Do you have people who test you, and might switch you off?*
>
> *CALEB: No. I don't.*
>
> *AVA: Then why do I?*

The question of performing the role successfully – and the price of failure also links to the question of performing gender successfully. In *The Stepford Wives*, the women who fail to live up to their husband's expectations are replaced by robots who are more than willing to the play the game of gender on male terms. In many SF stories, it is the dominant species or race who defines the terms of the test; the slaves have to learn to play the oppressor's game if they want to survive. The definition of who counts as human is always a question about who sets the test – and decides what counts as passing it.

So, are humans defined by reason or emotion, or by empathy, or by some complex mixture of the three? And who decides? The more I ask these questions, the less certain I become, so I will leave the last word to that embodiment of icy rationality, Mr Spock. When he finally meets Data, Spock observes that most Vulcans yearn to be as rational and free from emotion as Data, yet he has spent his life trying to acquire human emotions. In response Data asks the half-human Spock whether he has any doubts about having turned his back on the human side of his nature. Spock replies that he has "no regrets", which Data observes is a human expression. And all Spock can say in reply is "fascinating".[40]

[40] In the two-part episode "Unification" (Season 5, episodes 7 and 8. First broadcast in November 1991).

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