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BABBAGE'S DANCER by Simon Schaffer

Introduction

In a very well-known passage of *Capital*, Marx described labour as 'a process between man and nature' through which man 'acts upon external nature and changes it, and in this way he simultaneously changes his own nature.' Intelligence made the labour process distintively human. 'What distinguishes the worst architect from the best of bees,' Marx argued, ' is that the architect builds the cell in his mind before he constructs it in wax.' In this paper, we explore the relationship between intellectual and manual labour in the culture which Marx himself studied, the industrial-scientific complex of early nineteenth century England. Like him, we ask (a) how such labour processes change *human* capacities just much as they transform *nature*, (b) how different kinds of workers can be said to build structures in the mind and (c) how intelligence can be embodied in the labour process. My paper focuses on the work of Charles Babbage, whose designs for thinking machines, minature factories to process numbers launched in London between the 1820s and the 1850s, now figure so largely in the standard histories of computers. This is a story about *automata* because such devices, capable of self-government and intelligence, helped people understand the new factory system and also Babbage's intelligent machines. And this paper is about the *place* of intelligence and its display, because geography was crucial for the politics of the machinery system. When Victorians defined where the intelligence of a system was, they were defining where the political control of theat system was vested. Marx's parable of the architect and the bee is important, both becasue it draws our attention to the problem of thinking and unthinking labour, and because it reminds us that the place where thinking happens is a key aspect of any working machine. Marx was Babbage's most penetrating London reader, and during debates with the city's workers about mechanisation in 1856, he announced the 'all our invention and progress seem to result in endowing material forces with intellectual life, and in stultifying human life into a material force.' A year later, he observed that 'it is the machine, which possess skill and strength in place of the worker, is itself a virtuoso, with a soul of its own in the mechanical laws acting through it.' Within the 'system of machinery, the automatic one is merely the most complete, most adequate form, and alone transforms machinery into a system.' What follows is an attempt to examine some implications of this 'automatic system' by taking the geography of automata very seriously indeed.

Calculator or Dancer?

> 'They needed a calculator, but a dancer got the job' (*The Marriage of Figaro*, 1784)

In the steam-punk metropolis of Gibson and Sterling's *Difference Engine*, the sickly Keats runs a cinema, Disraeli is a gossip journalist unwillingly converted to using a keyboard, and fashionable geologists visit the Burlington Arcade to buy pricey mechanical trinkets, 'outstanding pieces of British precision craftsmanship'. Above them looms Lord Babbage, his original calculating engines already outdated, his scheme for life peerages on merit become part of everyday politics. Babbage's dreams doubtless deserve this treatment from the apostles of cyberfiction – he touted his schemes in pamphlets and exhibitions all over early nineteenth century London. It was a city apparently obsessed by displays of cunning engines, enthusiastic in its desire to be knowingly deceived by the outward appearance of machine intelligence, and Babbage heroically exploited the obsession in his lifelong campaign for the rationalisation of the world.

The enterprise of the calculating engines was certainly dependent on the city's workshops, stocked with lathes, clamps and ingenious apprentices, and on government offices, stocked with ledgers, blue books and officious clerks – a heady mixture of Bleeding Heart Yard and the Circumlocution Office. But, as Gibson and Sterling see so acutely, it was also tangled up with the culture of the West End, of brightly lit shops and showrooms, of front-of-house hucksters and backroom impresarios. Put the Difference Engine in its proper place, perched uneasily between Babbage's drawing room in wealthy Marylebone, the Treasury chambers in Whitehall, and the machine shops over the river in Lambeth, but at least as familiar in the arcades round Piccadilly and the squares of Mayfair, where automata and clockwork, new electromagnetic machines and exotic beasts were all put on show.

It was in the plush of the arcades that Babbage, barely eight years old, first saw an automaton. Some time around 1800 his mother took him to visit the Mechanical Museum run by the master designer John Merlin in Prince's Street, just between Hanover Square and Oxford Street. A Liègeois in his mid-sixties, working in London for four decades, Merlin was one of the best-known metropolitan mechanics, deviser of new harpsichords and clocks, entrepreneur of mathematical instruments and wondrous machines. His reputation even rivalled that of Vaucanson, the pre-eminent eighteenth century designer of courtly automata. As he rose through fashionable society, Merlin hung out with the musical Burney family, figured largely as an amusing and eccentric table-companion, and 'a very ingenious mechanic', in Fanny Burney's voluminous diaries, sat for Gainsborough, and used his mechanical skills to devise increasingly remarkable costumes for the innumerable masquerades then charming London's pleasure-seekers. To help publicise his inventions, Merlin appeared at the Pantheon or at Ranelagh dressed as the Goddess Fortune, equipped with a specially designed wheel or his own newfangled roller-skates, as a barmaid with her own drink-stall, or even as an electrotherapeutic physician, shocking the dancers as he moved among them.

Merlin ingeniously prowled the borderlands of showmanship and engineering. He won prestigious finance from the backers of Boulton and Watt's new steam engines. He opened his Mechanical Museum in Hanover Square in the 1780s. For a couple of shillings visitors could see a model Turk chewing artificial stones, they might play with a gambling machine, see perpetual motion clocks and mobile bird cages, listen to music boxes and try the virtues of Merlin's chair for sufferers from gout. After unsuccessfully launching a plan for a 'Necromancic Cave', featuring infernal mobiles and a fully mechanized concert in the Cave of Apollo, he began opening in the evenings, charged his visitors a shilling a time for tea and coffee, and tried to pull in 'young amateurs of mechanism'.

Babbage was one of them. Merlin took the young Devonshire schoolboy upstairs to his backstage workshop to show some more exotic delights. 'There were two uncovered female figures of silver, about twelve inches high'. The first automaton was relatively banal, though 'singularly graceful', one of Merlin's well-known stock of figures 'in brass and clockwork, so as to perform almost every motion and inclination of the human body, viz. the head, the breasts, the neck, the arms, the fingers, the legs &co. even to the motion of the eyelids, and the lifting up of the hands and fingers to the face'. Babbage remembered that 'she used an eye-glass occasionally and bowed frequently as if recognizing her acquaintances'. Good manners, it seemed, could easily be mechanized. But it was the other automaton which stayed in Babbage's mind, 'an admirable danseuse, with a bird on the forefinger of her right hand, which wagged its tail, flapped its wings and opened its beak'. Babbage was completely seduced. 'The lady attitudinized in a most fascinating manner. Her eyes were full of

imagination, and irresistible'. 'At Merlin's you meet with delight', ran a contemporary ballad, and this intriguing mixture of private delight and public ingenuity remained a powerful theme of the world of automata and thinking machines in which Babbage later plied his own trade.

Merlin died in 1803, and much of his Hanover Square stock was sold to Thomas Weeks, a rival 'performer and machinist' who had just opened his own museum on the corner of Tichborne and Great Windmill Streets near the Haymarket. The danseuse went too. The show cost half-a-crown, in a room over one hundred feet long, lined in blue satin, with 'a variety of figures inert, active, separate, combined, emblematic and allegoric, on the principles of mechanism, being the most exact imitation of nature'. Like Merlin, Weeks also tried to attract invalids, emphasising his inventions of weighing-machines and bedsteads for the halt and the lame. There were musical clocks and self-opening umbrellas, and, especially, 'a tarantula spider made of steel, that comes independently out of a box, and runs backwards and forwards on the table, stretches out and draws in its paws, as if at will. This singular automaton that has no other power of action than the mechanism contained in its body, must fix the attention of the curious'.

Once again, seduction was an indispensable accompaniment of the trade in automata. One of the most famous automata of the early nineteenth-century, a 'Musical Lady', was originally brought to London in 1776 by the great Swiss horologist Jaquet-Droz. His London agent Henri Maillardet put her on show after the turn of the century at the Great Promenade Room in Spring Gardens behind Whitehall: 'the animated and surprizing Motion of the Eye aided by the most eloquent gesture, are heightened to admiration in contemplating the wonderful powers of Mechanism which produce at the same time the actual appearance of Respiration'. The accomplished lady's eyes really moved, her breast heaved. 'She is apparently agitated', a contemporary remarked, 'with an anxiety and diffidence not alway felt in real life'. Such shows often turned to titillating effect modish materialist philosophies which, in the wake of enlightened theories of sensibility and mesmeric strategies for restoring health, sought to mechanize the passions, and especially those of women. Maillardet's adverts put love on sale:

> If the Poet speaks truth that says Music has charms Who can view this Fair Object without Love's alarms Yet beware ye fond Youths vain the Transports ye feel Those Smiles but deceive you, her Heart's made of steel For tho' pure as a Vestal her price may be found And who will may have her for Five Thousand Pounds.

The neat connection between passion, exoticism, mechanism and money permeated the showrooms. Since the 1760s, London designers, especially Merlin and his erstwhile employer James Cox, had built extraordinary automata for the East India Company's China trade, opened shops in Canton where mandarins could acquire mechanical clocks, mobile elephants and automatic tigers, and thus oiled the wheels of the booming tea business. Maillardet and his partners joined in the market. But this lucrative eastern commerce languished, as after American independence and a huge reduction in the tea duty, the British entrepreneurs found it ever harder to balance imports of the precious leaf. Bengal opium and Indian cotton were now used to help pay for Chinese tea, and successive delegations to the Chinese imperial court failed to impose what they tended to see as rational economic relations. Cox's firm went broke, and, while Weeks never quite managed to revive it, he ruthlessly exploited the appealing orientalist gloss it gave his Haymarket show. The word 'factory', it's worth remembering, was used for Company store-houses in the Indies before it was used to described workshops back in Europe, and the automata shifted between both these worlds. According to Weeks' advertisements for his machines, 'these magnificent specimens which constitute almost all the labour of a long life, and were all executed by one individual, were originally intended as presents for the east, they have, indeed, all the gorgeous splendour, so admired there, and we can fancy the absorbing admiration they would create in the harems of eastern monarchs, where their indolent hours must be agreeably relieved by these splendid baubles, which however are so constructed as to combine in almost every instance some object of utility'. The slippery move between images of langorous oriental baubles and honest utilitarian labour defines the significantly ambiguous place the automata occupied in a metropolis equally impressed by the mechanical ingenuity, excess wealth and eroticised luxury which all marked its new world-wide imperium. This was an apt stage for automatic Turks, mechanical elephants, and clockwork women.

The silver dancer never went on show at Weeks' Museum, but stayed neglected in an upstairs attic. Blocked from the Chinese trade, and failing to win London audiences, Weeks' Museum closed and its nonagenarian owner died in 1834. By now, Babbage was an engineer and entrepreneur in his own right, the heir to a fortune of over £100,000 from his banker father. Throughout 1834 he was in the toils of a disastrous dispute with his master-machinist Joseph Clement, a fight which soon ended with the abandonment of the Difference Engine project. At the start of the year, he presciently commissioned two demonstration models of the Difference Engine from the instrument-maker Francis Watkins, who also supplied electromagnetic and mechanical equipment to the new Adelaide Gallery of Practical Science, an exhibition of newfangled steam guns, clockwork model steamboats and telegraphic devices, in the Lowther Arcade just off the Strand and round the corner from Weeks' old showrooms. And in the midst of these machine plans and troubles, Babbage also took the time to visit Weeks' auction and buy, for £35, the long-lost silver lady. He painstakingly restored the automaton and put her on a glass pedestal in his Marylebone salon in the room next to the unfinished portion of the first Difference Engine.

What was proper to a machinist's storeroom was slightly risqu/ in the drawing room of a gentleman of science – the naked dancer needed a dress. Though he commissioned a new robe from local dressmakers, Babbage initially made do with a few strips of pink and green Chinese crepe, a turban, a wrap and 'a pair of small pink satin slippers, on each of which I fixed a single silver spangle'. She was a hit, drew amused if slightly off-colour jokes from his visitors, and provided Babbage with the chance to teach a portentous moral about the decline of the industrial spirit in England. 'A gay but by no means unintellectual crowd' of English guests could all too easily be entertained by the dancer's 'fascinating and graceful movements'. Only sterner Dutch and American inquirers would bother to visit the Difference Engine next door. Babbage ever after used the divergence to teach his audience about the sinister contrast between foreign seriousness and domestic triviality, between the easy charms of the silver dancer and the demanding challenges of the calculating engine.

Babbage worked hard to make, then exploit, this distinction between catchpenny and serious machines. He expostulated noisily and persistently against music machines, organ-grinders and steam-engines and published a long pamphlet, *Street Nuisances* (1864), describing the persecution he'd suffered in his once peaceful Marylebone home: 'the neighbourhood became changed: coffee-shops, beer-shops, and lodging houses filled the adjacent small streets. The character of the new population may be inferred from the taste they exhibit for the noisiest and most discordant music'. Eventually 'Babbage's Act' against street music became law: 'a grinder went away from before my house at the first word', reported Babbage's friend the London mathematics professor Augustus de Morgan. And the barrier between popular machines and scientific ones had more than merely the advantages of domestic tranquility. The story of the silver dancer was partly designed to help contrast the appeal of fashion with the demands of manufacture. In the midst of his tortuous negotiations of 1834 about funding a new Analytical Engine, Babbage told the Duke of Wellington that the switch from the older difference-based design to the new mechanism was not to be damned as modish novelty. 'The fact of a new superseding an old machine in a very few years, is one of constant occurrence in our manufactories, and instances might be pointed out in which the advance of invention has been so rapid, and the demand for machinery so great, that half-finished machines have been thrown aside as useless before their completion'. This was scarcely likely to mollify a penny-pinching administration, but throughout Babbage's career he felt it necessary to explain to what he saw as an irredeemably puerile public how to spot the difference between the engines which could make them rich and intelligent and those which deluded them into the gaudy fantasies of tricksy parlour-games and theatrical delights. The inquisitive polymath Sophia Frend, later de Morgan's wife, recalled that most of the audience for Babbage's engine 'gazed at the working of this beautiful instrument with the sort of expression, and I dare say the sort of feeling, that some savages are said to have shown on first seeing a looking-glass or hearing a gun'.

The obscure objects of desire embodied in the automata were never self-evidently distinct from any of Babbage's projects. For example, like the automata of Cox, Merlin and Weeks, the Difference Engine apparently was also an object of fascination to the Chinese, and one visitor from China asked Babbage whether it could be reduced to pocket-size. Babbage replied that 'he might safely assure his friends in the celestial empire that it was in every sense of the word an out-of-pocket machine'. Indeed, in the later 1840s, when all his engine schemes had run into the sand, he cast about for new ways of raising money to revive them, including writing novels, but was dissuaded because he was told he'd surely lose money on fiction. One such entirely abortive scheme involved designing an automaton 'to play a game of purely intellectual skill successfully'. This was at least partly an attempt to assert the very possibility of building an automatic games-player. Babbage knew, at least at second-hand, of just how seductive gambling could be – his close friend Ada Lovelace, Gibson and Sterling's dark lady of the Epsom motor-races, lost more than £3000 on the horses during the later 1840s. 'Making a book seems to me to be living on the brink of a precipice', she was told by her raffish gambling associate Richard Ford in early 1851.

The Games Machine

Babbage's attention turned to the prospects of a games machine. In a brief memorandum, he demonstrated that if an automaton made the right first move in a game of pure skill with a finite number of possible moves at each stage, the machine could always win. Such a device, he reckoned, must possess just those faculties of memory and foresight which he always claimed were the distinctive features of his Analytical Engine, the features which made it intelligent. So Babbage began to design an automaton which could win at noughts-and-crosses, planning to dress it up 'with such attractive circumstances that a very popular and profitable exhibition might be produced'. All his memories of Merlin, Weeks and the Regency world of mechanical wonders came into play. As he reminisced in his 1864 autobiography, 'I imagined that the machine might consist of the figures of two children playing against each other, accompanied by a lamb and a cock. That the child who won the game might clap his hands whilst the cock was crowing, after which, that the child who was beaten might cry and wring his hands whilst the lamb began bleating'.

But there was, of course, a hitch. One point of his games machine was to raise money for the more portentous Analytical Engine, and Babbage soon discovered that though 'every mamma and some few pappas who heard of it would doubtless take their children to so singular and interesting a sight', and though he could try putting three shows on at once, nevertheless the mid-Victorian public simply weren't interested any more. 'The most profitable exhibition which had occurred for many years', Babbage moaned, 'was that of the little dwarf, General Tom Thumb', Phineas Barnum's famous midget money-spinner, displayed in 1844 before gawping London audiences at the self-same Adelaide Gallery where a decade earlier the Difference Engine models, steam guns and electromagnetic engines had drawn large audiences. According to London journalists the Adelaide 'with its chemical lectures and electrical machines' had by the later 1840s 'changed its guise, and in lieu of philosophical experiments we have the gay quadrille and the bewildering polka'. So however apparently distinct, the fate of the automata shows and the calculating engines was remarkably similar, as metropolitan fashion switched away from the machines that could simulate human motions and emotions to the high life where the genteel tried these activities out for themselves.

Ultimately, Babbage's Difference Engine suffered more or less the same end as a whole range of Victorian automata, ending its days as a museum piece. In 1842, when the Government finally abandoned the project, Babbage told them it should be carefully preserved and 'placed where the public can see it, for example, the British Museum'. In the event, in January 1843 it was put behind glass in the very middle of the new Museum at King's College London, alongside a vast collection of memorabilia and eighteenth-century scientific instruments made for George III. For two decades, as Babbage bitterly remarked, 'it is remarkable that during that long period no person should have studied its structure'. The Engine was briefly brought out for the London International Exhibition of 1862 and put in what Babbage called 'a small hole, closed in and dark', where scarcely anyone could see it and, so he reckoned, it would have needed about 800 square feet of wall space to lay out all the diagrams required to explain its principles. Such exhibitions were increasingly devoted not to machines but to their products, and rapidly became the Victorians' favourite sites for display of mechanically-produced commodities. Babbage was told that he could have no more space for his calculating engines because of the room required for an appealing display of children's toys. Once again, he reflected, the British had revealed themselves to be more interested in entertaining tricks than thoughtful engineering.

This dismal fate was scarcely the sole link between the machine shows and Babbage's engines. There was an even more intriguing one, since all these devices neatly captured the puzzle of mechanical passion, of the possibility that artifices could think and feel. In his essay on the games machine, interpolated in a chapter of his autobiography entitled 'The author's further contributions to human knowledge', Babbage made the point in his characteristically pithy way. He asked his friends 'whether they thought it require human reason to play games of skill. The almost constant answer was in the affirmative. Some supported this view of the case by observing, that if it were otherwise, then an automaton could play such games'. Babbage set out to show that an automaton could do just this. For example, there would always be occasions when the automaton was faced with two equally good moves. Then Babbage would program it so that a random number could direct the machine's decision between them. 'An enquiring spectator who observed the games played by the automaton might watch a long time before he discovered the principle upon which it acted'. In combination with his celebrated principles of foresight and memory, this principle of random moves programmed in advance governed Babbage's stories about machine intelligence.

From the 1830s, his favourite party-trick, for those who got bored watching the silver dancer, was to program his Difference Engine to print out a very long series of unchanging numbers and then suddenly switch to a new series. Was this not exactly like a miracle? he would ask his guests. In summer 1833 Ada and her mother, Lady Byron, the Princess of Parallelograms, saw the trick. Lady Byron described the encounter to William King, a rather conventionally pious Cantab she'd persuaded to act informally as mathematics teacher for Ada. 'We both went to see the thinking machine (for so it seems). The Machine could go on counting regularly 1,2,3,4 & c – to 10,000 – and then pursue its calculation according to a new ratio. There was a sublimity in the views thus opened of the ultimate results of intellectual power'. The miraculous counting game was obviously a crowd pleaser, the implications of the machine's discontinuous outputs were allegedly clear and radical, and at least one of Babbage's guests, Charles Darwin, soon picked up the hint. Darwin saw that if apparently inexplicable discontinuities could really be the result of a system of mechanical laws laid down in advance, then here was a useful analogue of the way new species could emerge entirely through natural law. Indeed, for Babbage and his allies, this was turned into a definition of what made machines intelligent. They could foresee, they could remember, and they could switch their behaviour in ways which seemed random but were really determined.

And in the epoch of the new factory system and Chartist strikes, this was also just how economic journalists lauded the new machines of automatic industry. In his oleaginous work of industrial reportage, *A Tour in the Manufacturing Districts of Lancashir*e (1842), the free-trader William Cooke Taylor described a Manchester spinning-mule which 'recedes and then returns so gracefully that I was almost going to say the effect was picturesque. I can assure you that the brightness of the machinery, which looks like steel, and the regularity of its motions, produce a tout ensemble which has a novel and striking effect. It seems to me that the machines can do everything but speak'. These machines had been developed in Lancashire, following strikes in the cotton factories, to give employers more control over the production process. Cooke Taylor piously observed that in these factories 'the human agents work with all the exactness of machinery. So strange a combination of perfect despotism with perfect freedom never before existed, and to have produced such a state is one of the noblest triumphs of morality and intelligence'. There was no mistaking the moral that the intelligence belonged to the system, not the operatives. In his notoriously eulogistic *Philosophy of Manufactures* (1835), published little more than a decade after Mary Shelley's novel, the Scottish science writer Andrew Ure lapsed significantly into the imagery of her *Frankenstein, or the Modern Prometheus* to describe the new spinning mule as 'the Iron Man sprung out of the hands of our modern Prometheus at the bidding of Minerva – a creation destined to restore order among the industrious classes'.

So machine intelligence was a central theme of the politics of manufacture, just as it was being worked out in the London showrooms and Babbage's workshops. In his long drawn out contests with the engineers of the Lambeth machine shops, the dominant theme was precisely the kind of intellectual property represented by the calculating engines and the skills required for their construction. Babbage might try to keep street-organs and noisy proles away from his door, but he wanted the calculating engines indissolubly linked with his property, and even tried shifting the whole engine works from Lambeth to his own back yard. He told Wellington in 1834 that his ownership of the engines was complete, 'for they are the absolute creations of my own mind'. But it had been a tradition of the machinists that all their tools belonged to the workmen, not the customers or masters, and it was thus an extremely sensitive issue as to which aspects of the calculating engines' enterprise counted as tools, and which as finished work. It was not at all obvious to a master-machinist like Joseph Clement, the designer of remarkable new planing machines and facing lathes, that Babbage's mind was the unique source of these engines' value. The intelligence they embodied, therefore, was a prize contested by engineers, designers, proprietors and financiers, and intelligence's place was a major aspect of the political geography of the industrial system.

Babbage's most successful publication of the 1830s, a thorough survey of this geography, charted in great detail the ways in which mechanization automated the production process and insisted that the division of labour could be applied to mental just as much as to mechanical operations. Copying machines were one of his principal themes, and he explained them by describing such automata as the Prosopographus and the Corinthian Maid, machines shown in the Strand in the early 1830s which could apparently copy the likeness of any sitter. Babbage explained that such shows really relied on a concealed camera lucida where a backstage assistant using a pentagraph linked to the automaton's own hand could quickly produce a reasonably accurate portrait of the customer. Here intelligence turned out to be the result of concealed skill in alliance with ingenious mechanization. In all these places, indeed, the puzzle of thinking engines was wrapped up with the problem of selective vision. Cooke Taylor aestheticized the cotton factory so that its intelligence seemed vested in the machinery, not the labour force. Ure saw the machines as the immediate intellectual offspring of the manufacturers, just as his idol Charles Babbage

claimed that the Difference Engine was the unique product of his own mind. Clement saw his own workshop as a place of intelligent skill and so refused to move his workmen and their tools to Marylebone, where they would be under Babbage's immediate gaze. There Babbage's calculating engines looked miraculously prescient because of his party-goers' ignorance of their original programs. And, inevitably, the point of the West End automata was to mimic the actions of mind by concealing the springs of their artful design. To see such devices as intelligent, it was necessary to ignore, or conceal, or divert one's gaze from, the machinations which drove them and the human skill on which they all depended.

Babbage's dancer was never just a gaudy trick. She was rather an alluring emblem of the aestheticized gaze of the impresarios of intelligence. The attribution of intelligence and reason to any machine depended on the perspective of the machine's audience, and on the visibility of the labour on which its performance relied. Babbage's friends told him that to play a game of skill needed human reason and so denied any automaton could do it unaided. They would always suspect that any automaton which could apparently play chess must somehow be accompanied by a rational human temporarily hidden from view. Babbage and his critics both had one spectacular and timely precedent, a notorious automaton chess-player, first shown in London in 1783-4 on Savile Row, and then again from 1818 at the showroom in Spring Gardens, where the charming Musical Lady also found her home. This chess-player was built at the end of the 1760s by an aristocratic Slovak engineer, Wolfgang von Kempelen, as an entertainment for Maria Theresa, and its subsequent career took it from central European court society to the more vulgar milieux of French and English showrooms.

Von Kempelen himself never took the device very seriously, and frankly confessed it relied on a blatant trick. He temporarily dismantled it in 1773. Before then, guests at his house in Bratislava, just downriver from the Habsburg capital, were shown upstairs through his workshop, stocked with tools and unfinished projects for steam engines, perpetual clocks, and especially his favoured scheme for a speaking machine, into his study, decorated with antiques, curiosities and prints. There, in the middle of the room, stood a large cabinet running on castors, and behind it an impressive full-scale model of a seated Turk smoking a pipe. On top of the cabinet was screwed a chessboard, the object of the Turk's fixed attention. Von Kempelen would open both the front and the back of the cabinet, revealing an extraordinarily complex array of gearwheels, barrels and pulleys. The custom was to shine a candle into the cabinet to show that nothing could possibly be hidden, and the Turk's torso and legs would also be stripped bare. *Inanimate Reason* (1784), the significantly-titled publicity sheet for von Kempelen's machine, reported that 'you see at one and the same time, the naked Automaton, with his garments tucked up, the drawer and all the doors of the cupboard open'. Then, after von Kempelen had wound up the automaton, giving it enough power to run for about a dozen moves, the games would begin, the Turk gracefully moving pieces with his left hand, nodding his head when giving check, tapping the table and replacing any piece if a false move was made by his opponent, and bowing to the spectators when the game ended, almost always with the Turk's triumphant victory. The ritual of open display and brilliant chess never varied. 'Never before did any mere mechanical figure unite the power of moving itself in different directions as circumstances unforeseen and depending on the will of any person present might require', and nowhere else in Europe did the relation between intelligence, mechanism and concealment become such a matter of public interest.

The Mechanical Turk

Innumerable pamphlets followed the Turk's progress across Europe to London in the mid-1780s, where, having already been used in Vienna to bemuse aristocratic visitors to the Imperial court, and in Paris to contest the mastery of the chess wizards at the Café de la Régence, it now rivalled the shows of Merlin and Maillardet in Mayfair. The Turk's arrival in western Europe coincided precisely with that of another Viennese guru, Franz Mesmer – while von Kempelen had the ability to build an automaton which displayeé human intelligence, mesmeric s/ances seemed able to reduce the most rational humans to the condition of automata. Indeed, von Kempelen seems first to have built the Turk to distract attention from Viennese interest in the phenomena of animal magnetism. Enlightened philosophers drew the appropriately arrogant moral: 'these days', claimed a gossipy German periodical in 1783, 'physics, chemistry and mechanics have produced more miracles than those believed through fanaticism and superstition in the ages of ignorance and barbarism'. Others simply reckoned that von Kempelen must be dealing with the devil. Like Mesmer, however, the Turk was also the target of committed exposés. 'The machine cannot produce such a multitude of different movements, whose direction couldn't be foreseen in advance, without being subject to the continual influence of an intelligent being'. Some London commentators immediately alleged the automaton contained a child, or a dwarf, inside the box, without ever quite managing to explain where the diminutive prodigy lay hidden, nor did the hostile stories which appeared in such profusion yet damage the enthusiasm of the automaton's public.

On von Kempelen's death in 1804, the Turk was soon bought by a brilliant Viennese musical engineer, Johann Maelzel, court mechanician for the Habsburgs and a close ally of one of their favoured composers, Beethoven. Maelzel swiftly saw the patronage he could win by trading on von Kempelen's automaton, and the Turk became a temporary habitué of the new Napoleonic courts in Germany. E. T. A. Hoffmann, a fellow musician, found the figure of a mechanical Turk a suitably exotic subject for his pen, and in 1814 sent a Leipzig musical magazine a story entitled The Automata, in which he 'took the opportunity to express myself on everything that is called an automaton', teasingly hinting that the Turk might work by setting up a musical harmony with the mind of its audience. Hoffman used his story to debate the most up-to-date views of occultist German philosophies of nature, much devoted to the inner rhythms of human mental life, then turned his attention to the equally modish attempts to mechanize musical composition. Meanwhile, Maelzel threw himself into another lucrative mechanical project for regulating musical performance with a device he baptized the 'metronome'. The metronome was, of course, a rather more potent means of mechanizing and standardizing artistic creativity than any mere chess-player would ever be: 'an universal standard measure for musical time is thus obtained', chorused the musical journalists, 'and its correctness may be proved at all times by comparison with a stopwatch'. After furious patent suits with rival inventors, and complex negotiations with Beethoven, Maelzel established himself as the monopoly distributor of these newfangled musical timekeepers, re-purchased the Turk from the Bavarian court, and then, in 1818, set off on a marketing and publicity tour of Paris and London.

Maelzel's London show was very carefully staged. In autumn 1818 at Spring Gardens, in a pair of candlelit drawing rooms equipped with sloping benches, he displayed the Turk alongside a fine mechanical trumpeter, and when he soon moved round the corner to a larger chamber in St James' Street he added a moving diorama of the burning of Moscow, 'in which Mr Maelzel has endeavoured to combine the Arts of design, mechanism and music so as to produce by a novel imitation of Nature a perfect facsimile of the real scene', and a set of automatic rope dancers, 'scarcely to be distinguished from those of a living performer', moving 'with the utmost and correctness without any apparent Machinery'. Maelzel also helped realize his metronomic dream of a completely automatic orchestra, the Panharmonicon of 42 mechanized musicians, for which Beethoven had specially composed his ghastly Battle Symphony, a composition rather likely to appeal to jingoistic British audiences. One London paper praised such an orchestra which 'displayed none of the airs of inflated genius, but readily submitted to being wound up'.

The wind-up Turk, of course, occupied pride of place amidst these other wonders. Maelzel faithfully followed von Kempelen's recipe, imitating precisely the ritual opening of the cabinet front then back, moving a candle round the interior, and winding up the mechanism at regular intervals. And his metropolitan audience faithfully reproduced their earlier enthusiasm for the show. Ever considerate to this public, Maelzel even announced that the Automaton would purposely make bad moves so as deliberately to lose if the company seemed bored with over-lengthy games, while the Turk's opponents were ordered to move as fast as possible to alleviate the tedium. A pamphlet authored by a pseudonymous Oxford graduate alleged the whole trick relied on a hidden piece of wire or catgut: 'it seems to be a thing absolutely impossible', the Oxonian alleged, 'that any piece of mechanism should be invented which possessing perfect mechanical motion should appear to exert the intelligence of a reasoning agent'. Unmoved by this futile revelation, during the summers of 1819 and 1820, when the London 'season' ended, Maelzel took his show to the provinces and to Scotland, with apparently equal success. Back in St James' at the end of 1820, however, his nemesis was ready at last.

Robert Willis was an ingenious young Londoner, heir to a distinguished medical family – his father famously attended George III during the monarch's madness. In later life Willis himself became, like Babbage, a pre-eminent Cambridge mathematician, then distinguished professor of applied mechanics and untiring surveyor of ecclesiastical architecture. He also produced one of the best mechanical analyses of the principles of speaking machines, including those von Kempelen had tried to build. During 1819, still a teenager, he patented a new mechanism for harp pedals and toured all the major instrument-shops, including high-class machinists such as Holtzapffel and Bramah, and John Newman's works, supplier of equipment to many of the best scientific lecturers in the city. Early in the year he noticed a telling advert placed in the London papers by one 'Monsieur Novoski' of Knightsbridge Post Office, who offered to sell the secret of the chess-player for 2000 guineas. Willis took up the challenge at once. He bought copies of the games the Turk had played and won. He

made sure to visit Maelzel's show while it occupied the cramped space of Spring Gardens, 'more favourable to examination as I was enabled at different times to press close up to the figure while it was playing'. Then he smuggled an umbrella into the room so as to measure 'with great accuracy' all the dimensions of the Turk's celebrated cabinet. He went back to St James' for the 1820 season, and by the autumn had completed an obsessively detailed analysis of just how the 'automaton' really worked.

Willis' accurate umbrella and his command of wheel-work made all the difference. The chest, he demonstrated, was much larger than it seemed, giving more than enough room for a fully grown (and doubtless experienced) human chess player to fit inside. 'Instead of referring to little dwarfs, semi-transparent chess boards, magnetism, or supposing the possibility of the exhibitor's guiding the automaton by means of a wire or piece of catgut so small as not to be perceived by the spectators', Willis' *Attempt to Analyze the Automaton Chess Player*, finished in December 1820, proffered the simplest possible scheme of the Turk's hidden intelligence. The noisy gear-wheels were there simply so that their sound would conceal any noise made by the concealed player. Even more influentially, he ponderously laid down the law of mechanism's limits: 'the movements which spring from it are necessarily limited and uniform, it cannot usurp and exercise the faculties of the human mind, it cannot be made to vary its operations so as to meet the ever-varying circumstances of a game of chess. This is the province of intellect alone'. Despite the care with which he drew the dramatic plates for his pamphlet, there was still some continuing debate about Willis' story: for example, while he reckoned the hidden chessplayer put his arm inside that of the Turk, more reflective analysts guessed that the machine must use the kind of pentagraph which Babbage described in the case of drawing automata. These debates received their fullest publicity in the best-selling *Letters on Natural Magic* (1832) by the Edinburgh optical expert David Brewster. Maelzel himself left London, tried to sell the Turk in Paris, then went to the United States in 1825. Willis' pamphlet was frequently reproduced there by newspapers eager to exploit public interest in the automaton. After Maelzel's show had stunned Richmond and Baltimore, the local writer Edgar Allan Poe lifted Willis's report directly from Brewster, brazenly passed it off as his own brilliant detective job in the *Southern Literary Messenger* (1836), then used it as a precedent for a whole series of rather more original, and certainly better-known, stories about the application of analysis to cunning mysteries, whether purloined letters or concealed bodies. Poe never forgot von Kempelen, nor his deceit, for in the midst of the California goldrush Poe teasingly announced that a New Yorker of that name, doubtless connected with the Slovak engineer, had discovered how to transmute lead into precious metal. If the Turk's progenitor had this shadowy afterlife, its promoter Maelzel never came back to Europe – he died on board ship off Cuba in 1838 – and nor did the Turk, who went up in flames in Philadelphia scarcely fifteen years later.

Moralists found the story of the chess automaton irresistible. The pious drew the obvious implication that if a genius like von Kempelen had not been able to build a rational machine, what must be the skill of the divine Creator who had pulled off this trick? Others sang the praises of the Turk's hidden managers, now revealed as William Lewis and Jacques Mouret, who'd played chess so well and under such apparently overwhelming disadvantages in Britain between 1818 and 1820. George Walker of the Westminster Chess Club, writing in *Fraser's Magazine* in 1839, mourned Mouret's 'beautiful emanations of genius' when the Frenchman 'burnt out his brain with brandy' and died in Paris 'reduced to the extremest stage of misery and degradation'. It was a commonplace that such machines belonged at court, whether in the Orient of the *Arabian Nights* or the grandiose palaces of the Tzars. 'To the half-bred savages of the north', Walker sneered, 'the exhibition could not fail to be striking'. Novels and reviews told how the Turk had conned the powerful and humbled the great: 'even Bonaparte, who made automata of Kings and Princes at his will, was foiled in an encounter with the automaton chess player'. Later in the century, a successful French play put the Turk on stage in a victorious contest with Catherine the Great. It was rather the point, so populist writers explained, that self-styled experts, the politically powerful, and the superstitious mob, could all be deceived by a mechanism effortlessly unmasked in public prints directed at a new and confidently rational readership. 'Had the gulled mob reasoned on the matter earlier', Walker noted in dangerously republican terms, 'King Automaton would have been speedily deposed from his high places'.

But the most telling lesson of the Turkish chess-player was the relationship between machine intelligence, technological progress and the puzzles of concealment. This was a moment when, as the Automaton's admirers never hesitated to remark, 'political economists amuse themselves and the public with the nicely-balanced powers of man as a propagating and eating animal and philosophers and divines often assure us that he is, in other and higher respects, but a machine of a superior description'. Correspondents from the London chess clubs predicted that 'a man inside will most assuredly never again work the charm, but, advanced as science is during the present generation, a Brunel or a Stephenson could easily and successfully vary the deception'. And in the 1830s one economic journalist, describing the rapid growth and progress of automation in the Lancashire cotton industry, told the apocryphal story of the invention of the power loom, half-a-century earlier, by Edmund Cartwright. Cartwright had allegedly seen the Turk in London, trusted its purely mechanical origin, and thus been thoroughly convinced that a weaving machine could scarcely be harder to make than one which could play chess so well. Rather similar stories appeared in Poe's favourite source, *Brewster's Natural Magic*, which was dedicated to Brewster's close friend Walter Scott and entirely devoted to teaching his fellow-citizens the inner secrets on which all apparently miraculous and surprising mechanical devices really depended. Part of the point was characteristically Presbyterian: gaudy tricks conned the ignorant into idolatry. Part, however, was economic. In his chapter on automata, Brewster devoted pages to von Kempelen's chess player, summarised the other notorious stage-shows of the age, then moved straight to Babbage's calculating engines themselves. 'Those mechanical wonders which in one century enriched only the conjurer who used them, contributed in another to augment the wealth of the nation. Those automatic toys', he concluded, 'which once amused the vulgar, are now employed in extending the power and promoting the civilization of our species'. Apparently theatrical automata really had inspired the industrial revolution.

Surrounded by stories which made the intimate link between the plausibility of mechanizing intelligence and the reality of automatic manufacture, it was scarcely surprising that Babbage's new calculating engines, first seriously proposed to the new Astronomical Society in 1820 and first publicized in a pamphlet of summer 1822, should raise in such a lurid way the puzzles of mechanical intelligence which the Turk had just dramatised. It was also rather predictable that his reflexions on the intelligence of calculating machines should eventually culminate in a detailed analysis of whether chess could be reduced to a program and an engine whose inner workings would be completely hidden from view behind a gaudy exterior. In his public letter to the President of the Royal Society, Humphry Davy, written barely eighteen months after Willis' pamphlet on the chess automaton, Babbage conceded that his own plans for a machine to 'substitute for one of the lowest operations of human intellect' might 'perhaps be viewed as something more than Utopian, and that the philosophers of Laputa may be called up to dispute my claim to originality'. He was, as usual, absolutely right.

The Chinese Room

Babbage and his collaborators never found it very easy to teach their audiences just where the intelligence of the calculating engines really was. This became even more true when the Analytical Engine was launched in the 1830s. At the end of 1837, Babbage composed a long memoir on its powers, noting that 'in substituting mechanism for the performance of operations hitherto executed by intellectual labour, the analogy between these acts and the operations of mind almost forced upon me the figurative employment of the same terms'. Phrases like 'the engine knows', he confessed, were simply irresistible even though they might be misleading. And the lengthy *Sketch of the Analytical Engine*, a joint effort of the early 1840s by Ada Lovelace and Babbage's Piedmontese admirer, the mathematician Luigi Menabrea, urged that 'it is desirable to guard against the possibility of exaggerated ideas that might arise as to the powers of the Analytical Engine'. It was a slave which could only follow what it was ordered to do, could originate nothing, was not, in fact 'a thinking being, but simply an automaton which acts according to the laws imposed upon it'.

But there were real dangers in the apparently innocent word 'automaton'. Ada Lovelace, who in 1843 called herself 'the High Priestess of Babbage's Engine', famously explained how it worked by comparing it with the best-known programmable machine of the automatic weaving system, the Jacquard Loom, a device whose introduction had almost completely destroyed the jobs of silk-weavers in London's East End. 'We may say most aptly', she noted in the Sketch, 'that the Analytical Engine weaves algebraical patterns just as the Jacquard Loom weaves flowers and leaves'. Lovelace never raised the problem of the substitution of weavers' intelligence by a series of automatic program cards nor the consequent sufferings of London's skilled unemployed. Instead, she directed her polite readers to the Adelaide Gallery, where they would see the Loom at work. But such galleries were scarcely likely to resolve the problem of exactly whether the engines could think. In fact, just as in Babbage's reception rooms the Silver Dancer and the Difference Engine stood next door to each other, so at the Adelaide Gallery the Jacquard Loom 'in daily operation' stood in the next room to a splendidly automatic Chinese juggler. It was exactly in such places that the distinction between entertaining automata and rational engines was all too easily effaced, and it was there, too, that all the puzzles of mechanized intelligence were graphically put on show.

There is a tempting contemporary resonance to these stories of dancers, Turks, chess and calculating engines. The currently canonical way of telling whether a machine is intelligent explicitly involves deceiving an audience in a manner all too reminiscent of Maelzel's shows at Spring Gardens. The so-called Turing test requires the construction of a hidden device which can produce outputs capable of convincing human judges that it is one of them. Alan Turing, brilliant Cambridge-trained mathematician and veteran of the secret wartime campaign to crack the German Enigma code, was a keen reader of Babbage and Lovelace and much concerned with the problems of automating chess. 'One can produce paper machines for playing chess', Turing wrote in 1948, 'playing against such a machine gives a definite feeling that one is pitting one's wits against something alive'. In 1950, after a debate at Manchester University on the possibility of making intelligent machines, he wrote a paper proposing what he called an 'imitation game', in which a man and a machine would both feed typed answers to a judge concealed in a different room. Turing's own life was soon destroyed by homophobic persecution, so it is intriguing that his first version of the imitation game involved judging which of two invisible respondents was a man, which a woman. In the later test of human and machine, if the judge could not tell which was the man, then the computer would pass the intelligence test. Turing's 1950 paper explicitly discussed Lovelace's ideas about whether the Analytical Engine could be truly intelligent, while in an earlier version he proposed, like Babbage, programming random elements into the computer so as to increase its capacity for innovative intelligence. Turing over-optimistically predicted that by our century's end computers should have developed so much that they would win a five-minute game at least 3 times in 10, and public computer competitions, funded by a manufacturer of portable disco dance floors and directed by a behaviourist psychologist, are run nowadays in California on exactly the lines Turing set out.

The Turing test is about concealment and detection. Its appeal hinges on the place where intelligence is to be found inside a space to which access is forbidden. In a celebrated paper published in 1980, the philosopher John Searle argued against the conventional interpretation of the Turing test. He proposed a device of which von Kempelen would have been proud, a 'Chinese room' occupied by a human being completely devoid of intelligence about Chinese but supplied with a set of symbols and rules which would allow response to inquiries from outside the room. Searle envisaged that such a system might pass the Turing test by being indistinguishable from native Chinese speakers to anyone outside. But neither necessary nor sufficient conditions could be given for attributing intelligence to such a system. In response to the suggestion that while the room's occupant might not possess intelligence about Chinese, yet the entire system might be said to do so, Searle countered that the enterprise of artificial intelligence 'must be able to distinguish the principles on which the mind works from those on which non-mental systems work', and to judge that a system is intelligent just because of its imputs and outputs would force us to attribute intelligence to a wide range of non-mental systems. The parable of the Chinese room dramatises the spatial mode of such debates, by insisting on a definition of the place where intelligence might be said to reside.

Here the geography of intelligence is not simply a matter of mundane showmanship, but also relies on the exoticism of distance and the esotericism of concealment. In many western myths of mechanical intelligence, with Chinese or Japanese, Turks or Nazis as their protagonists, aliens are automata, mindless subjects of tyranny; they build automata, because they possess fiendish cunning; and they conceal what they have done, because they desire to master us. In the world of Babbage's Dancer, mechanical imitation seemed most at home in oriental climes of which rather little was supposed to be known and almost anything might be credited. In Turing's world, as his brilliant biographer Andrew Hodges points out, intelligence meant secretive messages passed within a guarded coterie and the cryptanalysis of enemy codes as least as much as computers' capacity to imitate human beings. At the end of Gibson and Sterling's fantasy, the cunning orientals would inherit the Earth by mastering machine programming and British engines fail through dark conspiracies. There is, perhaps, a long-term political and aesthetic relationship between intelligent automata, orientalism and the covert. The tale of the automata and their impresarios confirms that the places whence machines come, where machines are put on show and the places within machine-systems where intelligence is supposed to reside raised, and still raise, delicate political and philosophical issues.

Most of these issues hinge on the problem of work and its visibility. Babbage never reconciled himself to the workforce on which he relied; von Kempelen exploited preconceptions about the role of skill; Turing explicitly ruled out any computational task which required the use of a body. Much is made of the collaborative work required from human beings to make their machines look expert and intelligent in a recent book by the sociologist Harry Collins, *Artificial Experts* (1990). 'One of the reasons we tend to think a calculator can do arithmetic', Collins suggests, 'is the natural way we help it out and rectify its deficiencies without noticing. All the abilities we bring to the calculation – everything that surrounds what the calculator does itself are so widespread and familiar that they have disappeared for us'. This is the point of the tale of the Dancer and the Difference Engine. The intelligence attributed to machines hinges on the cultural invisibility of the human skills which accompany them. In Babbage's devices, the skills which surrounded automatic mechanization were systematically rendered invisible. Then and only then might any machines seem intelligent. The moral about the politics and geography of serious trickery is certainly worth remembering. If such machines look intelligent because we do not concentrate on where their work is done, then we need to think harder about the work which produces values and who performs it.

Suggestions for further reading:

Richard Altick, *The Shows of London* (Cambridge, MA.: Harvard University Press, 1978)

C.M.Carroll, *The Great Chess Automaton* (New York: Dover Books, 1975)

Alfred Chapuis and Edmond Droz, *Automata* (London: Batsford, 1958)

H.M.Collins, *Artificial Experts: Social Knowledge and Intelligent Machines* (Cambridge, MA.: MIT Press, 1990)

Anne French, *John Joseph Merlin: the Ingenious Mechanick* (London: Greater London Council, 1985)

William Gibson and Bruce Sterling, *The Difference Engine* (London: Victor Gollancz, 1990)

Andrew Hodges, *Alan Turing: the Enigma* (London: Hutchinson, 1983)

Anthony Hyman, *Charles Babbage: Pioneer of the Computer* (Oxford: Oxford University Press, 1982)

> Within this MySpace version of the electronic agora, cybernetic communism was mainstream and unexceptional. What had once been a revolutionary dream was now an enjoyable part of everyday life.

Research by author

- Franco Bifo Beradi (1)
- Celia Pearce (1)
- Cybersalon (4)
- Gillian Mciver (1)
- IPE (12)
- Jeffrey Kaplan (1)
- John Barker (2)
- John Blower (1)
- Lisa Devaney (7)
- Louis Rossetto (1)
- Mark Stahlman (1)
- Matt Eley (1)