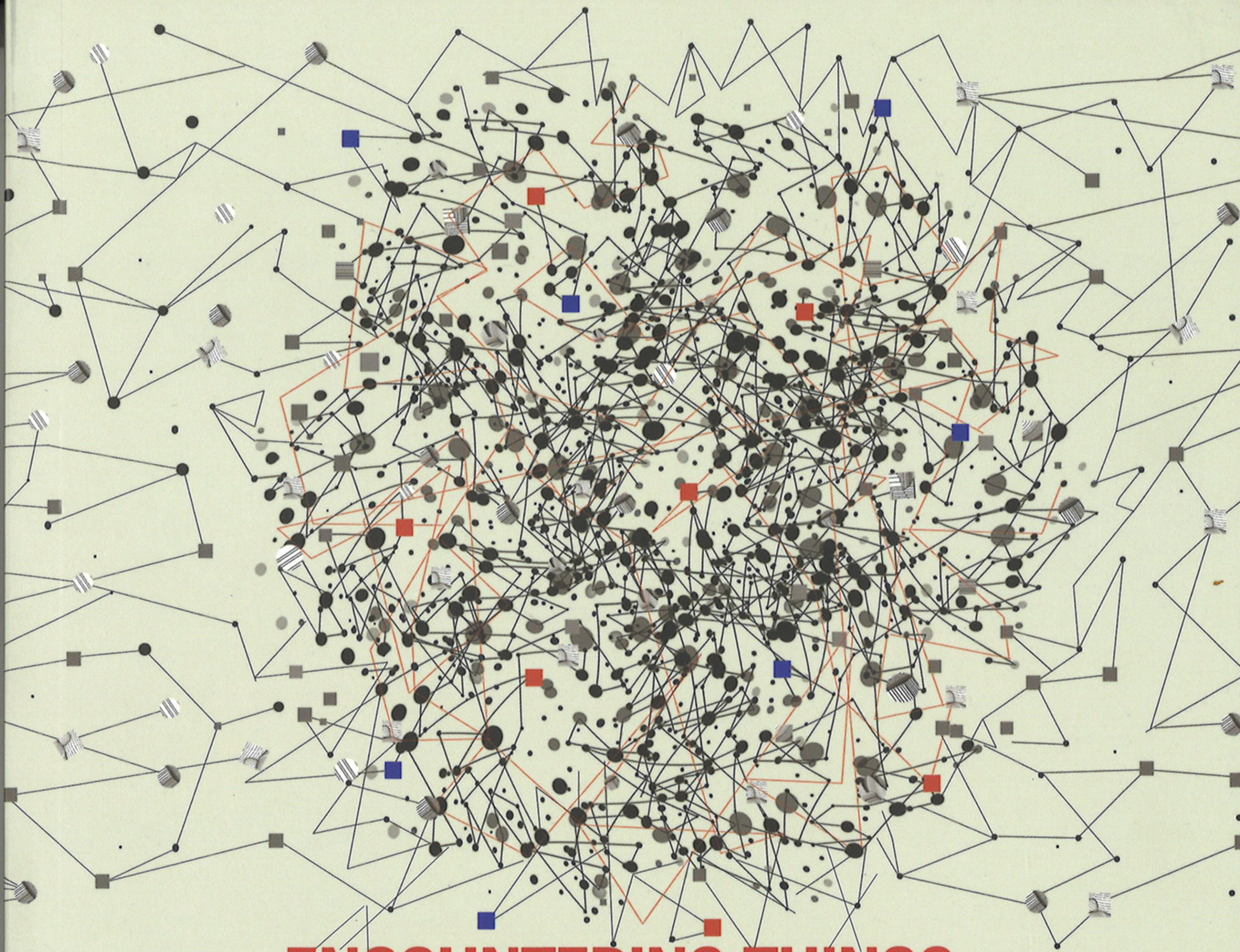

ENCOUNTERING THINGS

DESIGN AND THEORIES OF THINGS

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BLOOMSBURY

CONTENTS

1

Filled with wonder

The enchanting android from cams to algorithms

Betti Marenko

Instruments have a life of their own. They do not merely follow theory; often they determine theory, because instruments determine what is possible, and what is possible determines to a large extent what can be thought.

HANKINS AND SILVERMAN, *INSTRUMENTS AND THE IMAGINATION* (1995)

We are the androids

PIERRE JAQUET DROZ'S WRITING AUTOMATON (1770S)

Introduction

In the eighteenth century, androids mesmerized audiences with their astounding spectacle of movement and life like abilities. These masterpieces of engineering, "mechanical marvels, clockwork dreams" (Schaffer 2013), could move, play an instrument, write, even breathe, exactly like—and sometimes even better than—a human being. Today, the Android OS (Operating System), powering over a billion hand-held devices all over the world, astonishes with its memory, processing speed, and sheer computational power, all ungraspable by the human mind.

This chapter brings together these two types of androids: the eighteenth-century humanoid automata, and the contemporary Android-powered digital devices. The idea is that, although culturally and historically specific, these two types of androids have traits in common. Both eighteenth-century and contemporary androids are framed by and reflect ideas about the power of technology to enchant and delight, and to make us think. Both kinds of androids pose questions about what it means to be human in a world populated by machines that exceed human mental and physical capabilities. Mechanical or digital, both sorts of devices captivate with their capabilities, while prompting questions about the shifting boundary between the artificiality of life and the intelligence of machines.[1]

My investigation in this essay of the material and symbolic role played by androids in pre-industrial times can offer insights into how to rethink imaginatively our relationships with digital objects. This relationship is currently dominated by the twin technoscientific paradigms of dematerialization and perma-connectivity—the idea that devices require less and less material to operate, and the constant "online" status we now inhabit. We have come to expect (and demand) unlimited connectivity wherever and whenever; as digital devices and their components become increasingly miniaturized and more powerful, this connectivity takes place by largely invisible means. Our digital experience, mediated solely by omnipresent screens, seems to have dispensed with our perception of materiality in these experiences. The enchantment of our digital encounters, with flows of data appearing instantaneously as if by magic, is due to a great extent to our sense of the immateriality, invisibility and immediacy of these media.

To counteract this narrative, this essay locates "digital enchantment" within a history of the ways that technology produces "awe." This essay argues that both eighteenth-century and contemporary androids belong to a lineage of the "instruments of the imagination" (Hankins and Silverman 1995), an *imaginative*, yet *material* lineage of things that, by making us think, shapes who we are (Riskin 2003a). This gesture implies that there is nothing terribly new in the wonder that is inspired by our digital experiences. It imagines a *fil rouge*—a common thread—connecting the cams of the wondrous eighteenth-century androids to the codes of the Android phone. The eighteenth-century androids offered as enchanting an experience to their users as the twenty-first-century mix of technology and magic offers today.

Still, tempting as it might be to assert an unbroken lineage between Jacques de Vaucanson's androids[2]—to this day reputed the most astonishing automata ever created—and Android-run digital devices, we must be cautious.[3] The history of automata shows that our relationship with things that move and seem intelligent is more complicated and troubling than it appears to be. The lineage that I propose in this essay will reflect these complications.

Automata as eloquent metaphors

> All the questions that we ask now about computers, can it play chess, can it think independently, will it take over, were asked of mechanical automata. Gradually, however, clockwork suffered the fate of all technologies. Inspiring awe and fear when it was barely understood, then curiosity, it came gradually to seem trivial. (Hill 1992: 8)

Diderot's *Encyclopedie* (1751) defines *automaton* as a "device that moves by itself, or a machine that carries in itself the principle of its motion."[4] While this term refers to all sorts of moving machines, the word *android* is specific to humanoid automata: "an automaton in the figure of a human, which by means of certain well-arranged springs, etc., acts and performs other functions outwardly similar to those of a man" (Landes 2011: 50).

Automata are deemed crucial to the development of ideas about the relationship between human and machine—the way we think about the interaction between technology and us. Automata are eloquent metaphors for how changes instigated by technological innovations

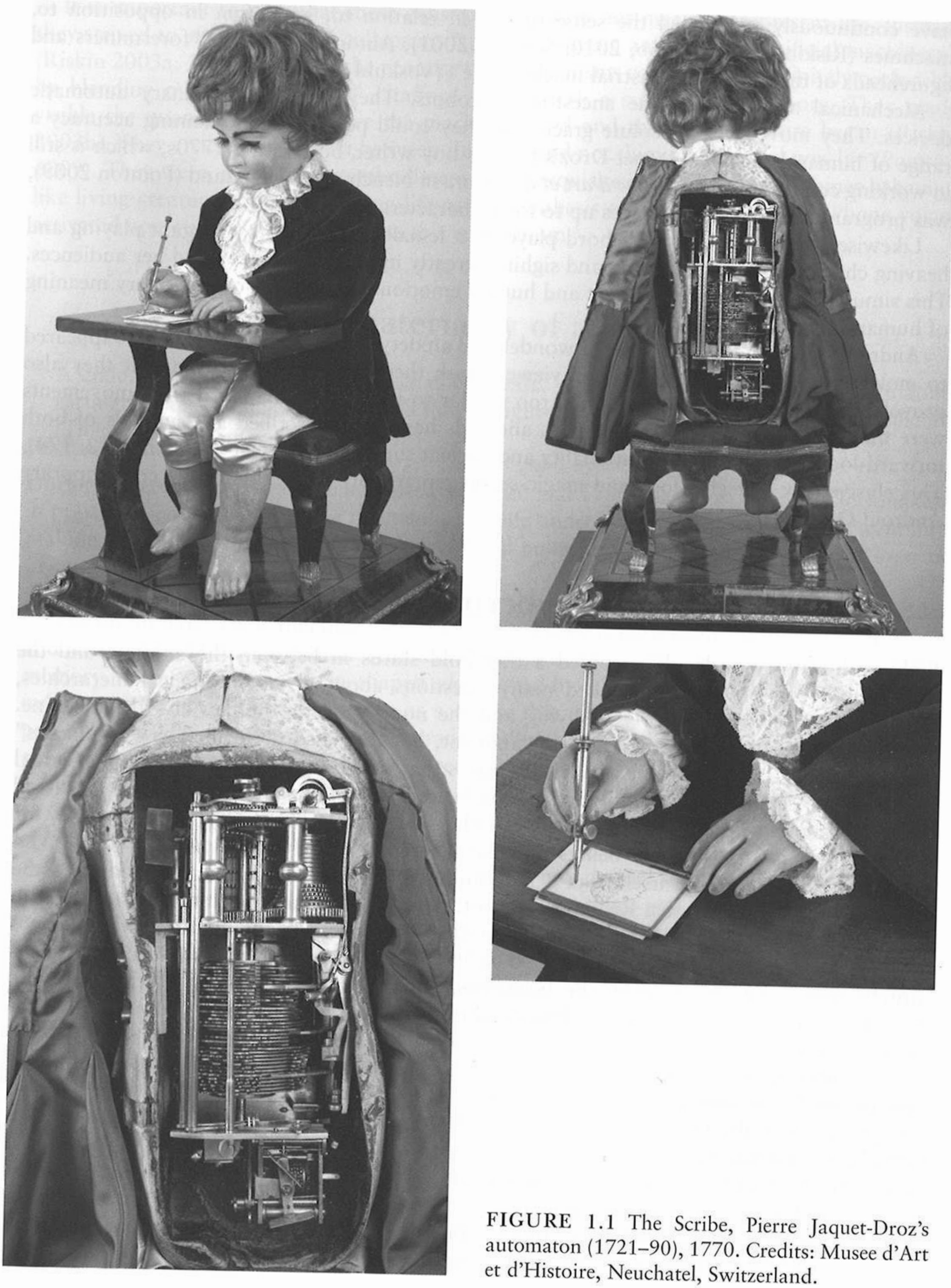

FIGURE 1.1 The Scribe, Pierre Jaquet-Droz's automaton (1721–90), 1770. Credits: Musee d'Art et d'Histoire, Neuchatel, Switzerland.

have continuously redesigned the sense of self in relation to, and often in opposition to, machines (Riskin 2003a, 2003b, 2010; Schaffer 2001). Automata are also "forerunners and figureheads of the modern, industrial machine age" (Voskuhl 2013: 2).

Mechanical androids are the ancestors of robots. They were extraordinary automatic devices. They moved with absolute grace, and they could perform with stunning accuracy a range of human behaviors. Jaquet-Droz's famous boy writer, built in the 1770s, which is still in working condition at the *Musee d'art et d'histoire* in Neuchâtel, Switzerland (Pointon 2009), was programmed to write messages up to forty characters.

Likewise, Jaquet-Droz's harpsichord player is a female android whose elegant playing and heaving chest simulating breathing and sighing, greatly impressed and troubled her audiences. This simulation of lifelike movement and human emotions cast doubts over the very meaning of humanity.

Androids were, indeed, a source of wonder and anxiety. As inanimate objects that appeared to move autonomously they charmed viewers with their skillful construction, but they also provoked unease. They were uncannily too similar to living creatures, as if their movements were the result of magical forces. Aptly, androids have been described as "symbols of both forward-looking technological rationality and ancient supernatural belief" (Tresch 2012: 174). This elusive mix of technology and magic seems remarkably applicable to the contemporary Android OS as well.

Automata as cybernetic constructions

Eighteenth-century androids occupied a threshold status in between the animate and the inanimate. Their existence provoked many questions about given ontological hierarchies, those that relate to existence—the living and the non-living, the human and the machine. Thus, these androids performed as entertainment, but they also performed as "arguments" (Shaffer 2001: 135). They were rhetorical devices that actively participated in the intellectual milieu in France and England, where the boundaries between life and non-life were discussed and experimented upon. Mechanicist philosophers such as Julien Offray de La Mettrie, for instance, thought that human beings are like machines. In *L'Homme-machine* (1748), La Mettrie declared that life itself was a mechanical and entirely reproducible affair. As the historian of automata Jessica Riskin points out, these philosophical arguments worked both ways: "If life was material, then matter was alive, and to see living creatures as machines was also to vivify machinery" (Riskin 2003a: 99). This notion of "vivified machines" seems entirely appropriate to describe the behaviors, expectations and narratives that circulate around our interactions with digital devices: objects to which we talk and which can talk back to us (Marenko 2014).

The philosophical debates about life and machines greatly influenced the design of Vaucanson's "cybernetic constructions" (Stafford 1994: 191). Vaucanson's *Flute Player* (1738), for instance, was the first automaton to actually play the instrument—versus the decorative flute-playing human figures that were often used to conceal music boxes. Air was blown through the *Flute Player's* lips, and to simulate life as much as possible, his fingers were covered in real skin. And yet, these moving machines were also artifices, designed to surprise, entertain and seduce by deception, like Vaucanson's celebrated *Defecating Duck*—a duck-machine that could ingest food and allegedly eliminate it as waste too (Riskin 2003b).

It is important to note that these constructions were not meant to represent life. Instead, they strived to *simulate* life by collapsing "the gap between animate and artificial machinery" (Riskin 2003a: 101). They held the promise that "organisms could become infinitely perfectible by blending muscle with metal" (Stafford 1994: 195): a sort of proto-cyborg. They made visible the quandary about where the machine ended and the living creature began (Riskin 2003b). They enacted the drama between thinking and not thinking, life and non-life (Pointon 2009). They were, in short, the embodiment of an exquisite contradiction: machines behaving like living creatures while simulating life as the antithesis of machines. *Siri*, the iPhone voice-activated operating system, represents this conundrum.[5]

The materiality of androids

> A code is a series of activated mechanical gears, or a stack of punched cards circulating through a tape-reading machine, or a flow of light-pulses or bits in a transistor or on silicon. (Thacker 2004: xiii)

During the golden era of automata—between 1720 and 1780—the most talented clockmakers in pre-steam-power Europe used their skills to build androids. A mix of technologies went into making them: hydraulics and gravity, springs and pulleys, and cogs and very intricate systems of cams.

Cams are rotating pieces in larger mechanisms, usually wheels with eccentric and irregular shapes on an axis. Their function is to translate rotational movement into linear movement, and vice versa. Historian Simon Schaffer (2013) describes cams as a sort of "mechanical memory." As each cam moves, its shaped edge is read by other cams, and this is translated into movement. We should imagine a cam as a device that stores memory, with each groove and pattern in its edge creating a movement translated with perfect fidelity every time. Thus, cams are a technology that captures movement, records it as a specific shape (set of instructions) and activates it by a mechanical sequence.

Can we then, paraphrasing media theorist Eugene Thacker's epigraph at the beginning of this section, consider a stack of cams as a material version of an algorithm? Algorithms are recipes, or sets of basic instructions arranged in any desired sequence. Can we, based on this definition, also imagine a relationship between algorithms and magic? After all, a magic formula is nothing but a sequence of spells that is associated to a procedural sequence whose enunciation creates a full cognitive plan. Incantations are like algorithms. And vice versa. This should not be surprising, as magic and enchantment are deeply woven in the history of technology (Grafton 2002; Bredekamp 1995; Stafford 2001).

If we consider the materiality of these technologies, the transition from cams to punched cards to microprocessors is well documented (Stafford 2001; Schaffer 2013). What perhaps still deserves attention is the role played in the prehistory of computing by Vaucanson, the designer of sublime androids. Before turning to Vaucanson, however, the next section introduces two ideas that are key to my argument: "thick things" (Alder 2007) and the evolution of technical objects (Simondon 1980).

Matter and meaning: In the thick of it

Historian Ken Alder (2007) suggests that things are "thick" because of their complicated enmeshing of materiality and meanings.[6] The material world possesses a degree of opacity and recalcitrance that can be acknowledged only by assuming that things are always partial negotiations. "Thick" things are thus the material embodiment of multiple and divergent perspectives. They are the coordination of "the diverse sets of human agents who design, make, and use them" (Alder 2007: 82). Alder observes how "attention to the thickness of things can help break down distracting dichotomies like science/technology, idea/thing" (Alder 2007: 82).[7]

What is at stake here is how this commingling of disparate elements (idea/thing, material/digital) enables things to exist and to produce meanings. In the case of both sorts of androids that are examined here, the notion of "thick things" offers a perspective on how to chart their lineage across different historical times, while insisting on their disruptive material-symbolic presence. By taking both eighteenth-century and contemporary androids as "thick things," we focus on how they enmesh materiality and meanings. Only in this way can we capture their significance beyond the alleged division between materiality and immateriality.

The evolution of technical objects: "That which forces thought"

> There is no moment at which humanity comes to be contaminated by technical objects and practices—no fall into a world of things—because there can be no human without them. The history of the human animal—and indeed the history of culture—is thus necessarily the history of stuff that is, from the beginning, part and parcel of human life. Our embodied relations with things are not something that come to be "added to" human life. The human body and its capacities emerge as such in relation to a technicity that precedes and exceeds it; there is no body, no original body, no origin outside this relation; no thinking, no thought, no logos, without that which forces thought. (Braun and Whatmore 2010: xix)

French philosopher Gilbert Simondon's notion of evolution of technical objects rethinks the human–machine interaction in terms of an evolutionary continuum (Simondon 1980; Chabot 2013; Schmidgen 2012). Simondon tells us that objects are always the concrete expression of a spontaneous evolution, which depends neither on natural processes nor on human design. Rather, technical objects gain "an intermediate position between natural object and scientific representation" (Simondon 1980: 46). Moreover, far from evolving in isolation, technical objects are the result of a process in which internal parts converge and adapt "according to a principle of internal resonance" (1980: 13). This process (*concretization*) involves a convergence of functions by which the object acquires an internal coherence propelling it beyond the intention of its inventor. For instance, the migration of silicon transistors from computers into a number of objects to make them "smart" (mobile phones, cars, smoke detectors) promotes innovations that feed back to the original solutions. The result is that computers are also changing and evolving (Hayles 2012).

Even though they are designed and made by human beings, technical objects *have a life of their own* (Schmidgen 2012). They create webs of associations, surfacing as elements in cultural lineages that possess an imaginative life while being profoundly material.

The implications of Simondon's theory of technology are significant for two reasons. First, the genesis of technical objects—the development of common artifacts, sophisticated machines of wonder or digital devices from conception to maturity—is understood as fully integrated into culture. Simondon's theory of evolution does not position technical objects as an extension of a pre-existing body, but as fully inherent to human life (Braun and Whatmore 2010). The computers and smartphones that we use for work and leisure, for instance, should not be considered to be extensions of our bodies or memories. Instead, they are intrinsic constituents of who we are now, and who we may become in the future.

Humans are always already among machines. Likewise, technical objects are always already among, and coevolving with humans. This means that the boundary between natural and artificial, animate and inanimate becomes harder to locate. It also signals the impossibility of thinking of "technology" as something that humans invent, design and produce that is either completely separate from, or an extension of, themselves.

Second, Simondon's theory draws attention to the materiality of things, not as something passive and given, but as something that emerges from a process of co-evolution and co-creation. This prompts us to reflect on the embodied significance of technological apparata as diverse as cams, punch cards, and codes, and to map their material participation to different cognitive metaphors and cultural paradigms.

The material form and the proximity of our devices shape our ideas about technology as well as our notions of personhood. The eighteenth-century automata I discuss in this essay were developed during the Enlightenment—a period during which philosophers and scientists privileged reason over ideas that were grounded in tradition and faith. During the Enlightenment, the metaphor used to think about technological innovation was philosopher Rene Descartes' image of a clockwork universe—the idea that the whole universe, including the human body, works like a clock and, like a clock, depends solely on mechanical functioning. Technology was seen as an extension of nature. Today's pervasive computational metaphor—which is derived from machines whose performance is measured in processing speed and miniaturization—has become the byword for technology as well as the model that is used in the neurosciences and cognitive sciences to represent the human brain (Daugman 2001).

As we shape technology, technology shapes us.

From automata to looms, from cams to codes

Vaucanson's prodigious work was favoured by King Louis XV, who appointed him in 1741 to be the Royal Inspector of Silk Manufactures. Vaucanson took his skills, knowledge and expertise to the pre-industrial arena, and applied them to weaving technology. In 1747, he built an automatic programmable loom that operated via punched cards.

Refined by Joseph-Marie Jacquard half a century later (1801), this machine "would revolutionize weaving and in the twentieth century, would be used to input data into computers and store information in binary form" (Stafford 2001: 44).[8] Inspired by Vaucanson, Jacquard's automatic weaving machine worked by encoding the pattern in a specific arrangement of holes in a stack of punched cards. These cards work as "a *memory* that holds the pattern the loom will 'recall' and 'obey,' as a *blueprint* for how a piece of cloth is to be woven, and as a *program* that drives the loom" (Dasgupta 2014: 20).

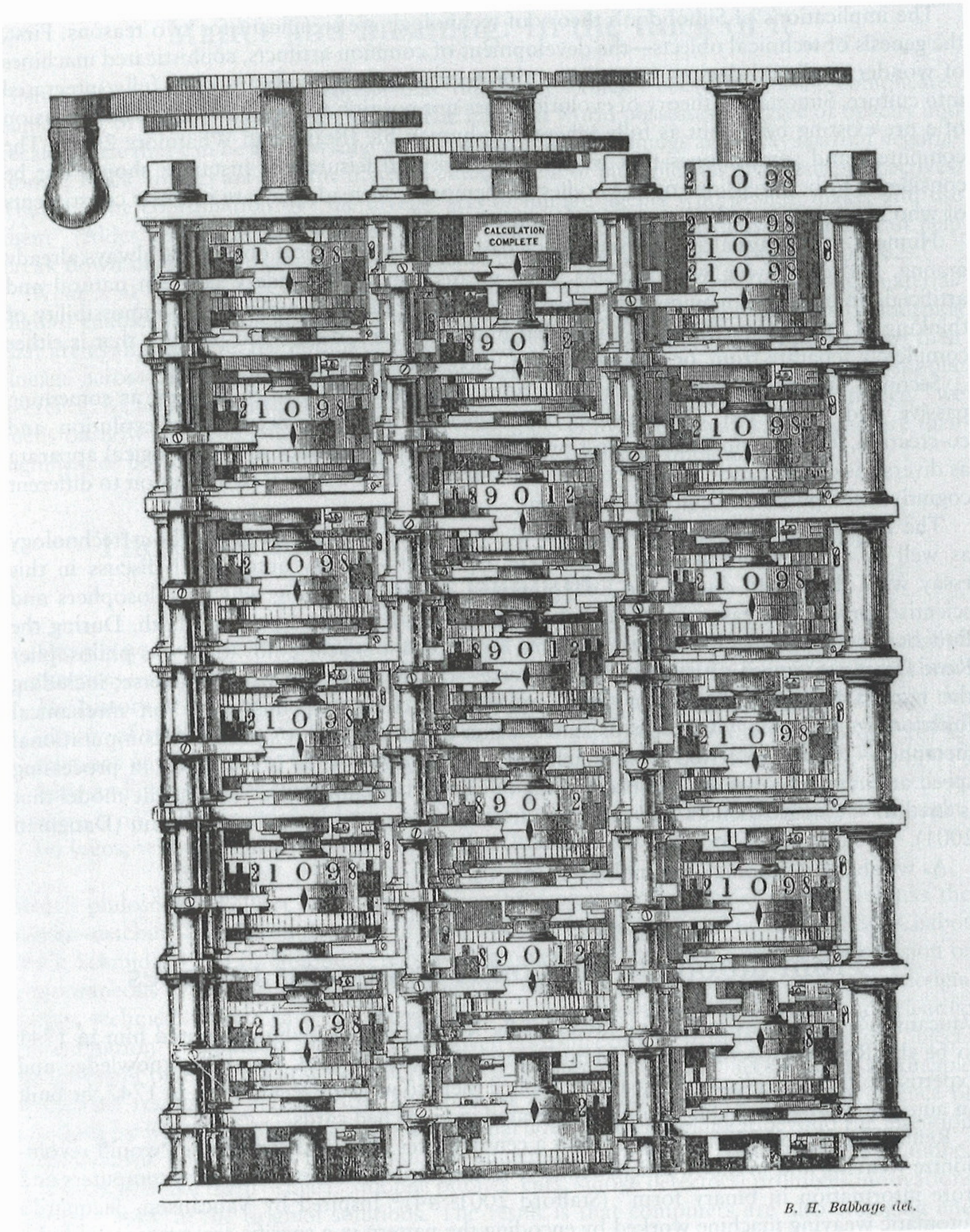

FIGURE 1.2 Difference Engine woodcut. Charles Babbage's Difference Engine No. 1, c. 1830s. Credits: Science Museum (London) / Science and Society Picture Library.

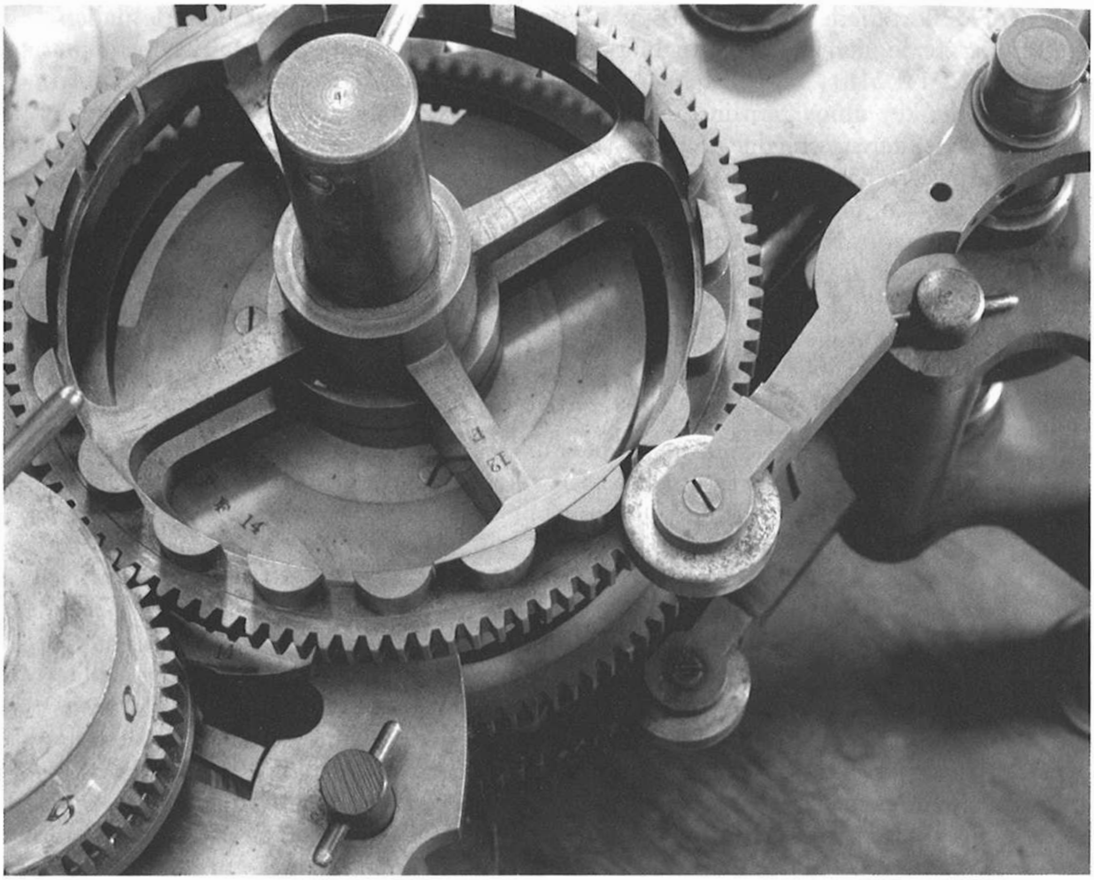

FIGURE 1.3 Difference Engine Cogs details. Demonstration model of Babbage's Difference Engine No. 1, nineteenth century. Credits: Science Museum (London) / Science & Society Picture Library.

It is remarkable that Vaucanson, the creator of both androids and automatic looms, had such a crucial role in the transition from the pre-industrial to the industrial era. What is even more so is that the punch card technology that he devised after working with cams later informed the first computational machine ever created, the Difference Engine by English scientist Charles Babbage. Astonishingly, this punch card technology remained in use until the 1960s when the IBM punch card systems were superseded by computers (Essinger 2004).

Babbage, the inventor of modern computers, was in equal measure fascinated by androids and by the Jacquard loom. Guests at Babbage's fashionable London soirées were entertained by a prototype of his automatic calculating machine and by an exquisite singing android (Schaffer 1994).[9] The coming together of these two automatic devices in the home of the inventor of modern computers is a testament to "the imaginative dimension in the advance of technology" (Pointon 2009: 228).

Babbage's great insight was to deploy the technology from Jacquard textile manufacture to design a universal computing machine that could perform without human intervention. He introduced the separation, familiar to us, between data processing ("mill") and data storage ("store") (Eames 1990).[10] He also figured out that changing the pattern of holes in the punched cards could alter the loom program—which was programming in its infancy. He understood that the same loom had "the capability for, potentially, an *infinity* of weaving patterns" (Dasgupta 2014: 21).

This is the key innovation in the Difference Engine. While the Jacquard loom works by analogy, the Difference Engine works by program. In the Jacquard loom, the loom can only weave the pattern corresponding to the holes in the pre-loaded punched cards, but there is no "accumulation" of information. In the Difference Engine, on the other hand, each calculation depends on previous results. Each numerical output is the input for the next step of the calculation" (Brennecke 2002).[11]

Babbage's machine therefore possessed features that are now associated with a modern computer; it was not just a mechanical processor. It was an instrument of the imagination. Its material form—a complicated system of springs and weights, gears and pulleys, wheels and chains, levers and barrels (Dasgupta 2014)—enabled the abstract reasoning necessary to propel technological evolution into the next stage of modern computing machines: the *Android* as we know it now.

Androids meet the Android OS

The imaginative lineage which I have charted in this essay is manifested in the name Google chose for its mobile Operating System: Android. This name, which is familiar to billions of users all over the world, harks back to automata, and suggests continuity with the history of human–machine interaction. Android is an "open-source software stack created for a wide array of devices with different form factors."[12] Different types of phones and tablets use this software resulting in a range of different graphical user interfaces (GUIs). "Built for you. Android keeps you connected to what matters," claims the tagline on Google's *Meet Android* website.[13] If we could imagine the Android meeting its eighteenth-century counterpart, as this essay proposes, we might at a first glance conclude that beyond the name little similarity exists. After all, the old android was a uniquely designed, tangible, anthropomorphic moving machine. The Android is a digital platform, intangible and invisible, that needs to be loaded onto standardized hardware—the ubiquitous smart devices with a uniform rectangular design that we know so well.

To capture their similarities, we need to unpack the tangible/intangible distinction as this fails to account for the materiality of digital media. The transition from mechanical to digital paradigms is marked by the contradictory "spectres of virtuality and dematerialization" (Gabrys 2011: 4). The result is that the materiality of our always-on status is seldom, if ever, acknowledged. The contradiction sociologist Jennifer Gabrys alludes to concerns dematerialization's double claim for invisibility and immediacy. This assumed invisibility and immediacy obscures the tangled, messy, material infrastructure upon which any digital performance depends: silicon, circuit boards, copper wires, optic fibers, cables, radio masts, servers' warehouses, minerals. Invisibility and intangibility do not mean absence of materiality. The trope of dematerialization is therefore problematic and misleading.

As historian of science Simon Schaffer reminds us when describing Babbage's automatic machines: "to make machines look intelligent it was necessary that the sources of their power, the labour force which surrounded and ran them, be rendered invisible" (Schaffer 1994: 204). This original displacement of the real labor behind machines is important in order to understand dematerialization.[14] As the smooth surfaces of our laptops and our smartphones seduce us into an exquisite experience of interaction and connectivity, they obfuscate the work and resources (both human and non-human: bodies, energies, materials, minerals, etc.) that go into producing such an experience. This has an effect at once enrapturing and spellbinding. Streams of data appear incessantly on our screens, as if the world was magically flowing towards us. It becomes easy, then, to grasp the intrinsic connection between technology and magic.

Technology is magic by other means

> Magical technology consists of representing the technical domain in enchanted form. (Gell 1992: 59)

Anthropologist Alfred Gell (1988) describes three different human technological capabilities: technology of production (concerning primary needs such as food, shelter, manufacture, and communication); technology of reproduction (concerning kinship and the social arrangements needed to ensure species reproduction); and technology of enchantment, strategies deployed to enchant and to various degrees convince, persuade, or manipulate others. Art, music, and rhetoric all belong to this technology, which concerns broadly the sphere of affects, passions, desire, fantasy, and wonder.

The connection between technology and magic is explicit. Magic is essentially a craft activity, whose goals are aligned with the goals of technology. Both aspire to change and control natural environment by artificial means.[15] This is why "magic haunts technical activity like a shadow" (Gell 1992: 59). Remarkably, Simondon makes a similar argument. Technicity, he argues, emerges from, and is the heir of, magic—together with religion (Simondon 2010: 118). It is impossible to understand technical objects if not in the context of "the entire genesis of the relations between man and the world," engendered from this "primitive magical unity" (Simondon 2010: 100).

If technology is "the pursuit of difficult to obtain objectives by roundabout means" (Gell 1988: 7), and magic is what "formalizes and codifies the structural features of technical activity, imposing on it a framework of organization which regulates each successive stage in a complex process" (1988: 8), then magic is "the ideal technology" (1988: 9), "the ideal means of technical production" (Gell 1992: 59). It can therefore be claimed that "technical innovations occur, not as a result of attempts to supply wants, but in the course of attempts to realize technical feats heretofore considered 'magical'" (Gell 1988: 8). Technology is, in other words, magic by other means.

Indeed, many scholars have articulated the link between the development of modern technoscience and the tradition of sixteenth-century natural magic (Hankins and Silverman 1995; Grafton 2002; Stafford 2001). Historian Anthony Grafton uses the expression "technological brand of magic" (2002: 18) to describe the work of military experts, clockwork makers, engineers, and architects—like Filippo Brunelleschi—who used innovations in fields as diverse as optics, hydraulics, pneumatics, and warfare as a kind of *technological spells* to harness and outdo the forces of nature and "to amaze and frighten their audiences" (2002: 24). Let us not forget that the Enlightenment, the era of the androids, was also the time when the inanimate forces of electricity, heat, steam, and gas were tamed and becoming alive (Tresch 2011).

In his erudite account of the *Kunstkammer*, art historian Horst Bredekamp (1995) emphasizes the presence of occult and magical tendencies in seventeenth-century mechanistic philosophies and their role in shaping attempts to synthesize life and generate autonomous movement. Automata were the most obvious expression of this yearning. The power of magic was elicited in order to do the impossible. An undercurrent of "mathematical" and "artificial magic" (Grafton 2002) clearly traverses Western history of technology. It is often overlooked, yet vividly present (Stafford 2001). Magic never really disappeared. It was "merely subsumed under new categories such as entertainment, technology, and natural science" (Hankins and Silverman 1995: 4). One of the reasons for its persistence was practicality:

> We tend not to think of magic as a practical art, certainly not in a utilitarian sense, but many of the goals of natural magic – creating realistic images where there is no substance, communicating instantly around the globe, imitating and preserving the human voice, revealing hidden sources of power, travelling under the sea, and flying through the air – are technologies we now take for granted. We no longer consider them magic, but in the seventeenth century they were. (Hankins and Silverman 1995: 5)

The persistence of magic is rooted in historically variable and materially diverse ecologies of objects. Whether machines of wonder or digital devices, they are all instruments of the imagination, able to enchant by movement, speed, instantaneous communication and, above all, by bestowing upon us what cannot be fully grasped, yet.

The imaginary meeting of androids evoked in this essay is an invitation to pay attention to the materiality of our digital encounters, even though unlike cams, codes cannot be touched. This meeting is not only to grasp better how digital devices work and how they came into being. It is a way to rethink them in a more imaginative way by positioning them within a wider cultural history of technologies of enchantment (Gell 1988, 1992). This imaginary meeting of androids casts a new light on today's digital enchantment.

Conclusion

The more impalpable and invisible the machines around us become, the more pressing is the urge to investigate the prehistory of our digital world. It is by looking into a past made of cogs and cams that we may find a way of unlocking some of the narratives shaping our experience of digital devices. Our permanent wired state is also the product of centuries of experiments, dreams and nightmares that are populated by machines that behave like humans. Today's complicated digital interactions, in which the boundaries between the artificial and the organic, and the real and the simulated, are blurred, should be sited within the lineage of human-machine interaction.

A kinship between the androids of the eighteenth century and today's Android emerges because of the name they share, but also because of the capacity of machines both to have lives of their own and to have impact on our lives. Both eighteenth-century and contemporary androids are "thick things" that embody the historically located form of a technology that continuously co-evolves with humans. Whether by mechanical or digital means—by cams or codes—they are both touch-points of the fluidity of the boundary between human and machine.

Eighteenth-century androids raised these philosophical questions through a spectacular enactment and simulation of life. The Android, on the other hand, is fast becoming a universal enabler. It does not simulate life. Instead, it is increasingly the optimized channel that makes life possible at all in our digital era. Both androids are designed objects whose roles go beyond spectacular entertainment (eighteenth-century androids) and data processing with instant connectivity (Android OS). Instead, both these objects work at redrawing imagined boundaries, and redefining what we take to be intelligence in an era of things that move.

Most important, this essay hints at the fact that the paradigm shift from mechanical to digital technologies is perhaps more seamless than we are led to believe. By dispelling the paradigm of dematerialization, we can recapture an originary magical union of human and machines. Sited within the history of "marvellous machines," our digital enchantment can be rethought imaginatively and grafted upon the undercurrents of magic that traverse Western history of technology. Magic never really disappeared. It morphed into the new categories of entertainment and technology and all their hybrid offspring that beckon to us from our screens.

If eighteenth-century androids were "philosophical animated experimental objects" (Landes 2011: 54) prompting questions about humanity, then today's Androids should be more than our indispensable connectivity devices. They too should be "philosophical animated experimental objects," inviting us to reflect on the dazzling forms that enchantment takes in our machine-inhabited world.

Notes

1 On automata and androids' role in defining technological paradigms and embodying critical interrogations about the human/machine relationship, see Schaffer 2001, Pointon 2009, Riskin 2003a, 2003b, 2007, 2010; Kang 2011; Landes 2011, 2007; Liu 2000; Reilly 2011; Voskuhl 2013. On the history of automata and androids, see Chapuis and Droz 1958.

2 Jacques de Vaucanson (1709–82) was a French inventor. He designed and built astonishingly complicated automata whose technological prowess has never been surpassed. They were so life-like that he was hailed as a modern Prometheus by philosophers La Mettrie and Voltaire (Cottom 1999: 56).

3 See Voskuhl (2013) for a critique of current literature that tends to modernize automata by assuming a direct link between them and contemporary technology. The risk is of overlooking the differences in the ever-shifting relationship between human and machines.

4 This definition contains some ambiguity: it is not entirely clear whether the spontaneous movement of the inanimate object is self-generated or merely *appears* to be so. Compare to the definition found, 250 years later, in Menzel and Aluisio (2000) where *automaton* is "a mechanism that is relatively self-operating, like a robot, and designed to follow automatically a predetermined sequence of operations, or respond to encoded instructions" (2000: 234), and android "a robot that approximates a human in physical appearance. A humanoid" (2000: 234).

5 Siri is an intelligent personal assistant that allows users to ask questions directly to their iPhone. The implications of a human chatting away with a machine are well captured by Spike Jonze's movie *Her* (2013), which tells the story of a man who not only chats with his voice-activated operating system, Samantha, but falls in love with "her."

6 In his afterword to the special issue of *Isis* on "Thick Things," Bruno Latour (2007) observes: "many descriptions of 'things' have nothing 'thingly' about them. They are simply 'objects'

mistaken for things. Hence the necessity of a new descriptive style that circumvents the limits of the materialist (in effect idealist) definition of material existence" (Latour 2007: 138).

7 This echoes Latour's concept of "hybrids," or Michel Serres's "quasi-objects"—things as the expression of entangled networks that cannot easily be pulled apart (Latour 1993), or occupying a position in between object and subject (Serres 1982). Latour (1993) offers some examples of these hybrid objects: "we find ourselves invaded by frozen embryos, expert systems, digital machines, sensor equipped robots, hybrid corn, data banks, psychotropic drugs, whales outfitted with radar sounding devices, gene synthesizers, audience analyzers, and so on [...] When none of these chimera can be properly on the object side [society] or on the subject side [nature], or even in between, something has to be done" (Latour 1993: 49–50). See also Henare, Holbraad, and Wastell (eds) 2007, for the proposal of "a methodology where the 'things' themselves may dictate a *plurality* of ontologies" (2007: 5).

8 See Riskin (2003b) for a detailed account of Vaucanson's preoccupation with issues of automation and life-simulation, and the application of his work from automata to automatic machinery. On his role in the transition to the industrial revolution see also Stafford (2001: 44).

9 Babbage saw this automaton, exhibited at Merlin's Museum, in Hanover Square, in 1783, as a child, and bought it thirty years later.

10 It is interesting to note that both words chosen by Babbage to define these two functions ("store" and "mill") come from the weaving industry.

11 In his classification of early programmable machines, computer scientist Andreas Brennecke (2002) uses the terms "analog" and "digital" to distinguish different forms of sequence control. Analog refers to a control sequence that is part of the construction of the machine. Control mechanisms are based on physical analogies. Digital refers to a control sequence based on abstract rules of algorithm—set of basic instruction arranged in any desired sequence. Brennecke notes that the generic term "program" can be used to describe a number of very different sequence controlled machines, from Heron of Alexandria's automata, early musical automata, Jacquard looms, sequence controlled calculating machines, and modern computers. See also Koetsier (2001).

12 From The Android Source Code, Google Inc., http://source.android.com/source/index.html (accessed June 21, 2014).

13 Google Inc., www.android.com (accessed June 21, 2014).

14 To consider here is also Marx's critique of capitalist production and objectification of the world of things, where the shift from artisan handcrafted production to serial machine production determines a shift in the social character of objects, from product to commodity. As a consequence of industrialization the connection between objects and world of things is interrupted. Objects lose their singularity, become all copies of a series, and, crucially, a gap is wedged between use value and exchange value.

15 On the general theory of magic, see anthropologist Bronislaw Malinowski (1992)

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