

Turing's Thinking Machines: Resonances with Surrealism & the Avant-Garde of the Early 20th Century

Klemens E. James¹

Abstract. This paper examines the thinking machines depicted in the visual and theoretical works of Surrealism and other avant-garde movements of the early 20th century. The aim is to establish to what extent the conceptions of these machines prefigure Turing's ideas about the mechanical brain. Whereas Surrealism and its artistic antecedents (such as the Dadaists) are generally thought to have been uninterested in or mistrustful of such technological developments, it will be shown that a number of artists/theorists (Ernst, Duchamp, Picabia, Hausmann, Matta, Dalí, Caillois) envisaged the notion of the thinking machine in a manner which anticipated a number of Turing's ideas (the gendered machine, machine consciousness, the child-machine, pleasure-pain systems, randomness).

1 INTRODUCTION

In his 1950 article 'Computing Machinery and Intelligence' Alan Turing asked the question 'can machines think?' and predicted that 'at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted'[1]. His statements were visionary, the product of a mind very much ahead of its time, especially given today's reliance on computers to conduct intellectual operations that were previously the work of the human mind. This paper aims to show how Turing's vision of a thinking machine was the preoccupation of many of his contemporaries and his immediate antecedents, not in the scientific world but in the European avant-garde, particularly in Dada and Surrealism. In so doing I want to challenge two principal assumptions: that of the irreconcilability of the sciences and arts, but also that all voices within Surrealism and its immediate precursors were uninterested in or opposed to the evolution of technology, and the further modelling of machine upon man.² Whereas it is true that two of Surrealism's founding fathers, André Breton and Max Ernst, were somewhat dismissive of science, they, like all Surrealists, were profoundly influenced by the scientific writer Gaston Bachelard in *Nouvel Esprit Scientifique* [2] (1934) which situated Surrealism and modern physics 'in a non-classical, non-Cartesian, non-Newtonian, non-Kantian epistemology'[3] and showed how the imagination could yield new scientific paradigms, new forms of architecture and space, new forms of poetry and thinking; this, according to Bachelard, occurred at the threshold between the conscious and subconscious mind, and the

inner reality of the self and materiality of the outer world. Inspired by Bachelard's theories, the Surrealists attempted to harness the knowledge gleaned from these liminal states not only for their creative projects but also to intuit and depict a vision of the future (and the role of machines and robots within it).

The Surrealists took on Bachelard's merging of the conscious and unconscious mind as part of a broader project to reconcile the antinomies of nature [4,5] (this not only fitted in with their belief in a Hegelian-inspired dialectics but formed the basis of their aesthetic). In their iconography and writings, experiments in reconciling oppositional concepts resulted in depictions of man merging with machine. The man-machine hybrid could be seen in the works of Max Ernst, Marcel Duchamp, Francis Picabia, Roberto Matta, Salvador Dalí and Roger Caillois – and although Ernst and Duchamp were deeply mistrustful of machine technology, the others viewed it in a rather more nuanced (and even more positive) light, even going so far as to postulate the future development of an intelligent machine.

Surrealist scholar Dawn Ades interprets Breton's underlying message in the *First Surrealist Manifesto* as "we as poets have just as much right to do research and do experiments in this field as the scholars and scientists do". And so, he was setting up Surrealism [...] as a kind of arena for experiment'[6].

2 THINKING MACHINES IN THE EUROPEAN AVANT-GARDE OF THE EARLY 20TH CENTURY

2.1 Artistic consciousness in the Machine Age

This paper begins by surveying the general view of thinking machines within the cultural and artistic movements of early 20th century Europe – and how this helped pave the way for the Surrealists' conception of such an invention. Historically speaking the early 20th century coincided with the end of the Second Industrial revolution (also known as the Machine Age). This saw the rise of mass consumption and the production line, Herman Hollerith's tabulation machines [7] (first distributed by IBM in 1924), telephone and radio technology, industrial, printing and military equipment, as well as improved transportation (in the form of trains, automobiles and aircraft). Whether at work, in leisure or in warfare, this was an age which

¹ School of Arts, University of New England, NSW, Australia.
Email: klem.james@une.edu.au

² In so doing, the paper develops the invaluable work already done in this field by Gavin Parkinson in *Surrealism, art, and modern science: relativity, quantum mechanics, epistemology* (2008) who has shown how Surrealists frequently drew on scientific theory to inform both theory and practice.

was to bring man and the machine inexorably closer together; an age which was also to forge the artistic and scientific conscience of the Western avant-garde and a generation of scientists to which Turing belonged (scientists who drew on the knowledge of this industrial age only to become pioneers of the information age).

According to Foster in *Prosthetic Gods*, the anticipation of a closer alliance of man and machine was common to avant-garde movements in many western countries, occurring: 'in Futurism in Italy, Vorticism in England, Purism in France, Precisionism in the United States, Neue Sachlichkeit in Germany, and Constructivism in Russia and elsewhere'[8]. Apart from Surrealism's prefiguration of a number of Turing's ideas, these movements did not generally demonstrate the viability of machine intelligence *per se*, but rather confirmed the fascination we have with human-like qualities of machine performance (as well as the machine-like, automatic qualities of humans). They also highlighted the encroachment of machines upon the domain of human industry, and the varying emotional reactions that thinking machines and mechanical men elicited. Individual members of the latter avant-garde movements reacted to these notions with a mixture of awe and jubilation, on the one hand, and extreme trepidation, on the other.

2.2 Futurism, Vorticism and the cult of the machine

One of the most confident predictions that machines would one day be able to think came from the Futurists whose spokesman Filippo Marinetti considered the oft-made assertion made by car owners and factory directors that vehicles appear to have 'a personality, a soul, will' to be indicative of a 'sensibility of the machine'[9]. In another Futurist manifesto of 1914, his colleagues Bruno Corra and Emilio Settemelli wrote 'there is no essential difference between a human brain and a machine. It is mechanically more complicated, that is all. For example, a typewriter is a primitive organism governed by a logic that is imposed in it by its construction'[9]. In addition to machines simulating organic life, humans were also encouraged by the Futurists to become more machine-like, denuding themselves of love, sentiment, filial attachments and irrationality. The Futurists also glorified the machine gun and war.

The Vorticists, who were based in Great Britain, denounced the Futurist's fetishisation of technology and their 'lyrical shouts about the God-Automobile'[10], which to them represented a cult that was no more credible than Voodooism. In a manner evoking the Futurists, however, they proclaimed that 'a machine is in a greater or less degree, a living thing'[10] while critiquing their depictions of machines in 'violent movement', which to them resulted in nothing more than a blur or a kaleidoscope; 'the very spirit of the machine is lost'[11] bewailed the movement's co-founder Wyndham Lewis.

In their assertions Filippo Marinetti and Wyndham Lewis were not unlike those of Turing, who also believed that machines had the potential to perform many of the cerebral operations of the human brain which were fundamental to intelligence. In his article 'Computing Machinery and Intelligence'[1], he also left open the possibility of machines developing conscience. He did this by arguing against his contemporary, the neurosurgeon Geoffrey Jefferson, who had insisted that computers would not become in any sense living until they were able to feel emotions

or passions, succumb to flights of inspiration or become fallible like humans. Turing riposted that this would presume we could only truly know of someone else's feelings (machine or person), if we became *them*; and that such an argument amounted to nothing more than a defence of solipsism. This would mean that the only knowledge of which we could be certain would be derived from our own selves, our internal processes, our own thoughts and emotions. In making this a criticism, Turing tacitly entertained the possibility of a conscious machine, whilst conceding that there is some mystery about consciousness[1].

2.3 Machines out of control: World War One and *Metropolis*

Let us return to the attitude of the avant-garde towards the notion of the intelligent machine. Following the realities of World War One, and the devastating impact of military armaments upon human life, a number of cultural and artistic movements became ambivalent or critical about the prospect of further technological development and the creation of a thinking machine. Vorticists and Expressionists who previously extolled technology now became sceptical about it. Dadaists and Surrealists were publically dismissive of technology, though willing nonetheless to employ those new media, which had resulted from the Second Industrial revolution (such as film and photography as well as typing and printing machines). And, as we have already established, neither Dadaists nor Surrealists could escape the conceptualisation of man as machine (and vice-versa) in their works.

Significant reappraisals of technology's value occurred within the avant-garde of Germany, including those that helped to define Surrealism's view of a machine-driven future. In 1927, the film *Metropolis* [12], an Expressionist film vividly portrayed the bringing to life of a robotic woman who is cloned from the city's proletariat leader and visionary, Maria. Maria is so convincing in her femininity that she is first employed as a dancing performer for the men of the upper classes, fuelling their lust for her and aggression toward each other as they vie for her attention. She is subsequently sent by the city's evil capitalist leader to incite rebellion amongst the working classes, so that he has a pretext to crush their dissent and reinforce his power over the city. Somewhat ironically, she also urges the proletariat to destroy all the industrial machines, which they work on by day. Mankind's integration with the machine is presented as dystopic, though this is hardly surprising given the devastation wreaked upon the world by the killing machines of World War One.

The film can also be interpreted in the light of Turing's ideas, particularly his test for machines in order to establish whether they can be considered in any way intelligent. The so-called Turing Test requires the machine to fool a human interrogator into believing it is of one particular sex or another. The interrogator also questions another participant who is an actual human of the opposite sex to the one which the machine is assuming, though both the human and machine are concealed behind a screen so that the interrogator has no knowledge of who is who.

In *Metropolis*, a similar process takes place whereby the human heroine, Maria, is captured and thus taken out of the narrative only to be replaced by a robotic *Doppelgänger*. The responses the imposter elicits, both erotic and verbal, are sufficient to indicate that her audience (who have a similar

function to the interrogator) have been totally duped into believing she is a woman. As Julia Dover states in her article on Turing and Metropolis 'the film plays disturbingly with the site of consciousness and authority in the relationship of human and machine (like the Turing test)' [13] – referring to robotic Maria's capacity to embody consciousness and to wield power, in a manner which makes her pass as human to all who encounter her.

3 CRITIQUE OF THE THINKING MACHINE: MAX ERNST AND MARCEL DUCHAMP

One erstwhile Expressionist who became a leading figure in both Dada and Surrealism was Max Ernst. In the immediate aftermath of the First World War, Ernst produced a series of 50 works based on machines and scientific instruments as a part of his early Dada phase. Dada was in rupture with those movements such as Futurism, which had sought to glorify the machine and foster its integration into human life. For this reason, a number of Ernst's diagrammatic works depicted machinery with human traits in a way that satirised or critiqued the notion of the living machine. As Foster affirms: 'this parodic presentation of the military-industrial subject is not only a riposte to fascist visions of war and masculinity. More generally, in keeping with German Dada at large ... , it is an insult to the humanist ideals of art and individuality cherished by the classes that forced the war in the first place' [8]. There was no doubt that Ernst perceived the realities of a fusion between intelligent man and machine, having been witness to the imperious role played by technology in the war and the increasing industrialisation of Europe. It was, however, the machine's capacity to dehumanise man (rather than its ability to become itself a thinking, sentient being) that Ernst found unsettling.

Two of Ernst's works reveal anthropomorphic machines, which are indicative of his attitude. The first, *The Hat Makes the Man*, reveals a human subject usurped on the one hand by phallic-shaped mechanical structures, all which are capped by the fetishised commodities of mass industrial production (in this case the hats, which also suggest a form of phallic embellishment). The second entitled *Fiat modes, pereat ars* represents the inversion of Latin saying *fiat ars, pereat vita* ('let there be art, life is fleeting'). The revised title translates as 'let there be fashion, art is fleeting', again, signifying the modern subject in the grip of commodity fetishism and conditioned principally by industrial and mechanical processes. The male tailor depicted in the drawing partakes in these processes by measuring up and working upon the model (both tailor and model appear as automata). Whereas Turing speaks about machines in terms of their future evolution as intelligent, reasoning entities, Ernst highlights the flipside of the equation – that as machines evolve, and become ever more intelligent, humans are stupefied, especially as their reliance on the latter grows.

As noted earlier, Ernst had allowed the mechanical structures of *The Hat Makes the Man* to appear phallic in nature; indeed many of his diagrammatic works had presented monolithic machines as precariously erected phallic edifices. Many of the gendered machines depicted in Surrealist and avant-garde artworks didn't resemble men or women in a physical sense (their gender being expressed by means of symbolism or metonymically). This brings us back to the Turing Test and the

question of just how persuasive a machine must be as a man or woman in order to be considered intelligent. In fact, Turing believed that thinking machines could convince the interrogator of their gender irrespective of external appearances: 'No engineer or chemist claims to be able to produce a material which is indistinguishable from the human skin. It is possible that at some time this might be done, but even supposing this invention available we should feel there was little point in trying to make a 'thinking machine' more human by dressing it up in such artificial flesh' [1]. We thus have a further area of correspondence between the avant-garde and Turing whereby machines are portrayed as imitating human behaviour and intelligence in terms of their status as gendered beings without necessarily sharing all their physical attributes.

Marcel Duchamp and Francis Picabia, who were associated with both Dada and Surrealism also produced works depicting gendered machines. Duchamp's painting *Nude Descending a Staircase* depicts a female walking down a staircase in a manner that evokes stroboscopic motion photography (a photograph created by a succession of superimposed images). By his own admission he was influenced by the stop-motion photography of Étienne-Jules Marey, exemplified by the photo *Man Walking* [14,15]. *Nude Descending a Staircase* mediates a sense of kineticism, which seems redolent of Futurism, though Duchamp was by no means the technophile that Marinetti was (despite being knowledgeable about science). According to Linda Henderson the work 'stands as his first fully realized response to Cubism's pursuit of the invisible realities suggested by the discovery of X-rays in 1895. At the same time, Duchamp deliberately distinguished that work from the Cubist style by incorporating both a figure in motion (virtually never seen in Cubism) and the humorous implications of X-ray stripping (here both the clothing and flesh of the nude disappear)' [16]. Rather strikingly, the stripping down of the human subject to its skeletal form (whose kinetic energies are visibly highlighted) gives it a highly robotic appearance.

Duchamp's influences (x-rays, invisible realities, stroboscopic photography) are interesting in so far as they reflect the impact of the Machine Age upon human consciousness. His work expresses an ambiguity by which we are uncertain as to whether the female subject is a human depicted under its mechanical guise or a robot depicted under a human guise (an ambiguity which we will witness time and again in the works of the avant-gardists). While being dismissive of science and art's more grandiose claims, Duchamp aimed in his own words at achieving in his works a 'juxtaposition of mechanical elements and visceral forms' [17]. Up to the time he had produced the painting he had moreover been involved in another avant-garde movement known as the Section d'Or or the Puteaux group, an offshoot of Cubism, which sought to express geometrical perfection in its paintings and endorsed the achievements of science and technology

4 THE LEARNING MACHINES OF FRANCIS PICABIA AND RAOUL HAUSMANN

Strongly influenced by Duchamp, Francis Picabia produced many paintings in the years 1915-1922 whose imagery has been termed mechanomorphic, in other words, striving to imitate the forms of machines. This stylistic turn was first inspired by a visit to New York, upon which he remarked: 'I have been profoundly

impressed by the vast mechanical development in America. The machine has become more than a mere adjunct of life. It is really a part of human life ... perhaps the very soul'[18]. Like Duchamp, Picabia emphasises the interconnectedness of man and machine, though unlike the latter (and very nihilistic spirit of Dada in general), he was willing to entertain the machine's more positive (functional and aesthetic) qualities. Moreover, to claim the machine constitutes the soul of human life does suggest a certain kinship with Turing's thinking. Picabia implies that the machine is not only man's central preoccupation, but that man's original preoccupations with himself and his own endeavours has been supplanted by the machine's capacities to perform so many of the tasks of everyday life (including, invariably, those which require intelligence).

A friend and associate of Picabia's, Paul Haviland, was a critical influence on the artist's life, especially in terms of how he theorised upon humanity's relationship to machines. Haviland and Picabia had collaborated on the same New York-based avant-garde journal 291, and Picabia had painted his friend in the form of an electrical lamp as if to pay testament to his ingenuity and interest in mechanical media such as photography. Commenting on the importance of the machine, Haviland had stated that:

We are living in the age of the machine. Man made the machine in his own image. She has limbs which act; lungs which breathe; a heart which beats; a nervous system through which runs electricity. The phonograph is the image of his voice; the camera the image of his eye.[19]

There is a striking similarity between Haviland's words and another of Turing's texts in which he lays out a methodology for creating a thinking machine, involving the replacement of each part of the human body with machinery that performs the equivalent function:

A great positive reason for believing in the possibility of making thinking machinery is the fact that it is possible to make machinery to imitate any small part of a man. That the microphone does this for the ear, and the television camera for the eye, are commonplaces. One can also produce remote controlled Robots whose limbs balance the body with the aid of servo-mechanisms. [...] The electrical circuits which are used in electronic computing machinery seem to have the essential properties of nerves.[20]

A further similarity between Haviland and Turing, as well as Haviland and Picabia is the engineering of a machine in the image of a human child, which is subsequently brought up and educated by its human creator, as noted by Haviland:

The machine is his "daughter born without a mother". That is why he loves her. [...] But the machine is yet at a dependent stage [...] She submits to his will but he must direct her activities....[19]

Haviland's comments about the machine being man's 'daughter born without a mother' encapsulated one of Picabia's

major preoccupations, as reflected in two of his works, which bore exactly this title *Daughter born without a mother*. The first, which is a drawing, represents an early attempt at developing his mechanomorphic style; the second, a painting, shows the style at a more developed stage of its evolution. Unlike in Duchamp's oeuvre, Picabia's subjects are not gendered in these and most of his other works. However, the notion of his machine as a child, which is still 'at a dependent stage' is certainly germane to Turing's thought.

Turing speculates that in order for a machine to become intelligent, it is preferable to train and educate it like a child. The process by which a machine is taught to think 'should bear a close relation of that of teaching.'[20] Starting from a tabula rasa the machine would thus learn behaviours and aptitudes that would lead to it becoming intelligent:

Instead of trying to produce a programme to simulate the adult mind, why not rather try to produce one which simulates the child's? If this were then subjected to an appropriate course of education one would obtain the adult brain. Presumably the child-brain is something like a note-book as one buys it from the stationers. Rather little mechanism, and lots of blank sheets.[1]

Turing refers to the machines who follow such a program as 'child-machines', a term which evokes Picabia's idea of a 'daughter born without a mother' who is still in need of the guidance of her creator.

Turing's quasi-constructivist ideas about the development of the child-machine can be related to a Dadaist work: Raoul Hausmann's *The Mechanical Head*, which had the subtitle of *The Spirit of Our Age*. Hausmann, who was the leader of Berlin Dada, sought to challenge the notion that intelligence was innate and that the genius of artists and poets was an inexplicable god-given attribute.

Various objects have been attached to the surface of his assemblage, which resembles a robotic head, suggesting that humans (and, potentially machines, as there is an ambiguity here) are conditioned and educated principally by external influences. Significantly, many of the objects on the side of the head are employed for mechanical or scientific operations: measuring devices, ruler, pocket watch mechanism, typewriter and camera segments. Hausmann thus seeks to question both the nature of man's inner self in the Machine Age and the processes by which he evolves into a thinking, reasoning individual:

What is the purpose of spirit in a world that proceeds mechanically? What is man? He can be both a happy and a sorry affair, and he is formed and spoken through his mode of production, his social environment. You see.... you believe you think and make decisions, you believe yourself to be original – and what happens? The social environment [...] has thrown the soul-machine into gear and the whole thing runs itself.[21]

The notion that intelligence evolves both as an upward expanding spiral from childhood and in relation to one's surroundings has resonances with important theories of education and cognitive psychology which were being

developed at the time. The Swiss developmental psychologist Jean Piaget propounded the idea that children behaved almost like little scientists, making and testing hypotheses fairly independently in order to construct an understanding of the world [22]. In the process they would adapt their mental structures to meet the demands of the environment and progressively become intelligent, reasoning adults. Piaget's theories point to a remarkable confluence of ideas within art, science and developmental psychology, which take the *tabula rasa* of the child (and its subsequent epistemological evolution) as the basis for acquiring intelligence.

5 MATTA, DALÍ AND THE INSPIRATION OF SCIENCE

5.1 Matta, pain and consciousness

The painting of Roberto Matta, a Chilean Surrealist artist, extended the notion of the thinking machine by combining the concepts of psychoanalysis and science in his paintings. He affirmed that 'a new school of painters could evolve from contemporary physics, as an earlier school (Surrealism) had evolved from modern psychology'[23]. Having studied architecture, he attempted to depict the architecture of the soul in terms of non-Euclidean geometry in paintings known as 'inscapes'. The word *inscape* is a portmanteau term denoting the interiority of the self as expressed through landscapes of external morphology. Matta also depicted outer reality as a reflection of the latest scientific discoveries (such as relativity, sub-atomic quanta and the latest inventions of the Machine Age).

Many of his paintings showed the implications of these discoveries for the future, including the proliferation of biomechanical mutations. The future as he saw it could be both vital and menacing. In the painting *Octrui*, we witness a menacing scene: industrial robots working on a production line blur the boundaries between man and machine, displaying clear organic characteristics. As with the machine of the Turing test these robots are gendered, albeit that their sexual attributes similarly straddle the organic and the mechanical (their genitalia resembling mechanical spiders!). According to the Surrealists' spokesman, André Breton, these were robots 'carrying harrows on their backs and wearing crossbows round their necks..... but who nevertheless maintain a frenzied lingual and genital commerce'[24]. The harrows, crossbows and other sharp implements mediate an atmosphere that is violent, clinical and disturbing. In *Octrui* and *Wound Interrogation* (which typify Matta's iconography in the 1940s and 1950s), we even have the impression that robots are being controlled by pleasure-pain systems. Turing discusses such systems in relation to machine learning. If the machine is to be made to think in the manner of a child, then:

The organisation of a machine into a universal machine would be most impressive if the arrangements of interference involve very few inputs. The training of the human child depends largely on a system of rewards and punishments, and this suggests that it ought to be possible to carry through the organising with only two interfering inputs, one for

'pleasure' or 'reward' (R) and the other for 'pain' or 'punishment' (P).[20]

In *Wound Interrogation*, we see a robot appearing to analyse a sizeable wound of the human flesh, which is nonetheless integrated into a network of robots surrounding it. The fact that the wound is being subjected to such scrutiny suggests that it is able to yield information and that the robot has something to gain from interrogating it. The process reminds one somewhat of Turing's comments on the value of pain in helping the machine to evolve:

Pleasure interference has a tendency to fix the character i.e. towards preventing it changing, whereas pain stimuli tend to disrupt the character, causing features which had become fixed to change, or to become again subject to random variation.[20]

We are, however, confronted here with an ambiguity similar to that in the works of Duchamp and Hausmann, as we cannot be certain whether these figures are humans with mechanical properties, or machines with humanoid traits. If the former, then our future appears dystopian, with humans becoming slaves to industrial processes and barely distinguishable from the production line upon which they operate; if, on the other hand, they are thinking robots, then we can again see a prefiguration of the type of intelligent (and gendered) machine postulated by Turing, which is guided like a child and responds to stimuli of pleasure and pain.

5.2 Dalí, quantum mechanics and randomness

For the painter Salvador Dalí physics was 'the new geometry of thought'[25] and he too saw the artist as an interpreter of the scientific phenomena of his time. Like Matta, he had been inspired by Freudian psychoanalysis in order to depict the inner life and by scientific theory in order to represent external reality. He was influenced above all by Einstein's theory of relativity[26] and Heisenberg's Uncertainty Principle. Heisenberg had made foundational contributions to quantum mechanics, asserting that it was impossible to record simultaneously the position and momentum of a particle without the measuring equipment of one impacting upon the nature of the other. In other words, the observer had a direct impact on the phenomena he was measuring. Dalí used this idea to draw parallels between science and human conscience and create a new artistic style known as nuclear mysticism. He sought to show how the observer of the physical world could, from his own subjective viewpoint, also help to shape its reality (this idea extended his famed paranoiac critical method): 'From a quantum mechanics standpoint, Dalí's double [i.e. illusionistic] images perfectly reflect Heisenberg's Uncertainty Principle: what one sees depends on the observer. In the same way as he had done with Freud, Dalí assimilated a new scientific theory and reworked it visually'[6]. It must be stressed here that Dalí's eccentric mix of science and art takes us quite far from the quantum mechanics of the laboratory, becoming rather a science of subjectivity (which, as will shortly be demonstrated, is nonetheless germane to Turing's thought).

Dalí's interest in quantum mechanics was further reflected in his works by depicting his subjects as agglomerations of sub-

atomic particles. As we will now see, these particles, which were shaped like rhinoceros horns (i.e. perfect logarithmic spirals), were shown to be common to material objects as well as human consciousness.

The painting *Raphaelesque Head Exploding* represents a head composed of a plethora of spiral-shaped particles. This image challenges our view of the integrity of matter and the appearance of coherent phenomena which are, in fact, totally fragmented. Whereas the painting represents a head in its externality, *The Disintegration of the Persistence of Memory*, portrays the interiority of the head, and specifically man's consciousness of the passing of time in its subjective, non-linear aspect. Significantly, this inner world is also shown as being composed of the same sub-atomic particles.

What interests us in Dalí's theories, especially in how they relate to Turing's, is this connection between thought and quantum mechanics. Turing believed that one component within a thinking machine had to be capable of random behaviour in order for it to imitate human thinking convincingly: Turing 'had a deep-seated conviction that the real brain has a "roulette wheel" somewhere in it' [20]. Although Turing affirms that a thinking machine should, to a substantial degree function according to predictable processes, being of a type that resembles a calculator (rather than a bulldozer), he concedes that this is not always possible:

It was also necessary that this machine should be of the sort whose behaviour is in principle predictable by calculation. We certainly do not know how any such calculation should be done, and it was even argued by Sir Arthur Eddington that on account of the indeterminacy principle in quantum mechanics no such prediction is even theoretically possible. [27]

Interestingly it is on the basis of quantum mechanics that he casts doubt over the possibility of a machine operating entirely by deterministic principles. As scientists have discovered in quantum mechanical experiments, the behaviour of wave functions, when measured, appears to be quite random. Turing's reference to Sir Arthur Eddington and quantum theory to establish the limits of predictability in machine behaviour suggests that machines need to display signs of randomness if they are ever to simulate human intelligence. Randomness is a concept which Turing returns to time after time in his writings, and, in so doing, he underlines the wisdom of including a random element in a learning machine [20]. If, for example, a digital computer can perform the equivalent operation of throwing a die, it might produce numbers which can be kept in a store for future functions or can be helped to generate random approaches at solving a particular problem [20] (in other words, engage in trial-and-error style interrogations). Moreover, if a program allows for random behaviours it may even allow a computer to exhibit a certain amount of 'free will', though this is not a term, which Turing necessarily favoured [20].

Dalí effectively extends Turing's ideas by suggesting that the 'quantum' randomness of human thought not only determines behaviour but, much more radically, the nature of reality as perceived by the consciousness.

6 DALÍ, CAILLOIS AND THE PROPHECY OF THE MECHANICAL BRAIN

In addition to exploring the quantum nature of the human mind, Dalí shared Turing's conviction about the possibility of thinking machines. In an interview with Alain Bosquet he stated:

People usually think of cybernetics as something abominable, they imagine that the world is being guided more and more by mechanical brains. They're afraid that the intervention of human genius is decreasing. But in point of fact, the opposite is true. Cybernetic machines are getting rid of the things that encumber us; until now, first-rate brains were stockpiling a mass of useless information. It's comforting to know that from now on the machines will be supplying the dimensions of the noses in all paintings and sculptures; all we'll have to do is press a button or develop a couple of microfilms. In other times, the same task would have taken experts and scientists decades to finish. The IBM machine will clean away all the drudgery and red tape of second-class human knowledge. Furthermore, the computers are already starting to act like human beings and with their own psychology. [25]

Although Dalí made these comments in 1969, they were still prophetic in nature given that machines were still a long way from their modern-day incarnations. Throughout the post-war period, Dalí maintained an interest in the very latest scientific developments commenting that 'literati can't give me anything. Scientists give me everything' [6]. He was therefore well positioned to gauge the scientific developments of the present and the near future. His comments also seem to mirror those of Turing in dispelling the scare-mongering about mechanical brains. Turing describes the argument that 'thinking machines are simply too awful to contemplate and can therefore never become a reality' as the 'head in the sand' objection, dismissing it as insufficiently 'substantial to require refutation' [1].

In the same decade, the sociologist and philosopher Roger Caillois, who had written widely on science in the Surrealist journal *Minotaure*, also posited the existence of a thinking computer. He considered its success in terms of its ability to compete in an 'absolute' chess game:

It is not probable, but it is possible and perhaps theoretically necessary that there should be such a thing as an absolute chess game, i.e. one in which from the first move to the last no stratagem should work, since the best possible move is automatically neutralised. It is not too farfetched to suppose that an electronic computer having exhausted all conceivable combinations, could construct this ideal game. However, one would no longer be playing chess. The first move alone would determine the winner or perhaps the loser of the game. [28]

Significantly Caillois wrote this comment in a treatise on game-playing entitled *Man, play, and games in which mimicry*

was foregrounded as one of four major characteristics of play³ – a concept which was also seen by Turing to be fundamental for machines to succeed at the Turing test. Caillois seems to be even more positive than Turing about the prospect of a computer successfully playing chess. Indeed, his comments seem vindicated in as much as the reigning world chess champion, Gary Kasparov, was beaten by IBM's Deep Blue in May 1997. On the other hand, Turing believed a computer could evolve to play 'very good chess' despite making errors, and only after it had been programmed to display intelligence:

Can the machine play chess?' It could fairly easily be made to play a rather bad game. It would be bad because chess requires intelligence. We stated at the beginning of this section that the machine should be treated as entirely without intelligence. There are indications however that it is possible to make the machine display intelligence at the risk of its making occasional serious mistakes. By following up this aspect the machine could probably be made to play very good chess. [29]

He was, however, very positive about the capacity of the machine to develop to such a degree as to make it extremely difficult for an interrogator to distinguish between human and machine in the Turing Test: 'I believe that in about fifty years' time it will be possible to programme computers ... to make them play the imitation game so well that an average interrogator will not have more than 70 per cent chance of making the right identification after five minutes of questioning'[1]. Both Turing and Caillois thus foresaw a vast improvement in the computer's ability to play games with human beings, even to the point of beating them.

7 CONCLUSION

Whether in its scientific and theoretical writings or in its visual works, the Surrealist imagination mediated a vision of man in symbiosis with the machine. This was not an attempt at proving irrefutably the viability of machine intelligence when regarded as equal or superior to human intelligence (such notions remain highly debatable given the limitations of machine intelligence). This was, rather, a vision that was inspired by the *Zeitgeist* of the Machine Age and creatively explored the ramifications of the scientific discoveries which defined it. Surrealism thus intuited facets of the thinking machine as described in Turing's writings. Its view of such a machine was more differentiated and critical than that of its avant-garde predecessors, who either idolised technology in the manner of Marinetti and the Futurists or dismissed it out of hand like the Dadaists. Ernst, Duchamp and Picabia's works were replete with mechanical organisms, which were depicted as gendered. These images hinted at the potential for machines to imitate human nature and sexual identity, bringing Surrealism and the ideas of the Turing Test closer to one another.

Whereas Ernst and Duchamp's mechanomorphic forms sought to critique the evolution of technology, Picabia's robots were

conceived as children who were made in the eyes of their human creators and needed the latter's guidance for their future development; this notion was also advanced by Turing who believed that humans could help to train robots to become thinking, reasoning entities. For Matta and Dalí, the same energies and structures underpinned both human consciousness and technological processes. For Dalí the effect of the consciousness apprehending the world was analogous to the role of the observer of wave-particles in quantum mechanics, reflecting how randomness and subjectivity were an integral part of human thought. Turing similarly realised the importance of the capacity for randomness within intelligent machinery, especially in its simulation of human behaviour. Both Dalí and Caillois believed in the future evolution of thinking computers, which would replicate human thought processes in the context of game play. In their capacity to merge antinomies (such as human and machine) and establish conceptual connections between disparate disciplines, the Surrealists anticipated many significant aspects of Turing's thinking machine.

REFERENCES

- [1] A. Turing, 'Computing machinery and intelligence' in *Mind*, Vol. 59, No. 236, pp. 433-460 (Oct., 1950).
- [2] G. Bachelard, *Le nouvel esprit scientifique*. Paris. PUF. (2003)
- [3] D. Ades, M. R Taylor, M. Aguer, *Dalí*, New York. Rizzoli (2004)
- [4] A. Breton, 'Limits not Frontiers of Surrealism'. In: *What is Surrealism*, trans. by F. Rosemont, New York. Monad, distributed by Pathfinder Press (1978).
- [5] A. Breton, 'Second Manifesto of Surrealism'. In: *Manifestoes of Surrealism*, trans. by R. Seaver and H. R. Lane, Ann Arbor. University of Michigan Press (1969).
- [6] J. Úbeda, S. Marqués, E. Pons, *The Dalí Dimension, Script*, transcript of documentary 'The Dalí Dimension'. Media 3.14, Mediapro Group. <http://www.dalidimension.com>. (2004).
- [7] H. L. Capron, *Essentials of Computing*. Redwood City, California. Benjamin/Cummings Pub. Co. (1992).
- [8] H. Foster, *Prosthetic Gods*. Cambridge, Mass. MIT Press (2006)
- [9] L. Rainey, C. Poggi, L. Wittman (eds.), *Futurism: An Anthology*, New Haven. Yale University Press (2009).
- [10] W. Lewis, 'A Review of Contemporary Art'. In: *Blast* 2, No. 2, London, John Lane, The Bodley Head (July, 1915).
- [11] W. Lewis, 'The Skeleton in the Cupboard Speaks'. In: *Wyndham Lewis, the artist: from "Blast" to Burlington House*, New York. Haskell House Publishers (1971).
- [12] Metropolis, (F. Lang), Length: 153 minutes, Universal Film AG (UFA), 1927
- [13] J. Dover, 'The Imitation Game: Paralysis and Response in Fritz Lang's Metropolis and Contemporary Critique's of Technology'. In: *Fritz Lang's Metropolis: Cinematic Visions of Technology and Fear*, eds. M. Minden and H. Bachmann, Rochester, N.Y. Camden House (2000).
- [14] C. Tomkins, *Duchamp: A Biography*, New York. Henry Holt and Company, Inc. (1996).
- [15] P. Cabanne, *Entretiens avec Marcel Duchamp*, Paris. Belfond (1967).
- [16] L. D. Henderson, 'Marcel Duchamp's The King and Queen Surrounded by Swift Nudes (1912) and the Invisible World of Electrons'. In: *Weber Studies, An Interdisciplinary Humanities Journal*. 14.83-101. (1997).
- [17] A. D'Harmoncourt, K. McShine (eds.), *Marcel Duchamp*, Greenwich (Connect.). New York Graphic Society (1973)
- [18] F. Picabia. 'French Artists Spur On American Art'. In *New York Tribune*, pt. iv (October 24, 1915)
- [19] P. B. Haviland, statement. In: 291, Nos. 7-8. (Sept-Oct 1915)

³ These four characteristics were mimicry, agôn (competition), alea (chance) and ilinx (vertigo).

- [20] A.M. Turing, *The Essential Turing: seminal writings in computing, logic, philosophy, artificial intelligence, and artificial life, plus the secrets of Enigma*, Ed. B. J. Copeland, Oxford. Oxford University Press. (2004)
- [21] R. Hausmann, 'Dada in Europa'. In *Der Dada 3*, Berlin. Der Malik Verlag (1920)
- [22] A. Tryphon, J. J. Vonèche, *Piaget-Vygotsky : the social genesis of thought*. Hove, East Sussex, UK. Psychology Press. (1996).
- [23] J. T. Soby, *Contemporary Painters*, New York. Museum of Modern Art (1948).
- [24] A. Breton, *Surrealism and Painting*, trans. by Simon Watson Taylor, New York. Harper & Row (1972).
- [25] A. Bosquet, S. Dalí, *Conversations with Dalí* http://www.ubu.com/historical/dali/dali_conversations.pdf. Ubu Classics (2003).
- [26] S. Dalí, 'Mystical Manifesto'. In *The Collected Writings of Salvador Dalí*, ed. H. Finkelstein, Cambridge. Cambridge University Press. pp. 363-366 (1998).
- [27] A.M. Turing, 'Can Digital Computers think?' (1951). In *The Essential Turing*. Ed. B. J. Copeland, Oxford. Oxford University Press. (2004)
- [28] R. Caillois, *Man, Play, and Games*, New York. Free Press of Glencoe (1961).
- [29] A. Turing, 'Proposed Electronic Calculator'. In *Alan Turing's Automatic Computing Engine*, Ed. B. J. Copeland. Oxford. Oxford University Press (2004).