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How Come Information? Mind, Nature, and Artificial Magic †

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Abstract: The ambition to invent a machine for the "perfect imitation" of the mind appears to flow, by logical consequence, from the invention of machinery for the "perfect imitation" of nature. From perspective drawing to photography, the Western science of art has taken advantage of mechanical means, such as lenses and mirrors, to replicate our visual experience of nature. Its main concern has always been to capture the "magic" of nature into the "synthetic instant" of a picture. Indeed, the main achievement of visual art might be described as *sight enhancing*. In a similar way, the science of logic has taken outstanding advantage of computing machines to simulate our experience of thought, where the main goal appears to be nothing more than to recreate the nature of the mind in the form of a sort of artificial magic. How else might we pursue the simulation of human thought, and to what extent can the cognitive experience of information processing be regarded as *thought enhancing*?

Keywords: appearance-reality; seeing-creating; artificial perspectives; acts of measurement

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1. Introduction

According to the American physicist John A. Wheeler [1], we may never understand "how come the quantum", until we understand "how come information", namely, how information may underpin reality. His claim is that "information may not be just what we *learn* about the world. It may be what *makes* the world" [2]. On reflection, the meaning of such a claim goes beyond the meaning of his influential motto "it from bit". While the latter appears to refine the idea that *what* we learn about the world ("it") comes from the answers to *yes-no* questions ("bits") that we get through measurement, the former focuses on the essence of measurement itself, on the crucial question of how the "sensible world" takes shape through the *acts* of measurement. From a philosophical point of view, the issue has already been recognized by Plato in the fleeting existence of *visible* knowledge. Thus, it might be worth reconsidering how the image of the world depicted by modern physics, to the extent that it rests on in-formation, may be traced to Plato's "theory of forms".

2. The Art of Producing Appearances

How does modern physics expand our understanding of reality? It was Minkowski's idea to see events as the essential stuff of physics and to locate them in a four-dimensional spacetime. In his view, space by itself and time by itself "recede completely to become mere shadows and only a type of union of the two will still stand independently on its own". On this spacetime stage of the world theatre, events result from interrelations between "worldlines". As he wrote:

> To never let a yawning emptiness, let us imagine that everywhere and at any time something perceivable exists. In order not to say matter or electricity I will use the word substance for that thing. [...] We then get an image, so to say, of the eternal course of life of the substantial point, a curve in the world, a *worldline*, whose points can be clearly related to the parameter t from $-\infty$ to $+\infty$. The whole world presents itself as resolved into such worldlines, and I want to say in advance, that

> in my understanding the laws of physics can find their most complete expression as interrelations between these worldlines. [3] (p. 40)

A further step was taken by Niels Bohr. Captivated by the beauty, coherence, and clarity of the theory of relativity, where the thought of an objective reality of the phenomena open to observation is rigidly maintained, he unquestionably shared Einstein's conviction that the definition of any observation, independently of the reference system of the observer, is fundamental to achieve the whole theory. Nonetheless, he clearly saw that the discovery of the *quantum of action* conflicts with the classical ideal:

> Since the discovery of the quantum of action, we know that the classical ideal cannot be attained in the description of atomic phenomena. [...] any attempt at an ordering in space-time leads to a break in the causal chain, since such an attempt is bound up with an essential exchange of momentum and energy between the individuals and the measuring rods and clocks used for observation; and just this exchange cannot be taken into account if the measuring instruments are to fulfil their purpose. Conversely, any conclusion [...] with regard to the dynamical behaviour of the individual units obviously necessitates a complete renunciation of following their course in space and time. [4] (pp. 97–98)

What does it mean that the classical ideal of an "objective reality of the phenomena open to observation" can no longer be attained? It means that the "conditions of observability" of the phenomena (which is to say, in line with Kant, the conditions of the possibility of knowledge) must be revised and fixed. This requirement for new bounded conditions on observability was fulfilled by Heisenberg's *uncertainty relations*.

In an engaging passage of his *Reality Is Not What It Seems*, Carlo Rovelli [5] reports how the key-insight into the quantum world came to Heisenberg one night, while walking in the darkness in the park behind the Copenhagen Institute of Physics. At that time, in 1925, only sporadic streetlamps casted dim islands of light here and there. Suddenly, a figure of a man appeared beneath a lamp, then disappeared into the darkness before reappearing and then vanishing again. The figure moved forward from one island of light to another, until eventually disappearing into the night. Heisenberg was not even touched by the idea that a man could vanish and (re)appear. Obviously, a man is not a shadow; it is a real thing, with objective properties. Yet, Heisenberg could not help wondering whether it is the same for an electron. What if, between one observation and another the electron could literally be *nowhere*? What if the electron could be something that exists only when it interacts? After struggling to give a mathematical form to his baffling insight, Heisenberg would father an amazing theory in which electrons, namely, *material particles*, are described not by their position at every moment but only by their position at the instants in which they interact with something else. "Electrons don't always exist. They exist when they interact". Here, in the *relational* aspect of things, is the most problematic character of quantum physics.

> In the world described by quantum mechanics there is no reality except in the *relations* between physical systems. It isn't things that enter into relations but, rather, relations that ground the notion of 'thing'. The world of quantum mechanics is not a world of objects: it is a world of events. Things are built by the happening of elementary events. [5]

As Rovelli underlines, the quantum picture of a physical world moulded from continuous fluctuations reveals "empty space to be in fact a cauldron of activity". Now, to those who have been attracted by the Platonic world picture, such a "cauldron of activity" may well be reminiscent of Plato's *chora*. In *Timaeus*' words:

> [As for] the nature which receives into it all material things: we must call it always the same; for it never departs from its own function at all. It ever receives all things into it and has nowhere any form in any wise like to aught of the shapes that enter into it. For it as the substance wherein all things are naturally moulded,

> being stirred and informed by the entering shapes; and owing to them it appears different from time to time. (*Timaeus*, 50b-c)

While measurable properties of physical systems come from quantum fluctuations, it is the act of measurement that produces the appearance of quantum phenomena that makes the viewless and formless substance of all things temporarily perceptible. In this perspective, it is the demiurge's "art of producing appearances" (For an insightful analysis of Plato's conception of *mimesis*, see Palumbo [6].) that comes back to life in quantum physics. For a quantum physicist, like for Timaeus but in contrast to Einstein's conviction, it is the "act" that *creates* the sensible world, i.e., there exists no element of physical reality prior to measurements.

> Therefore, the mother and recipient of creation which is visible and by any sense perceptible we must call neither earth nor air nor fire nor water, nor the combinations of these nor the elements of which they are formed: but we shall not err in affirming it to be a viewless nature and formless, all-receiving, in some manner most bewildering and hard to comprehend partaking of the intelligible. (*Timaeus*, 51a-b)

Despite the millennial distance, one may question whether Wheeler's idea that *information* is "what makes the world" could not be traced back to Plato's view. (For a thoughtful discussion on Plato's view in connection with modern mathematical sciences, see Burgin [7].) For Plato, the clear separation between intelligible and sensible world, "idea" and "appearance", is functional to his theory of knowledge as a path from the temporal visible form of appearances to the eternal invisible form of ideas, as a tension toward the intelligible. Indeed, if, on the one hand, an "art of conversion" is required to turn the soul's eye from the word of becoming into that of being, (See *Rep*. 518c-d: "... the instrument of knowledge can only by the movement of the whole soul be turned from the world of becoming into that of being, and learn by degrees to endure the sight of being [...] And must there not be some art which will effect conversion in the easiest and quickest manner; not implanting the faculty of sight, for that exists already, but has been turned in the wrong direction, and is looking away from the truth?—Yes, he said, such an art may be presumed".) on the other hand, this creates the demand for the demiurge to enter the stage and plays his part in the *mimesis*. (On the relation between the demiurge and the forms, see Perl [8].) Not surprisingly, the first act performed by the demiurge is the generation of time, because time, as a condition of the possibility of becoming, is the condition of the possibility of "appearance", namely, of making the invisible pattern, which is "existent *for all eternity*" (*Timaeus* 38c.), visible in the sensible world. Thus, thanks to the demiurge's art, "the pattern of the eternal nature" becomes a *piece of information*.

3. Imitation Game: From Leonardo to Turing

According to the art historian Erwin Panofsky, the dogma that a work of art is a direct and faithful representation of a natural object was established and unanimously accepted by the Renaissance. This dogma, which may seem obvious, is in fact the most problematic one of aesthetic theory as well as of the scientific theory of nature. Since the Renaissance artist could no longer rely on traditional patterns and techniques, he had to be trained for his individual encounter with reality.

> The art theory of the Renaissance, then, was faced with two main problems, one material and the other formal or representational. On the one hand, it had to furnish scientific information about the natural phenomena themselves... On the other hand, it had to develop a scientific process by which [...] these phenomena [...] could be correctly represented, or rather reconstructed, on a two-dimensional surface. The first of these pursuits falls clearly within the province of what we now know as the natural sciences; but since these were practically non-existent by the end of the Middle Ages, the theorists of art themselves had to become the first natural scientists. [...] The second pursuit was of a purely mathematical

> character; it resulted in that discipline which more than anything else deserves the title of a specific Renaissance phenomenon, perspective. [9] (p. 244)

In contrast with the demiurge, the Renaissance artist was supposed to "reproduce" the visible forms of things in nature "as they are". To pursue this goal, he could be assisted by a new mathematical theory, which, born of measurement, allowed the artistic representation to be *costruzione legittima*: perspective. Thus, the invention of perspective, traditionally ascribed to the architect Filippo Brunelleschi, appeared to grant art, particular painting, a theoretical foundation. (As Cassirer emphasizes: "In a manner which is characteristic and determinative of the total intellectual picture of the Renaissance, the logic of mathematics goes hand in hand with the *theory of art*. Only out of this union, out of this alliance, does the new concept of 'necessity' of nature emerge. Mathematics and art now agree upon the same fundamental requirement of 'form'" [10] (p. 152).) Perspective was not merely a technique of faithful representation of reality—it was the first mathematical method to ensure the creation of what we now call "virtual reality". Among the great artists who fell under the spell of "*art* in secret perspective" (*Kunst in heimlicher Perspectiva*), Albrecht Dürer did not hesitate to undertake a special trip to Italy, eager to grasp the theoretical foundation of a process which he mastered only empirically. He wished to attain a rational understanding of the "science of art". (For more on the development of the science of art in Renaissance, see Kemp [11].) Although as a theorist of art he was much indebted to the Italians, he was one of the first artists to clearly conceive of perspective not simply as a technical invention subsidiary to painting, but as a *visual geometry*. To his eye, "the more accurately one approaches nature by way of imitation, the better and more artistic [one's own] work becomes". What does it mean "to approach nature by way of imitation"?

Undoubtedly, neither for Dürer nor for Leonardo, it means "to copy" like a mirror *senza ragione*. (With Leonardo's words: "The painter who draws by practice and judgement of the eye without the use of reason [*senza ragione*] is like a mirror which copies everything placed in front of it without knowledge of the same" [12] (p. 212).) It means, rather, to act as a mirror, "stirred and informed by the entering shapes". (For a comparison between mirror and *chora*, see Merker [13]).

> The painter ought to be solitary and consider what he sees, discussing it with himself in order to select the most excellent parts of whatever he sees. He should act as a mirror which transmutes itself into as many colours as are those of the objects that are placed before it. Thus he will seem to be a second nature. [12] (p. 204)

Imitation, then, does not concern what is seen, but the "generative structure;" in Leonardo's words, "you cannot be a good painter unless you are *universal master to represent* by your art every kind of form produced by nature". In this framework, "by way of imitation" is to be read "by way of science", as the primary task of a painter should be the search, through all the visible works of nature, for the nature of all forms. On these grounds, Leonardo set painting as a science born out of nature.

> If you despise painting, which is the sole *imitator of all the visible works of nature*, you certainly will be despising a subtle invention which brings philosophy and subtle speculation to bear on the nature of all forms—sea and land, plants and animals, grasses and flowers, which are enveloped in shade and light. Truly painting is a science, the true-born child of nature, for painting is born of nature. [12] (p. 185)

Indeed, looking at Leonardo's art works, the painter's visual sensitivity and the scientist's mathematical insight blend together in a synthesis which enhances life by stimulating "ideated sensations", to use an eloquent expression of Bernard Berenson [14]. Moreover, what gradually takes shape, through Leonardo's discussion with himself, is the image of a painter as an *analogic computer*:

> *The painter is lord of all types of people and of all things*. If the painter wishes to see beauties that charm him it lies in his power to create them, and if he wishes to see monstrosities that are frightful, buffoonish or ridiculous, or pitiable he can

> be lord and god thereof... In fact whatever exists in the universe, in essence, in appearance, in the imagination, the painter has first in his mind and then in his hand... [12] (p. 185)

Essentially, the art of measurement works in tandem with the art of representation to accommodate whatever exists in the painter's mind in the sensory world, to make it "real". After deconstructing the mind of nature to learn how to "simulate" its works, the painter ought to be able to "encode" the contents of his own mind, to make the power of his imagination effective. However, as a disputable side effect, this may also induce the artist to nourish the hope that the transient beauty of natural forms could be freed from time and forever immortalised by the "artificial magic" of science.

> Oh wonderful science which can preserve the transient beauty of mortals and endow it with a permanence greater than the works of nature; for these are subject to the continual changes of time which leads them towards inevitable old age! And such a science is in the same relation to divine nature as its works are to the works of nature, and for this it is to be adored. [12] (p. 187)

While the demiurge's creation was securely fastened with time, the painter-scientist seems rather to be concerned with the space-temporal constrains of creation. If, on the one hand, the transient beauty of natural forms is viewed as something to be captured and enhanced by art, on the other hand, the rationale behind them is taken as a challenge for science. Here we can see, on the one hand, the reason for Berenson to regard the main achievement of visual art as *life enhancing*, on the other hand, the motive for sciences struggle to grasp the machinery of natural harmony and make it technically feasible. Thus, the ambition to invent a machine for the "perfect imitation" of the mind appears to flow as a logical consequence from the feasibility of an *artificial* device for the "perfect imitation" of nature. If to create can be interpreted as to generate visible forms with a tension toward the intelligible, then to think is to convey the intelligible into channels of communication. In both cases the point at issue is not to imitate what an agent does, to perform like nature or mind, but to be instructed to play the game, namely, to take part in information processes.

Questions like "Can artists create?" or "Can machines think?" do not make much sense. In his well-known *Computing Machinery and Intelligence* (1950), Alan Turing proposed to address the question, "Can machines think?" in terms of what he called "imitation game". It is played with three people, a person, a machine, and an interrogator. The interrogator is required to determine, only based on the answers written by the other two players, which of them is the person and which is the machine. Thus, the ability to play the imitation game successfully may be a "criterion for *thinking*". (Cf. Copeland [15] (pp. 234–240).) The idea that a machine could "think", namely, provide "intelligent" answers in playing the imitation game, arises from a thorough discussion about the capabilities of digital computers. For Turing, if it is accepted that a real brain is a sort of machine, then a digital computer, suitably programmed, will behave like a brain. The key point, then, is to ponder whether machines could not carry out something which is very different from what is involved in human thinking and which, nevertheless, ought to be described as "thinking". (See Turing [16] (p. 442), and also Turing [17]).

4. Mind, Nature, and the Appearance of Information

Among the various objections to Turing's criterion for thinking, the most significant (for the present discussion) is that of Lady Lovelace: a machine "has no pretensions to *originate* anything. It can do *whatever we know how to order it* to perform". Turing [16] revised Lady Lovelace's objection to Babbage's Analytical Engine. A better variant of this objection, he noted, is that a machine can never "take us by surprise". One may also add that any possible surprise is due to some "creative mental act" on our part. However, the appreciation of something as surprising, Turing emphasized, "requires as much of a 'creative mental act' whether the surprising event originates from a man, a book, a machine or anything else". Moreover, the belief that machines cannot provide any new knowledge rests on a fallacy.

> This is the assumption that as soon as a fact is presented to a mind all consequences of that fact spring into the mind simultaneously with it. It is a very useful assumption under many circumstances, but one too easily forgets that it is false. A natural consequence of doing so is that one then assumes that there is no virtue in the mere working out of consequences from data and general principles. [16] (p. 456)

Finally, the question becomes whether to play the imitation game satisfactorily, namely, to be able to provide meaningful answers to relevant questions, should be taken as a criterion for identifying credible partners to be confronted with in our search of knowledge. From this perspective, should the cognitive experience resulting from information processes performed by computing machines not be regarded as equally *thought enhancing* as those performed by a human being?

As for the ability to bring about a surprising event, a major challenge to humans as well as mechanical intelligence comes from quantum measurement. It is well known that, investigating how to simulate a quantum system efficiently, in 1982, Richard Feynman reckoned the task beyond the capacities of any Turing machine, even probabilistic. This is because information involved in describing the evolution of quantum states with classical digital computers grows exponentially with time. However, instead of shying away from the difficulty, Feynman seized on it as a chance to overcome classical constrains and, one may add, metaphysical assumptions. He realized that the very act of performing a measurement could be tantamount to reading the outcome of a complex (quantum) computation. (This led him to put forward the idea that a quantum evolution may be simulated efficiently, provided the simulator itself is a quantum system. Feynman's conjecture was proved by David Deutsch (1985) and further developed in quantum computing. For more, see Feynman [18] and Deutsch [19].) Accordingly, quantum theory turns the classical notion of computation as a logical procedure, which can be recorded and checked step-by-step, into a physical process, which cannot be reproduce "as it is:" neither a human brain nor any artificial device will be able to play the imitation game with a quantum system.

This brings us back to the key role of the act of measurement in determining the appearance of what is called "reality". If, as Bohr and Wheeler maintained, there exists no element of physical reality prior to measurements, then it is the act of measurement that generates the result of a quantum computation, i.e., the value of a physical quantity; in other words, that brings any element of physical reality into temporal existence. Going deeper into this line of thoughts, Wheeler [2] also suggested reconsidering the history of the universe as a mirror of quantum phenomena, and not a history as we usually conceive history. "It is not one thing happening after another after another. It is a totality in which what happens 'now' gives reality to what happened 'then,' perhaps even determines what happened then". The reality, which we are supposed to find "out there" independent of us and which history is supposed to faithfully document, is "informed" by acts of measurement, "and owing to them it appears different from time to time". Ultimately, being is becoming, reality is information.

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References

1. Wheeler, J.A. How Come the Quantum. *Ann. N. Y. Acad. Sci.* **1986**, *480*, 304–316. [CrossRef]
2. Wheeler, J.A. *Geons, Black Holes, and Quantum Foam*; W.W. Norton & Co.: New York, NY, USA; London, UK, 2000.
3. Minkowski, H. Space and Time [1908]. In *Minkowski's Papers on Relativity*; Minkowski Institute Press: Montréal, QC, Canada, 2012. Available online: https://www.minkowskiinstitute.org/mip/MinkowskiFreemiumMIP2012.pdf (accessed on 1 September 2021).

4. Bohr, N. The Quantum of Action and the Description of Nature [1929]. In *Atomic Theory and the Description of Nature*; Cambridge University Press: Cambridge, UK, 1961.
5. Rovelli, C. *Reality Is Not What It Seems [2014]*; Penguin: London, UK, 2016.
6. Palumbo, L. *Mimesis. Rappresentazione, Teatro e Mondo nei Dialoghi di Platone e nella «Poetica» di Aristotele*; Loffredo Editore: Naples, Italy, 2008.
7. Burgin, M. Ideas of Plato in the Context of Contemporary Science and Mathematics. *Athens J. Humanities Arts* **2017**, *4*, 161–182. [CrossRef]
8. Perl, E.D. The Demiurge and the Forms. A return to the Ancient Interpretation of Plato's Timaeus. *Anc. Philos.* **1998**, *18*, 81–92. [CrossRef]
9. Panofsky, E. *The Life and Art of Albrecht Dürer*; Princeton University Press: Princeton, IL, USA, 1955.
10. Cassirer, E. *The Individual and the Cosmos in Renaissance Philosophy [1927]*; University of Pennsylvania Press: Philadelphia, PA, USA, 1963.
11. Kemp, M. *The Science of Art*; Yale University Press: New Haven, CT, USA, 1990.
12. da Vinci, L. *Notebooks*; Oxford University Press: Oxford, UK, 2008.
13. Merker, A. Miroir et χωρα dans le Timée de Platon. *Études Platoniciennes* **2006**, *2*, 79–92.
14. Berenson, B. *The Central Italian Painters of the Renaissance*; G.P. Putnam's Sons: New York, NY, USA; London, UK, 1908.
15. Copeland, B.J. (Ed.) *The Essential Turing: Seminal Writings in Computing, Logic, Philosophy, Artificial Intelligence, and Artificial Life*; Oxford University Press: Oxford, UK, 2004.
16. Turing, A.M. Computing Machinery and Intelligence [1950]. In *The Essential Turing: Seminal Writings in Computing, Logic, Philosophy, Artificial Intelligence, and Artificial Life*; Copeland, B.J., Ed.; Oxford University Press: Oxford, UK, 2004; pp. 441–464.
17. Turing, A.M. Intelligent Machinery, A Heretical Theory [c. 1951]. In *The Essential Turing: Seminal Writings in Computing, Logic, Philosophy, Artificial Intelligence, and Artificial Life*; Copeland, B.J., Ed.; Oxford University Press: Oxford, UK, 2004; pp. 472–475.
18. Feynman, R. Simulating Physics with Computers. *Int. J. Theor. Phys.* **1982**, *21*, 467–488. [CrossRef]
19. Deutsch, D. Quantum Theory, the Church-Turing Principle and the Universal Quantum Computer. *Proc. R. Soc. Lond.* **1985**, *400*, 97–117.