

# A Science of the Probable; epistemological inventiveness according to Diderot

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## Abstract

In *Thoughts on the Interpretation of Nature* (1753), Denis Diderot discusses what may be the novelty of a science of becoming and morphogenesis, consequent with the autopoietic of nature. Far from arriving at a positivist conception, as is common among materialistic philosophies, the author projects a science of the probable, the contingent, the transitory, which requires the combined efforts of all capacities of the knowing subject to carry out the ceaseless dialectic between the two poles of observation and interpretation. Imagination, intuition, prospect, and conjecture are summoned to accompany experiential activity, introducing an inventive dimension in science, whose freedom contributes to subverting the epistemological canon, blurring the rigidity of disciplinary boundaries, intensifying scientific discovery, and giving meaning to the cluster of research. Consequently, science becomes a plurality of texts, intersecting facts and conjectures, data and metaphors, protocol rigour and rhetorical procedures.

The unusual character of this exuberance has led the main commentators on the work to presume that it is the fruit of philosophy's intervention, to which it would be fitting to add the step of creativity, unfeasible in scientific methodology. In contrast, we argue that, for the philosopher, those various processes are constitutive of the same scientific research, which finds in judgment the central faculty and in abduction the privileged process of discovery.

Keywords: Diderot; science; imagination; inventiveness; abduction

As Mandosio (2013) rightly saw, the *Thoughts on the Interpretation of Nature* constitute “*le discours de la méthode de Diderot*”. There, the philosopher gives shape to what he sees as the ongoing scientific revolution, drawing in detail the epistemology of a science in accordance with the regulatory idea of a nature without determinant intelligence or conductive purpose, all formed by material, variable and self-productive processes in permanent evolutionary transformation. Faced with the difficulty in defending the need for a perennial state of the world, the new science becomes a function of conjectural interpretation. Its success depends less on observation data, always relative to a given instant and relying on interpretation than on the pertinence and coherence of the conjectures, destined to offer contexts of signification to the constitutive opacity of the former.

It is what stems from how Diderot (1999, p. 71) establishes the hierarchy between the two attitudes that, not having to be produced by the same individual, form the general process of science:

one of the main differences between the observer and the interpreter of nature is that the latter begins at the point where the former ceases to use his senses and his instruments; on the basis of what now exists, he speculates on what is to come; from the established order of things, he draws abstract and generalised conclusions which, for him, have all the force of particular, ascertainable truths.

Consequently, if the observation appears

indispensable to give epistemic consistency to the interpretation, it is up to the latter to guarantee the complex task of giving meaning to the scientific discovery.

It is, thus, fit to recognise that the typical process of new science, what makes it progress, as Diderot sees it, is abduction, in other words, the search for the best explanation for a phenomenon that is always the controlled result of serendipity, “chance (which is never idle – and is more fruitful than man’s wit)” (Diderot, 1999, p. 63), even if all sorts of experiments and reasonings provoke that discovery. What makes a phenomenon epistemologically meaningful relies, precisely, on the random character of its discovery, without which it would be no more than an effect predicted by theory. In turn, it is the abductive reasoning that makes possible the construction of the epistemological access to a world of matter, moving progressively from the agreed theses – in a world view in which a double principle of matter and spirit predominates –, to a general framework in which material monism imposes itself as more keeping with the results of scientific research. If we consider, following Robin Smith, that, in the traditional Aristotelian sense, *apagogè* “involves leading the argument away from one question or problem to another because of taking something in addition” (Aristotle, 1989, p. 233), it becomes understandable to expect its protagonism as a gnoseological process. Diderot himself practices it extensively to assert his philosophical perspectives

at least since the «Letter to Paul Landois» (Bernardo, 2015, pp. 173-179). The term or its direct definition does not appear in the work, the same being true for others, like deduction and induction, probably because the philosopher seeks to avoid the conventionality of its use in logic, but what may correspond to them, from the epistemological point of view, seems sufficiently characterised in the aphoristic sequencing. Thus, Diderot conceives abduction as an ample and complex gnoseological process, geared towards promoting scientific discovery, by combining structural components of the Aristotelian definition, and elements that anticipate the proposed interpretation, almost a century later, by Charles Peirce, at the Harvard conferences on pragmatism (1978, p. 172):

Abduction is the process of forming an explanatory hypothesis. It is the only logical operation which introduces any new idea; for induction does nothing but determine a value, and deduction merely evolves the necessary consequences of a pure hypothesis.

Likewise, Peirce's assertion could be his, according to which "every single item of scientific theory which stands established today has been due to abduction" (1978, p. 172). Consequently, he takes over Stagirite's idea of a sort of approximate reasoning, according to the degree of probability, which is justified:

when it is clear that the first term belongs to the middle and unclear that the middle belongs to the third [...]; or, next if the middles between the last term and the middle are few (Aristoteles, 1989, p. 100)

However, confers it an amplitude and efficacy that lead him to relate it to a set of less conventional processes, equally identified by the American author: divination, breakthrough, instinct, discovery, inventiveness (Peirce, 1978, p. 173). In such an advance, what is discerned is not so much a genealogical link as the centrality that the eighteenth-century philosopher confers to the abductive exercise, in tune with a full realisation of its reach.

Such does not mean that, for Diderot, as also latter for Peirce, the two other processes are not part of scientific research, quite on the contrary, given that the abduction, due to the freer context of the discovery, is marked by a constant tension between objectivity and meaning, truth and conviction. What occurs is a change in the way they are understood, both, henceforth, committed to the balance between experimentation and interpretation, geared to make nature speak, sometimes manipulating it intentionally, sometimes proposing its plan of action.

In effect, the absence of a substantial perennial fund and the return of truth to the probability, make the idea of a necessary sequential reasoning unsustainable, one corresponding to the

deduction. As Duflo summarizes (2013, p. 166):

Les principes les plus généraux ne doivent pas nous servir pour déduire, mais pour chercher, et les hypothèses ne sont véritablement fécondes qu'à condition de féconder des expériences qui seules étendent véritablement le savoir.

It is precisely the epistemological core of Diderot's critique of the Methodists, particularly to Linnaean taxonomy, presented as the finished example of the abuse of deduction (Diderot, 1999, p. 64):

Man, says Linnaeus in the preface to his *Fauna Suecica*, is neither a stone nor a plant; he must, therefore, be an animal. He does not have only one foot, so he cannot be a worm. He is not an insect because he has no antennae [...]. So what is man? He has a mouth like a quadruped. He has four feet; he uses the two fore-feet to touch with, and the two hind-feet to walk with. So he must be a quadruped. [...] 'So your logic must be wrong', the logician will say.

In contrast, the deduction, put at the service of the interpretation of nature, becomes a reasoning by analogy, resulting from a comparative exercise on the similarities and differences between notions, explanations and theories, whose example is found in the 'fifth conjectures' about the molecular formation of bodies, within the framework of a theory of elasticity.

Likewise, inductive reasoning loses its conventional abstractive reach, starting to correspond to an effort to find analogies among similarities or differences between the phenomena and facts resulting from several experiences, designed to highlight those relationships. Inductive work becomes, thus, one of the means of sustaining the adequate production of scientific conjectures, that may satisfy the double criterion of the maximum of possible probability and the maximum of possible reference relation. It stands halfway between singularity and generality, much more than mere collections of sparse data, but rather less than inferences allowing the establishment of a systematic legality or the founding of the exclusivity of one of those explanations. Consequently, the procedure from particular to the universal is reconducted to the horizontal and expansive logic of a network, while the cumulative process of data, personified by Reaumur's entomology (Diderot, 1999, p.70), ends up being questioned, replaced by a particular version of the eight operations of Bacon's experimental method, where the requirement of variation and complexity of the experiments prevails (Diderot, 1999, p. 61) in a science aimed at following the seriality of nature. His critique is, in this case, directed against Reaumur's monumental work on insects, as he asks (1999, pp. 69-70):

What would posterity think of us, if all we had to leave behind was a complete entomology or a vast survey of microscopic creatures?

This position leads him to suggest even that, in the impossibility of fulfilling this experimental protocol, it is preferable to opt for experiences of thought whose script recreates it. The entire *Letter to the Blind* illustrates this option, offering a complete thinking experience, replacing the failure to be present at the surgical intervention of Cheldesen, considered insufficient to generate effective progress of knowledge.

Serendipity, experimentation, deduction and induction are not the only procedures in which abduction relies on. The use of the productive imagination, aimed at suggesting images that give shape to the new perspectives, that make tangible the conjectured forms, that confer the due consistency to the foreseen processes, becomes, also, indispensable. Referring to *D'Alembert's Dream*, Bourdin evidences this dynamic (1998, p. 79):

Imaginer, extrapoler, généraliser, tirer des conséquences, tout le Rêve est animé par des appels à prolonger les suggestions de l'imagination mise en contact avec des savoir positifs.

Just like Diderot's philosophy, the conception of science that he draws, finds in phantasy, simultaneously, the insertion of the most abstract levels of thought into physicality, and the scheme of translation of conjectural flashes into representations, whose figurative character ensures the system of equivalences with the material conditions of nature. However, regardless of how free it may seem, the use of the imagination is doubly delimited: on the one hand, imagination finds itself linked to the composition of *partes extra partes*, which guarantees the external reference; on the other hand, by taking place in the context of scientific discovery, its function becomes, *ipso facto*, defined by the intended objectives. It is not, therefore, a matter of weakening epistemic intentionality by introducing a fictional aspect, but rather of making it benefit from the intrinsic translatability of cognitive faculties. In visually demonstrating, the scientist, while acquiring a superior accuracy over his mental representations, fully shares his vision with the community, favouring intersubjective modes of consensus, fundamental to a science of the probable.

This justifies, likewise, the metaphorical use of images, recovered from cultural imagination or from the latest scientific imagery, namely from Chemistry (Pépin, 2014), put in operation in science's signification regime. Bourdin reminds us that the three central images of *D'Alembert's Dream* – the harpsichord, of La Mettrie, the swarm of bees, of Maupertuis and Bordeu, and the spider, of Chrysippus and Saint Paul – are not original (Bourdin, 1998, p. 97). Originality comes from how they are correlated with the issues under discussion – the sensitivity of matter, the consciousness of

identity and the centrality of the brain. This play between resumed and reallocation results in a kind of saturation of the expressive potentialities of each procedure – the imaginary functioning as a true scheme of positivity, the understanding brought back to the plane of matrix analogies – should they be, as we proposed, constitutional, processual, metaphoric or direct (Bernardo, 2009, pp. 213-216) –, which contributes to illuminate the paths of inquiry. The result is neither pure metaphor, nor pure concept, but a “concept-metaphor” (Ibrahim, 2010, p. 100).

In either case, however, there is no place to encourage astonishment with a hypothetical teleological order, in the genesis of a vision marvelled at the prodigies of nature. Diderot, thus, remains faithful to “the principles of adequate conviction, set out in the article “Agnus scythicus” of the first volume of the *Encyclopédie*. Far from apologetically seeking to strengthen the motives for belief, this joint exercise of imagination and reflection aims to consolidate the reasonableness and positivity of knowledge.

In such hybridity, made of science, philosophy and literature, but that Diderot rightly wants not as an amalgam, deviant of the reach of every single one, another process takes on the determining role. It is instinctive intuition, which Diderot (1999, p. 47) defines, with the help of a neologism [flair], as

a propensity for divination, enabling them [scientists and practitioners] to ‘scent’, so to speak, unknown procedures, fresh experiments and hitherto-undiscovered results.

It is so, given that the inventiveness, that assists the interpreter of nature in the formulation of conjectural explanations, still requires a capacity to explore the meanings of experimental results, palpitation on the evolution of phenomena and projection of a unifying conjecture of the diverse phenomena. These cannot occur either from the pure exercise of reason, too distant from the physicality of natural processes nor the mere experimental observation, tied in the excessive familiarity with each case.

To enter the functional logic of nature presupposes, rather, a paradoxical faculty, sufficiently attached to animality to convey the most elementary processes of nature, sufficiently intelligent to guarantee the translation of those intuitions to objectified forms of knowledge, that combines a natural spontaneity, a certain unconsciousness destined to facilitate risk-taking and power to combine diverse information. As Diderot writes (1999, p. 48):

It is an irrational form of behaviour found to a surprising degree in those who have acquired, or who possess naturally, a gift for the experimental sciences.

Inasmuch “dreams of this sort have led to a number of discoveries” (1999, p. 48), he considers that “it is

this sort of guesswork which should be taught to learners” (1999, p. 48), more than “to introduce them to procedures and results” (1999, p. 47), given that it constitutes one of the more significant processes to help the passage from the status of observer to the one of interpreter of nature, not at the beginning of the research, where it would be a mere phantasy without foundation, but at a stage already sufficiently supported in factuality.

This intuition is not, therefore, intellectual or noetic, does not stem from innate, *a priori* or preconceived ideas, but is “based on feeling, in the same way as men of taste judge works of the intellect” (Diderot, 1999, p. 47). Likewise, it is not about directly connecting a sensation to a psychic or mental representation, like in the imaginative apprehensions of Epicureanism (Gigandet, 2007, p. 76), but of developing the potentialities of a device of our animality, by way of “the long-established habit of conducting experiments” (Diderot, 1999, p. 47), in order to combine nature and culture.

Diderot clearly marks this distance from the old conceptions of inventiveness and abduction, which assume an ontological character that is expressed in the presupposition of a stable gnoseological element – sensation, prolepsis, obvious major premise – when it replaces the classical definition of the process in question – “go from the known to the unknown” – with a formula that, parodying it, profoundly changes its structure – “the art of proceeding from the relatively unknown to the completely unknown” (Diderot, 1999, p. 48). Establishing the possible knowledge between two negative values, the author accentuates the dynamic character of science, always in constitution, there being no *alfa*, nor *omega*, from which to leave or arrive at. In such regime, what must be saturated is the process itself, making it benefit from the poetic-interpretative media with which, in other domains, the connection of ideas is promoted, the variants of segments of the world are suggested, and textualities are rehearsed, which, in being fictional, do not stop fulfilling the criteria of internal coherence, likelihood or pertinence, without abandoning the intentionality that guides scientific research.

The context in which the aphorism arises that of the first conjectures about the spring constitutes in itself an excellent illustration of its scope. By subscribing to the contemporary debates on human reproduction, the series starts from a relatively unknown area, which the initial sentence – “There is a certain body known as a *mola*” (Diderot, 1999, p. 48) – soon indicates. As the assumptions succeed one another, complying with the protocol of inquiry, on its generation, its constitution, its organisation or its behaviour, the spectrum of what is ignored thickens, making apparent the inversion of the proportionality between the already known

and the yet unknown. The manifold conjectures that arise, therefore, appear as invested in that unknown land, combined effects of scientific rationality and creative imagination.

When practised well, that blurring of disciplinary boundaries allows, likewise, the gaining of ‘insights’, that lead to a profound rotation of the problems and suggest their eventual solution. *D’Alembert’s Dream* enacts such a possibility: amidst fantasies, daydreams, phantasmagorias and erotic dreams, the classic problem of vital animation, that led to the paroxysm of the substantive duality defended by Descartes, ends up converted into the one of animalisation, which confers explanatory plausibility to the hypothesis of life and thought as effects of the organisation of the same matter (Duflo, 2013, pp. 203-204).

Thus, even if Diderot may characterize this scent with terms that refer to mystic enthusiasm or reverie – “a feeling of knowing what is about to happen which is akin to inspiration” (1999, p. 47) – , he keeps it within the limits of the epistemological context, with the purpose of empowering judgement and hence to develop the exercise of conjectural reasoning. What characterises the use of enthusiasm in science is, effectively, its relation to abduction, how it contributes to the progress of scientific discovery, thanks to its power to raise the perception of the relations, the passages and the enchainment, in all the domains where it is exercised.

Consequently, the judgements that originate from such practice cannot assume a dogmatic value, like the one that they hold in religious fervour, but assume the same conditional and conjectural form to which investigative science is obliged. Integrated into the abductive process, they cannot also assert a narrative self-referentiality. Instead, they must be subject to the general process of falsification, which is an integral part of the logic of the abductive procedure. Similarly, the dispersion and the disarticulation of intuitions, that suggest an approximation to dreamlike irrationalism, in this ‘extravagant’ use, that is, destined to foment the extension of scientific knowledge, become eloquent by being put in the service of the same conjectural textuality around analogies, previously identified in the course of the research, whose validity is assessed by its “relation to what precedes or follows it” (Diderot, 1999, p. 47).

It is such subjection of creativity to the conditions of scientific practice that is indicated in this other definition (Diderot, 1999, p. 47):

it is ‘a facility for supposing or perceiving contrasts or analogies which is rooted in a practical knowledge of the physical properties of subjects taken in isolation, or of their reciprocal effects when taken in combination’.

As all that we have been describing, the scent

constitutes, likewise, an epistemological procedure, integrating abductive labour, that benefits from the transposition of general schemes of inventiveness to attain the construction of a wise and useful knowledge, not despite its contingency or its capacity for subversion, but thanks to them. The new scientific research, as Diderot conceives it, arises, thus, as a permanent effort of discovery, interpretation and conjecture, based on analogical reasoning on data acquired in compliance with experimental protocols, on the invention of processes of experimentation designed to favour such a domain and on the gradual transposition of the information collected into acceptable explanatory sequences, a whole engineering that calls for a balance between creative freedom, the normative rigidity of the method and the learning capacity, up to the limit of resilience, which the work of Franklin or modern chemistry would symbolise (Diderot, 1999, p. 60):

Open a book by Franklin; thumb through those written by chemists, and you will see how heavily the art of experimentation depends on opinions, imagination, sagacity and resources.

Consequently, all the processes described are fully inscribed in scientific practice, not forcing the distribution of the order of knowledge between scientific method and curiosity (Ibrahim, 2010, p. 94), nor lacking the extraordinary intervention of philosophy, whose task would be to take the step of freedom (Bourdin, 1998, p. 73) or to form the set of hypotheses that would make scientists think (Duflo, 2013, p. 241), even if they can benefit from visiting such repository, and everything points, in this conception, to the ideal of a philosophical science in interaction with a scientific philosophy. The key to their advance is found in that “alliance [...] entre la liberté imaginative et la légalité cognitive”, which Jean Petitot considered aesthetic in Kant (Petitot, 2004, p. 118), and that, as will be deduced from our exposition, seems epistemological for Diderot, as he defends (1999, p. 39):

The whole enterprise comes down to proceeding from the senses to reflection, and from reflection back to the senses: an endless process of withdrawing into oneself, and re-emerging.

Most commentators have also mentioned, that Diderot's epistemological paradigm is marked by the tension between this trial of a science that attempts to keep up with nature and the subjective conditions that make that intent possible. This tension, in fact, cannot but intensify with the progression of knowledge, given that the interpretation, becoming ever more necessary, requires an increased control of its connection to factuality. However, Diderot assumes an optimist position on this dynamism (1999, pp. 67-68):

Are these conjectures borne out? The more

experiments are performed, the more these conjectures are verified. Are the hypotheses valid? The wider the consequences range, the more truths they embrace, and the more compelling the evidence they provide.

This trust originates in another master key of its epistemology: in seeking to calibrate science according to the possibilities of man, the philosopher identifies judgement as the true manager of all the processes involved in knowledge. At all the stages, the research appeals to the ability of judging, be it to select the data for observation, be it to choose the aspects that deserve the attention of the researcher, be it to identify the relations between the phenomena, be it to ponder the value of conjectures, be it to choose the best among them, be it, yet, to prefer one theory over another and, even, to weigh the arguments for a metaphysical conception like materialism, be it to determine the degree of inventiveness and of phantasy necessary to feed the intelligence.

With his defence of the decisive role that the faculty of judgement must have in what he considers to be the new scientific paradigm, Diderot identifies probably the principle that allows the overcoming of one of the significant obstacles to science as an interpretation of nature, formed by the opposition between rationalism and empiricism. In fact, being fit to recognise that it is judgement that carries on the fundamental operations associated to the justification and validation of the results obtained, one must see in that understanding the expression of a perspective that is sufficiently innovative not to be, yet, banalised. Likewise, his perception of an episteme geared by discovery, that benefits from judicious cooperation between the conventional processes of scientific research and different *modi operandi*, usually attached to other spheres of cultural production, points to an epistemological alternative whose relevance has only recently begun to be evidenced. Could it have been his materialism that prevented him from continuing this intuition in a critical theory of the faculty of judging, and led him to prefer the development of a physiology of the faculties and of genius as found in *D'Alembert's Dream*?

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