> Todos sueñan lo que son, aunque ninguno lo entiende. —Calderón de la Barca

A profoundly thought-provoking work of Nietzsche, often overlooked, is the small essay entitled *On truth and lies in a nonmoral sense*. This was the first truly intelligent critique of science which I read, and, in all of its brevity, one that has very rarely been matched.

I read this work at seventeen, when I was a young student at the department of philosophy. Ten years later, today, with a few years of experience in science and research, and close to graduating from the department of mathematics, I read it again. What I write here may be considered a commentary on this particular work, though I should strive to provide more general observations on the nature of scientific knowledge as I understand it.

The central thesis of this work, at least as far as I can see, is that scientific theories are not representations of an objective reality, but rather the subjective (and hence ultimately arbitrary) cognitive elaboration of certain stimuli. (Here «subjective» does not refer to the *individual* subject, but to the *human* subject.) To Nietzsche, inferring objective properties from the result of any such stimulation is unguaranteed:

> [...] the further inference from the nerve stimulus to a cause outside of us is already a result of a false and unjustifiable application of the principle of sufficient reason.

The phrase «the stone is hard» expresses then the result of a subjective feeling and not an objective «hardness» in the rock. A word is but the formulation of a *qualitas occulta* underlying the infinite complexity and multiplicity of that to which the word refers:

> Truths are illusions which we have forgotten are illusions; they are metaphors that have become worn out and have been drained of sensuous force, coins which have lost their embossing and are now considered as metal and no longer as coins.

Reason is understood at least partly as a self-referencing and tautological instrument:

> If I make up the definition of a mammal, and then, after inspecting a camel, declare “look, a mammal,” I have indeed brought a truth to light in this way, but it is a truth of limited value.

Furthermore, inquiry through science and reason to him was fundamentally anthropocentric. Oblivious to the fact that in trying to describe reality «he again

proceeds from the error of believing that he has these things immediately before him as mere objects», the scientists acts as the astrologers who treated stars as agents in man's service:

> It is even a difficult thing for him [the inquirer] to admit to himself that the insect or the bird perceives an entirely different world from the one that man does, and that the question of which of these perceptions of the world is the more correct one is quite meaningless [...]

If we could perceive matters «as a bird, now as a worm now as a plant, or if one of us saw a stimulus as red, another as blue, while a third even heard the same stimulus as a sound - then no one would speak of such a regularity of nature». Quite pertinently, Nietzsche cites Pascal's famous passage on a labor man who dreams each night that he's a king.

In my opinion, Nietzsche's premises are fundamentally correct. This early work of his draws strongly from Schopenhauer's conception of the world as will and representation, which I also deem fundamentally right. Such a thing as an objective reality is not only unknowable but impossible to imagine. Every species is endowed with more or less wide, but necessarily bounded faculties of representation which are specific to it. Yet, contrarily to believing that this undermines science, I would venture this itself constitutes a scientific fact. I should hope to escape any form of circularity by suggesting this, and hopefully the reader will allow me to digress a bit in order to bring forth my point.

For some reason, it is common to teach that the Newtonian revolution «overcame» mind-body dualism by exorcising the ghost from the machine and providing a more or less complete description of the physical world. This could not be further away from the truth. Newtonian physics is based on the concept of *force*, which serves to correctly explain nature, but which has no material ground. The postulates of, say, gravitational force or electrostatic force proceed simply from *observing* that distant (i.e. non-contacting) objects attract, repel and generally influence each other. What distinguishes the gravitational and the electrostatic force is simply the observed properties of this otherwise arcane interaction. There is no understanding of what the word *force* means beyond this.[REF1]

In this sense, the epithet *physical* is meaningless and serves a merely honorific function, just like the epithet *real*. To say *the real truth* is simply to say to truth, but with a certain emphasis; to say *the physical world* is simply to say *the world*, with a certain condecoration. We have no notion of what *physical* means and, instead of ridding ourselves of the ghost in the machine, Newton destroyed the machine and left us with the ghost alone. [REF2]

Furthermore, it is correct to claim that what we call *reality* is a specific represen-

tation, and, to repeat Nietzsche's words, that

> [...] the further inference from the nerve stimulus to a cause outside of us is already a result of a false and unjustifiable application of the principle of sufficient reason.

We can safely say certain stimuli are processed so and so, and acquire a rather sophisticated understanding of the underpinnings of such processing (as is the case, for instance, in the visual system). But we are limited, both in the sight of a moving object as well as in our description of the visual system itself, by the specific encoding which our nervous system imposes upon the external world. A trivial corollary of this is that human understanding has limits. It is conceivable that our brains are simply ill-prepared to grasp certain properties of the world—and I suspect philosophers are correct when suggesting that mental phenomena may depend on some of such properties.

Take, for instance, the cognitive faculties of rats, a matter of thought-provoking research. Though able to learn highly intricate mazes, rats cannot learn to traverse a prime-maze, i.e. a maze with $i = 1, \ldots, N$ turns which is solved by the program: **if** i **is prime turn right else turn left**. This suggests three interesting things with regards to the way in which «reality» relates to our innate, limited representational faculties.

Firstly, rats seem to posses some sense of numerosity directed by what is technically termed the approximate number system (ANS), which adheres to Weber's law. [1] This is a fancy way of saying that rats discriminate different quantities based on their ratio, not their absolute difference. Even so, the experiment suggests that rats have no innate notion of prime number. Secondly, this is another (of at this point infinitely many) results contradicting behaviorism. Not only do rats lack the capacity to figure out a prime number maze on their own, but they can't be taught to solve it. Though rats are capable of rule-based learning[2], prime numbers seem to be «beyond» the limits of their cognitive abilities. Lastly, a prime-maze is a computational problem and thus its solution can be interpreted as a program. This allows us to express, at least heuristically, that the rat's brain-hardware is incapable of implementing it.

Another interesting study [3] suggests that apparently geometric, abstract learning in rats is in fact more concrete than it may seem. The researchers successfully trained rats to find a submerged platform in a pool using the length of the walls (e.g., "the platform is in the middle of the long wall"). Then the researchers changed the color of the walls—an obviously non-geometric property—only to find that the rats' ability to find the platform was gone. This finding suggests that the rats never acquired an abstract understanding of *length*, separate from all

sensible context, but rather formed a concrete and integrated representation of the problem such as «platform-at-long-*black*-wall».

However, the fact that the rat, the worm and the mosquito all live, so to speak, in different worlds, is neither a scientific problem nor a problem to science. Science is objective, but not in the sense of describing the world *as-is* (la *cosa-en-sí*, como leeríamos en Schopenhauer): as I have tried to suggest, the Schopenhauerian thesis that the world is representation is correct. Recall that Nietzsche claims science is subjective not in terms of the individual, but of the human condition, i.e. it is subjective in contrast to whatever science another cognitively capable species could hypothetically produce. Science is objective understood within the human domain, and in the traditional sense of basing itself upon impartial analysis of the facts.[REF3] That these facts are not purely given but rather elaborated by our representational faculties poses no problem, since said faculties are shared and these facts appear more or less the same to everyone.

I could be accused of bigotry when supposing that our representational faculties are shared and that facts appear more or less the same to everyone. I do not deny that cultural and psychological predispositions influence the way we interpret the facts. However, this is a matter of interpretation, not of observation. When I see a painting of Christ I see a Jew from Nazareth that lived a virtuous life two thousand years ago; a fellow Christian sees the son of God. But no one can deny our sensed experience is, *mutatis mutandis*, the same.

With regards to Nietzsche's claim that reason is tautological and self-referencing, I believe it is only partially correct. It is certainly true that formal disciplines are completely tautological, which is by the way an uncontroversial statement (see for instance Russell's work *Human knowledge*). Furthermore, formal structures are typically used as extremely simple and abstract models of a real system, and as tautological the deductions derived from the model may be, the truths they uncover about the represented system are less trivial than Nietzsche lets on. Take, for instance, the famous example of the seven bridges of Königsberg, which inspired Euler to found graph theory.

Interestingly, formal disciplines take us back to the matter of innate representations. It is generally accepted that some foundational concepts of logics and mathematics lack any clear definition. The paradigmatic example is the notion of *set*. Ever since Russell's paradox showed the contradictions contained in naive set theory, axiomatic set theories were developed to overcome such paradoxes without arriving at a clear, universally accepted definition of the notion. One is tempted to infer from this that, though mathematics operates by necessity in tautological fashion, some of its foundational concepts correspond to categories of thought which are embedded in our cognitive faculties, however much we struggle to define them.

It is certainly the case that our biological endowment includes categories such as «number», «set», etc. This «innatist» view—for lack of a better term—may be supported by certain interpretations of Gödel's incompleteness theorems, which prove the existence of true but unprovable statements in any sufficiently complex formal system. Even within formal systems, something quite beyond the grasp of formal computation is involved in their semantics.

With regards to non-formal disciplines, we must understand Nietzsche's description of the fraught taxonomist, who defines a mammal and then declares every new mammal he finds to be a discovery, with precision. To contradict it, it is not sufficient to claim that scientist do not post aprioristic definitions and then search for instances of them. Nietzsche's point is more subtle, since he suggests that the nature of language renders any definition a lie—in a nonmoral sense, as the title of the work suggests. In other words, to Nietzsche it is fundamentally impossible not to act as the fraught taxonomist: whenever we speak, let alone postulate a definition, we are necessarily weaving a metaphor or a myth. And it is unjustified to then claim such metaphor corresponds to this or that objective instance.

I must admit that I don't find this point to be so convincing. To describe language as a lie, to claim that speaking the truth is nothing but uttering the correct metaphor, is somewhat simplistic. Nietzsche commits a common error among philosophers in treating language like an abstract faculty, when in fact it should be viewed as faculty not different in kind from the visual or the auditory systems. Nietzsche's claim that language is a lie is not different from the claim that, when seeing a moving object, we don't perceive a pure object but some impure elaboration of it. I don't mean to say that language does not have distinct and particular properties, but rather that the *kind* of relationship upon which Nietzsche bases his critique of language is not different from that of other human faculties. It henceforth follows that we should care about the fact that every word is a lie, in Nietzsche's sense, just as much as we should care about the fact that every visual perception is an illusion. Of course it is, but insofar as this «illusion» is what we denote by *world* we must reckon that treating it as such leads to a contradiction.

I have little else to say on the matter. I should reiterate how profound I believe Nietzsche's insights to be on this matter, regardless of finding myself at odds with a few of them. With some fortune, I hope to have shown why I believe we have no clear notion of *physical*, that we have rid ourselves not from the ghost in the machine but rather from the machine itself, that science supports the claim that, in Schopenhauer's terms, the world is our representation, and that this does not pose a problem to scientific objectivity.

I should wish to end this entry recalling the verses that Calderón de la Barca, whom Schopenhauer read in Spanish, wrote on this matter:

> ¿Qué es la vida? Un frenesí. ¿Qué es la vida? Una ilusión, una sombra, una ficción, y el mayor bien es pequeño: que toda la vida es sueño, y los sueños, sueños son.

[REF1] In *How to make our ideas clear*, Peirce uses the concept of *force* as a paradigmatic example of an idea which is to be understood only trough the effects which it produces. He's discussion is highly stimulating and worth reading.

[REF2] This interpretation of Newtonian physics is put forward in summarized, but in my view still convincing fashion, in Chomsky's short work *What kind of creatures are we?*

[REF3] A post-modern critique of science may object to this impartiality. I don't take such objections too seriously, since they typically rest on a complete misunderstanding of what scientific objectivity means. But this is not the place to discuss this.

[1] https://www.mdpi.com/2076-2615/6/8/46

[2] https://pubmed.ncbi.nlm.nih.gov/18369151/

[3] https://pmc.ncbi.nlm.nih.gov/articles/PMC4296930/pdf/xan$_4$1$_{19}$1.pdf