

Handbuch Nietzsche und die Wissenschaften

Natur-, geistes- und sozialwissenschaftliche Kontexte

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DE GRUYTER

ISBN 978-3-11-028578-9
e-ISBN 978-3-11-028568-0

Library of Congress Cataloging-in-Publication Data

A CIP catalog record for this book has been applied for at the Library of Congress.

Bibliografische Information der Deutschen Nationalbibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über <http://dnb.d-nb.de> abrufbar.

© 2014 Walter de Gruyter GmbH, Berlin/Boston
Satz: jürgen ullrich typosatz, Nördlingen
Druck und Bindung: Hubert & Co. GmbH & Co. KG, Göttingen
♻ Gedruckt auf säurefreiem Papier
Printed in Germany

www.degruyter.com

Pietro Gori

Nietzsche and Mechanism

On the Use of History for Science

Let us not let go the guiding hand of history.
History has made all; history can alter all.
Let us expect from history all, but first foremost,
and I hope this of my historical investigation,
that it may not be too tedious.
Ernst Mach

1. Introduction

Nietzsche's ideas concerning science have been widely discussed during the last decades, and nowadays most scholars agree that his critical remarks do not imply a complete rejection of the main outcomes of 19th century physics, biology, mathematics, and so on. As many studies have shown, his interest in these topics started early, when he was a young teacher in Basel, and persisted throughout his life.¹ Even though he went through an early 'positivistic' phase,² and during the 1880s his remarks on science become considerably critical, one must make sense of the considerable amount of scientific books in his private library, as much as of his speaking in favourable terms of several scientists of his era. One way to solve this apparent contradiction is to consider Nietzsche's middle and late stage of thought not as anti-positivistic, but rather as *post*-positivistic, and therefore to argue that he developed his critique of science *in compliance* with science itself. This should not be surprising, given that in the second half of the 19th century many scientists reconsidered the status of their own discipline, and tried to get rid of the old Newtonian paradigm. In their works one finds critical remarks concerning the limits of the old scientific worldview, but also the principles of a brand new one.

The idea that Nietzsche's critique of the scientific world-description was not a critique of science in itself, but rather of some specific aspects of it, is particularly clear in his later writings. In the first chapter of *Beyond Good and Evil*, for example, so as in the last book of *The Gay Science* (written in the same period as BGE), Nietzsche explicitly makes reference to that particular "interpretation" of the world held by the science of *mechanics*, claiming it to be a worldview unable to provide an "explanation"

1 See for example Mittasch 1952, Babich/Cohen 1999, and Small 2001.

2 See Vaihinger 1902, Kremer-Marietti 1997, Cohen 1999, Hussain 2004b.

of the world itself. In BGE 14, for example, he writes that 19th century physics is grounded on “belief in the senses”, and thus it cannot reach beyond the realm of pure appearances. In GS 373 (“*Science*” as *prejudice*), he states:

A “scientific” interpretation of the world, as you [materialistic natural scientists] understand it, might still be one of the stupidest of all possible interpretations of the world, i.e. one of those most lacking in significance. This to the ear and conscience of Mr Mechanic, who nowadays likes to pass as a philosopher and insists that mechanics is the doctrine of the first and final laws on which existence may be built, as on ground floor. But an essentially mechanistic world would be an essentially meaningless world! (KSA 3, p. 626).

What Nietzsche calls “prejudice” here (and in the first chapter of BGE, devoted to *The Prejudices of Philosophers*), is the idea that the natural world can be understood by schematizing it, reducing it to a formula, and therefore demoting “existence in this way to an exercise in arithmetic and an indoor diversion for mathematicians” (KSA 3, p. 626). In *Beyond Good and Evil*, Nietzsche stresses this point, and criticizes the physicists who glorify “nature’s conformity to law” (BGE 22, KSA 5, p. 37). Since they believe mathematics to be the only “true” world-description, they pretend to reach the inner side of reality through it (BGE 22, KSA 5, p. 37). On the contrary, Nietzsche claims the science of mechanics to be just one of the many possible interpretations one can give; a very useful one, and that is why it became a long lasting paradigm in science, but still unable to provide a “good”, a “complete” description of the world (in Nietzschean terms: an “explanation” of it).

The main statements of the *materialistic mechanism* against which Nietzsche writes in his last works are chiefly two: a) the world has a material ground (an idea that follows from the belief in the senses); b) everything can be explained in terms of the laws of (Newtonian) mechanics. In Nietzsche’s view, both these statements are a misinterpretation of a natural, pure necessarily becoming (that he describes in terms of “will to power”).³ More specifically, they both are a misinterpretation of an interpretation of this becoming, since it is commonly believed that our way of describing the latter in terms of human action is “truthful” (see for example GS 109 and BGE 22). In an important note from 1888 (*Critique of mechanistic theory*) Nietzsche sums up all of this, and writes that

in order to sustain the mechanistic theory of the world, we always have to include a proviso about the use we are making of two fictions: the concept of motion (taken from the language of our senses) and the concept of the atom = unity (originating in our psychological “experience”). Its prerequisites are a sensual prejudice and a psychological prejudice (NL 1888, 14[79], KSA 13, p. 259).

³ See Abel 1984, Spiekermann 1992, and Gori 2007.

I will come back later to this note. What interests me at this stage is to focus on the core of Nietzsche's critique to 19th century physics: as we read in the first section of *Beyond Good and Evil*, Nietzsche's idea is that the materialistic mechanism satisfies men's fundamental "metaphysical need", since it is grounded on a (bad) sensualism,⁴ on the *belief* in what our senses testify (BGE 12, KSA 5, p. 27). In this sense, 19th century physics – the physics of mechanics – is itself metaphysical.⁵

Nietzsche found the idea that the materialistic worldview which 19th century physicists refer to is metaphysical in Lange's *History of Materialism*. This book has been of the greatest importance for Nietzsche,⁶ since it provided to him a fundamental presentation of "the materialistic perspective of our era, the natural sciences and their Darwinian theories" (letter to Gersdorff, 16.02.1868, KSB I/2, Bf. 562). Lange thus showed to Nietzsche the main topics of the 19th century scientific debate, and the direction of its development. For example, in the extended edition of his book (bought by Nietzsche in 1882) Lange dealt with the problem of force and matter, and stated that it would soon be possible to accept the "dynamical conception of nature", which was "the mere development of Atomism" (Lange 1880, vol. 2, p. 365). Before this, in a chapter included in the first edition of the *History of Materialism* (1866), Lange spoke about a science that "trusts the senses", whose "metaphysics is formed on analogy of the world of experience", and whose "atoms are small corpuscles" (Lange 1880, vol. 2, p. 338). To sum up, "the whole materialistic theory of the world is brought about through the senses and the categories of understanding" (Lange 1880, vol. 2, p. 338) – a conclusion that sounds notably close to Nietzsche's remarks from 1888.

Nietzsche's writings testify how deeply Lange influenced him. The critique of modern Atomism in BGE 12, for example, clearly recalls the latter's statements,⁷ as two important notes concerning the mechanistic world-description do. In the first one (NL 1884, KSA 11, 26[410]), Nietzsche deals with "the belief in cause and effect" of the "mechanistic-atomistic worldview", and predicts the advancement to a new stage, i.e. a "dynamical world-conception". In the second one he shows what, according to him, is really problematic in this interpretation of the world, i.e. its believing in "matter":

4 On Nietzsche's *sensualism* one can say many things, since his ideas on how our sense organs operate seem to change from the first notes of the late 1870s to *Twilight of the Idols*. For a recent discussion of this topic see Riccardi 2011, Hussain 2004b, and Clark 1990.

5 The first section of *Beyond Good and Evil* is devoted to the three metaphysical notions that one finds in science: atom (12), I or ego (16–17), and (free) will (19). Nietzsche will later deal with these topics in *Twilight of the Idols*, in particular in the section on *The four great errors*. As regards Nietzsche's critique of 19th century physicists' use (and abuse) of substantial notions, see Gori 2009.

6 The most important studies on Nietzsche and Lange are Salaquarda 1978 and Stack 1983.

7 It is noteworthy that Lange, in writing his observations on the development of modern Atomism, refers to Gustav Fechner's *Über die physikalische und philosophische Atomenlehre* (Fechner 1864), a book that Nietzsche himself read when he was in Basel.

In thinking of my philosophical genealogy, I feel myself connected with the anti-teleological, i.e. Spinozian, movement of my era; but with one difference: I think that also “aim” and “will” in us are illusions; I can say the same with regards to the mechanistic movement (the reduction of all the moral and aesthetic questions to physiological ones, the physiological to chemical, the chemical to mechanical); but with the difference that I do not believe in “matter”, and consider Boscovich to be one of the main turning points, as Copernicus (NL 1884, 26[432], KSA 11, p. 266).⁸

From these excerpts one argues that 1) Nietzsche’s critique of materialistic mechanism does not concern the entire scientific world-description; 2) Nietzsche carries on his observation in compliance with the development of 19th century science itself. As regards the first point, in the second of the two notes quoted above Nietzsche’s remarks are clearly not directed against the mechanistic view in itself; he only rejects what makes it a pure metaphysical view (i.e. its believing in “matter”). Furthermore, any critique published in the first chapter on BGE is devoted to that peculiar scientific world-description which is grounded on a belief in the senses. As for the second claim, the reference to Lange alone can be enough to confirm the “scientific” ground of Nietzsche’s remarks. Indeed, in the *History of Materialism* Nietzsche found an exposition of the most recent ideas concerning the scientific world-description, with some important observations and critical remarks on the science of mechanics. But Lange has not been the only source of Nietzsche’s thought on this topic. As regards, once again, *Beyond Good and Evil*, during the last decades the scholars found many other scientists and thinkers who influenced Nietzsche’s ideas, and whom he quotes, or even implicitly refers to: Georg Lichtenberg, as regards the critique of Descartes’ *cogito*;⁹ Afrikan Spir and Gustav Teichmüller, for what concerns Nietzsche’s “sensualism”;¹⁰ Gustav Fechner and his *Atomenlehre*, and many others. All these thinkers contributed to the development of a new scientific worldview, a new paradigm, which has been completely accepted only at the beginning of the 20th century. I obviously cannot deal with all of them now; let me just emphasize their role in Nietzsche’s critique of mechanism, and stress the fact that his later observations were not directed against the science in itself, but rather against a specific way of looking at its outcomes. This is of the greatest importance, since many scholars during the 20th century sharply rejected

8 The Dalmatian scientist Ruggiero Boscovich plays an important role in Nietzsche’s critical remarks against the science of mechanics. According to Nietzsche, Boscovich’s investigations on force and matter show that science can get rid of the old – metaphysical – paradigm. In 6 2, Nietzsche wrote to Peter Gast that the ‘material’ prejudice has been “well and truly disproved”, and “the disproving come not from an idealist but from a mathematician – from Boscovich” (letter to Köselitz, 20.03.1882, KGB III/3, Bf. 213). This observation can be compared with an excerpt from Lange’s *History of Materialism*: “We should have found our way by the mere development of Atomism into the dynamical conception of nature, *and that not by means of speculative philosophy, but of the exact sciences*” (Lange 1880, vol. 2, 365, my italics). On Nietzsche and Boscovich see Stack 1981, Whitlock 1996, Gori 2007 and Gori 2013.

9 On Nietzsche’s reference to Lichtenberg in BGE 17, see Loukidelis 2005 and Gori 2011b.

10 Hussain 2004b stresses the question of sensualism in BGE 15. As regards Nietzsche’s reading of Spir and Teichmüller, see also Green 2002 and D’Iorio 1993.

any connection between Nietzsche and the scientific debate of his era. On the contrary, his philosophy was deeply grounded on it, and his interest in the results of scientific investigation persisted throughout his life, as he himself acknowledged. Thus, as regards the science of mechanics, Nietzsche's statement in BGE 14, according to which "it is perhaps just dawning on five or six minds that physics, too, is only an interpretation and exegesis of the world [...] and not a world-explanation" (KSA 5, p. 28), can be properly understood only by admitting his reference to a debate concerning the limits of the paradigm which 19th century science was still referring to.

2. Nietzsche's Interest in Ernst Mach

In order to show both the core of Nietzsche's criticism towards the mechanistic world-description and its compliance with 19th century science, I turn now to a more detailed topic: Nietzsche's relationship with Ernst Mach's philosophy of science. Actually, one cannot properly speak of a "relationship", since the role played by Mach in Nietzsche's thought cannot be compared with the influence of Lange, Spir, or many others. Nevertheless, there are several similarities between their fundamental assumptions concerning epistemology, and this is something that cannot be neglected, all the more so, since Mach's contribution to Western science has been fundamental to get rid of the mechanistic worldview and open a new stage of investigations.¹¹ The correspondence of many of Nietzsche's ideas on scientific knowledge with Mach's statements can thus confirm that the former carried out his critique *in compliance* with science itself. I do not have enough space for a detailed study of this topic, and I do not want to repeat what has been already written on it. Therefore, I will focus on both the fundamental assumption of Mach's criticism and his definition of the term "metaphysics", since most of Nietzsche's statements against the science of mechanics correspond to them.

During the last decade the name of Ernst Mach appeared in some studies concerning Nietzsche, most of the time in order to describe the context which the latter referred to in carrying on his mature philosophy, and to testify his persisting interest in the features of 19th century epistemology.¹² Unfortunately, there're not many documents concerning Nietzsche's interest in Mach, and therefore a direct influence between them cannot be proved. Nevertheless, in Nietzsche's private library one finds two of Mach's works: the first one is a book from 1886 – which Nietzsche most likely bought in the same year – titled *Beiträge zur Analyse der Empfindungen*, the first edition of one of

¹¹ See on this topic Kleinpeter 1913, Frank 1950 (chapter 2), Fischer 1993, Stadler 1982, and Blackmore 1972.

¹² See Brobjer 2008, pp. 91–95, and Brobjer/Moore 2004, pp. 21–46 and pp. 41–46. More detailed studies concerning the compliance of Nietzsche's view of science with Mach's epistemology have been carried out by Hussain 2004a and 2004b and myself (Gori 2009).

Mach's most known works;¹³ the other text is an essay on projectile's paths, published by Mach and Peter Salche, which the former sent to Nietzsche with his own sign (see Campioni et al. 2003, p. 382). In all likelihood Nietzsche received this essay in return for his *Genealogy of Morals*,¹⁴ but that does not mean that Mach has been interested in his philosophy. On the contrary, as Hans Kleinpeter – a friend of Mach – wrote to Elisabeth Förster-Nietzsche in 1912, the Austrian scientist found in Nietzsche's book some not specified "polemical claims against one of his views" (see Gori 2011a, p. 293). Kleinpeter did not know what Mach was exactly talking about, and explained this to Elisabeth. Moreover, in the same letter he stated that, in his opinion, some observations on truth and knowledge that Nietzsche wrote in his notebooks were very close to Mach's statements on the same topics. Finally, Kleinpeter added that he was trying to persuade his friend of all this (apparently without success. See again Gori 2011a).

If Nietzsche's private library helps us in finding some references to Mach, his writings do not. Despite the fact that both Nietzsche and Mach were interested in the same topics and followed the same perspective in dealing with many epistemological questions, a deep investigation concerning Nietzsche's writings shows that any attempt to refer a single passage to Mach, even indirectly quoted, is vain. Most of the ideas that Nietzsche shares with the Austrian scientist have been published (or written, in case of notes) before his reading one of Mach's works.¹⁵ Moreover, many excerpts that sound like Mach's statements can be directly related to other thinkers that the scientist himself quotes in his books, e.g. Fechner or Lichtenberg. Therefore, it is arguable that Nietzsche and Mach made the same epistemological statements since they referred to a common scientific debate, and not because one of them influenced the other.¹⁶ The only place of Nietzsche's writings where one finds the name of Mach is a note from 1882, discovered by Alwin Mittasch and published in the critical apparatus of Nietzsche's complete works (see *Ergänzungen im Text der Abtei-*

13 Die Analyse der Empfindungen und das Verhältnis des Physischen zum Psychischen. Mach changed the title in the second edition.

14 One finds Mach among the people to whom the publisher Naumann was supposed to send Nietzsche's book (see the letter to Naumann, 08.11.1887, KGB III/5, Bf. 946).

15 A good example of all this is the presumed source of TI Errors 4, which Thomas Brobjer assumed to be a proof of Nietzsche's reading Mach's *Analysis of Sensations* (see Brobjer 2003). Despite the fact that this texts reveals many correspondences with an excerpt from Mach's book, the topic of the time-inversion (*Zeit-Umkehrung*) they both concern occurs many times in Nietzsche's writings between 1884 and 1885, before the publication of Mach's work on sensations (see NL 1884, KSA 11, 26[35] and 26[44]; NL 1885, KSA 11, 34[54]; NL 1885, KSA 11, 39[12]; NL 1888, KSA 13, 15[90]). Moreover, it appears even before, in HaH I 13 (*Logic of the dream*). In this aphorism one finds all the elements with which Nietzsche later deals in TI Errors 4, from the general topic of the time-inversion to the specific example of the gunshot he uses in his argument. On the impossibility of claiming Mach to be a direct source of Nietzsche see also Gori 2009, pp. 113f.

16 One can say, with Hussain 2004a, p. 120, that Mach's view was "in the air" during the last decades of 19th century, but only if that means that he shared statements that other scientists made before him and/or without knowing his own position.

lung VII, KGW VII/4.2, p. 67). In a notebook, among other books that he studied some years before, Nietzsche wrote the title of an early essay of Mach: *Die Geschichte und die Wurzel des Satzes von der Erhaltung der Arbeit* (Prague, 1911 [1872]). This reference is usually neglected, chiefly since there is no evidence that Nietzsche read this text, and no one knows where he found its title. Nevertheless, it can be a good starting point for an investigation concerning Nietzsche's compliance with the development of 19th century philosophy of science, since in this work Mach outlines for the first time his own critique of the science of mechanics.

3. Metaphysical Concepts and Scientific “Truths”

The History and the Root of the Principle of Conservation of Work (or *energy*, as one reads in some translations) is the title of a lecture that Mach gave at the Royal Bohemian Society of Sciences in 1871, and published the following year in Prague. In this very short book Mach a) deals with the meaning of the term “metaphysical” and the role that historical studies should play in science; b) speaks about the real meaning of the notions daily used by the physicists (such as that of “matter”), and argues that in some sense one can talk about “economy” in science; c) shows the reasons why the law of causality must be substituted by that of “functional relation”. In short, in this text one finds all the guiding lines of Mach's epistemology, i.e. the fundamental ideas of his quite new perspective lying on the use of the historical reconstruction of both physical concepts and laws, whose main result is the rejection of the old mechanistic worldview. This perspective can be directly compared with Nietzsche's thought, e.g. with his statements on the notion of *genealogy* or, more specifically, with his claims concerning the contrast between *historical* and *metaphysical philosophy* (see HaH 1, KSA 2, p. 23).

In the opening pages of his work on the *Principle of Conservation*, Mach states what does “metaphysical” mean for him: “We accustomed to call concepts metaphysical, if we have forgotten how we reached them” (Mach 1911 [1872], p. 17). To avoid any misunderstanding, it is important to say that Mach's view of this topic is far from the idea of a logical analysis of the scientific notions; his aim is rather to show the importance of working with concepts whose origin is known, or can at least be found through a genealogical reconstruction. Mach's epistemology should thus not be interpreted in an analytical way, so to say, *à la* Wittgenstein or – better – *à la* Carnap. Even though Carnap directly referred to Mach in carrying on his new philosophical perspective, the latter was a pure “continental” philosopher with a peculiar interest in the history of his own discipline, in its genealogical development. Mach just warned the scientists of his time not to mistake the pure logical function of the concepts they used with their ontological content. According to him, metaphysics is just an illusion of our knowledge; therefore, in his writings the word “metaphysical” sounds like “a notion accepted without any preliminary investigation”. Thus, if one wants to get the

scientific knowledge rid of any dogmatic heritage, the only way to follow is an inquiry concerning the genesis of the notions daily used in physics, psychology etc., since it reveals their development during the history of thought and culture. This is what Mach writes in his work from 1872:

Quite analogous difficulties lie in wait for us when we go to school and take up more advanced studies, when propositions which have often cost several thousand years' labour of thought are represented to us as self-evident. Here too there is only one way to enlightenment: historical studies (Mach 1911 [1872], p. 16).

Mach first presented the idea of the usefulness of a retrospective look some years before, in his *Über die Definition der Masse* (1868), by suggesting what he later wrote in this terms: “One can never lose one’s footing, or come into collision with facts, if one always keeps in view the path by which one has come” (Mach 1911 [1872], p. 17). He soon developed his idea in a wider project concerning the historical explanation of both scientific concepts and laws, a project briefly outlined in the conference from 1871, and which Mach dealt with in his later works, e.g. in the books concerning *The Science of Mechanics* (1919 [1883]) and the *Analysis of Sensations* (1914 [1886]). Within these texts, the first one is probably the most important, since it clearly shows that in dealing with his own discipline Mach aimed to carry on “a critical and historical account of its development” as the subtitle of his *Science of Mechanics* indicates. Moreover, according to him, a *critical* analysis of the principles of the Newtonian physics can be provided only through a *historical* reconstruction of their genesis. In the opening pages of this work, Mach writes that the aim of his volume is “to clear up ideas, expose the real significance of the matter, and get rid of metaphysical obscurities” (Mach 1919 [1883], p. x). Thus, his *critical* aim has a deep *anti-metaphysical* value, in a sense that clearly recalls Kant’s investigations.¹⁷ Moreover, Mach explains that

the gist and kernel of mechanical ideas has in almost every case grown up in the investigation of very simple and special cases of mechanical processes; and the analysis of the history of the discussions concerning these cases must ever remain the method at once the most effective and the most natural for laying this gist and kern’s bare. Indeed, it is not too much to say that it is the only way in which a real comprehension of the general upshot of mechanics is to be attained (Mach 1919 [1883], p. x–xi).

According to Mach the historical analysis allows us to get “the positive and physical essence of mechanics” rid of the “mass of technical considerations” beneath which it’s buried, and which conceals how the principles of mechanics “have been ascertained, from what sources they take their origin, and how far they can be regarded as

¹⁷ See Mach 1914 [1886], XII: “The opinion, which is gradually coming to the front, that science ought to be confined to the compendious representation of the actual, necessarily involves as a consequence the elimination of all superfluous assumptions which cannot be controlled by experience, and, above all, of all assumptions that are metaphysical in Kant’s sense”.

permanent acquisitions” (Mach 1919 [1883], p. x). That can therefore be the only way one has to reach the inner side of scientific notions, and look at them as mere ideas, thought symbols that human beings created during their development, and that change together with the “paradigm shifts” (to use Kuhn’s words). Mach dealt for the first time with the use of history for science in his lecture on the *Principle of Conservation*, by claiming that this is the only tool one has to see the frequently changing of views, concepts, and theories, and thus to let us “get used to the fact that science is unfinished and variable” (Mach 1911 [1872], p. 17).

In stressing the historical nature of science, Mach also argues the inner impermanence of its notions, since they are a mere product of an ever changing and improving description of the natural world. Thus, as regards this topic, Mach clearly assumes the concepts to be but resting points of our mind, thought symbols that a scientist temporarily adopt as the best result that *until now* has been reached from the researchers working in his field of study. These “labels” are first of all useful to save experience and let the scientists communicate the results of their studies to other researchers who will carry on the formers’ work. This is what Mach thinks in talking about an *economical office of science*: “Science is communicated by instruction, in order that one man may profit by the experience of another and be spared the trouble of accumulating it from himself” (Mach 1919 [1883], p. 481). In 1871 he presented the same idea by stating that a formula, a scientific ‘law’ has “no more real value than the aggregate of the individual facts” it explains. “Its value for us lies merely in the convenience of its use: it has an economical value” (Mach 1911 [1872], p. 55).¹⁸ It is easy to see that this perspective directly follows from Mach’s view on the development of his own discipline, since he thinks that the physicists (but we can say the same for what concerns the researchers working in other fields) keep on creating new concepts that would adapt in a better way to the objects or to the processes they want to explain. In 1910 Mach summed up this “evolutionary” interpretation of the investigating process talking about the “*adaptation of the ideas to the facts and the adaptation of the ideas to themselves*” (Mach 1910, p. 226). On the philosophical plane, that leads to a new evaluation of the results of scientific investigation: even though the practical usefulness of the concepts daily used cannot be denied, one must say that they have a mere relative value on the ontological plane, and thus reject (or at least limit) the “truthfulness” of scientific knowledge. According to Mach, unlike both 17th and 18th century scientists, any concept has to be defined only as a methodological reference point to describe and manage the natural world, a mere *thought symbol* that does not

¹⁸ In the endnote to this claim Mach writes that “in science we are chiefly concerned with the convenience and saving of thought”, and that “the moment of inertia, the central ellipsoid, and so on, are simply examples of substitutes by means of which we conveniently save ourselves the consideration of the single mass-points”. Moreover, Mach refers to his friend Emanuel Herrmann, the political economist from whom he took what seemed to him “a very suitable expression: ‘Science has a problem of economy or thrift’” (Mach 1911 [1872], p. 88).

lead to something stable and permanent under the becoming surface of our sensations. In a way very close to Nietzsche's perspective, Mach rejects the reference to any kind of "thing in itself": even though he never claims that it does not exist, Mach argues that this reference is not important, in order to investigate *our own* reality, which is a pure phenomenal world (see Mach 1914 [1886], pp. 29–31).

Turning back to Mach's definition of the *metaphysical concepts* in the introduction of his text from 1872, we can stress the similarity between his words and Nietzsche's famous statement from *On Truth and Lie in a Nonmoral Sense* (1873): "Truths are illusions of which one has forgotten that they are illusions" (TL, KSA 1, p. 881). In this text Nietzsche calls "truth" a schematization of the external data which value is related (or even mistaken) with both its practical usefulness and its having been helpful for the preservation of the species. Therefore, "truth" is a concept that has never been brought into question and, after a long time, has been adopted with no reference to its origin. In particular, Nietzsche talks about "metaphors that have become worn-out and deprived of their sensuous force, coins that have lost their imprint and are now no longer seen as coins but as metal" (TL, KSA 1, p. 881). As well as the metaphysical notions which Mach deals with in the *Principle of Conservation*, the "truths" that Nietzsche describes in TL are the result of a wrong judgment, since they're isolated from the process of becoming which they are part of. On the contrary, both the scientific concepts and these "truths" can be properly described only through a historical analysis.

Nietzsche's criticism towards the notion of truth in his unpublished writing from 1873 directly follows from his idea that a genealogical reconstruction tracing the development of human thought is the only tool one has to enlighten the character of the notions one usually adopts, the "mobile army of metaphors, metonyms, and anthropomorphisms" which are nothing but illusions of knowledge. The same statement is published in the first section of *Human, all too Human*, where Nietzsche deals with many questions first treated in TL (but left unpublished). In HaH I 16 he writes that the concepts commonly used to describe the external world are not fixed and unchanging, rather they're a gradually evolved and still evolving product of our intellect. According to Nietzsche,

it is the human intellect that has made appearance appear and transported its erroneous basic conceptions into things. Late, very late – it has reflected on all this: and now the world of experience and the thing in itself seem to it so extraordinarily different from one another and divided apart that it rejects the idea that the nature of one can be inferred from the nature of the other (HaH I 16, KSA 2, p. 37).

Thus, the world of phenomena is an "inherited idea, spun out of intellectual errors" (HaH I 16, KSA 2, p. 37). This way of treating the problematic relationship between appearances and "thing in itself" directly leads to a possible solution, since if one admits that the "real" world is a mere product of our intellect generated during the development of the species, then a genealogical analysis can easily show its inner *lack of content*.

With all these conceptions the steady and laborious process of science, which will one day celebrate its greatest triumph in a history of the genesis of thought, will in the end decisively have done; for the outcome of this history may well be the conclusion: that which we now call the world is the outcome of a host of errors and fantasies which have gradually arisen and grown entwined with one another in the course of the overall evolution of the organic being, and are now inherited by us as the accumulated treasure of the entire past – as a treasure: for the value of our humanity depends upon it (HaH I 16, KSA 2, p. 37).

In *Human, all too Human* Nietzsche first presented his statements against the metaphysical realm of absolute and unchanging concepts that he will later call “the ‘true’ world”. This is quite clear if one reads HaH I 11, where Nietzsche writes that “in language, man juxtaposed to the one world another world of his own” (KSA 2, p. 30). Language is an essential tool for human beings, since without it they could not manage the world and win the struggle for life. Moreover, “the shaper of language was not so modest as to think that he was only giving things labels; rather, he imagined that he was expressing the highest knowledge of things with words; and in fact, language is the first stage of scientific effort. [...] Very belatedly (only now) is it dawning on men that in their belief in language they have propagated a monstrous error” (KSA 2, pp. 30f). Therefore, the knowledge of the external world as knowledge of (pure *logical*) shapes and schemes created by our intellect must be distinguished from the knowledge of the essence of this world, i.e. of its *ontological* plane. The *creation* of a world of concepts laying next to the one in which we live directly follows from men’s inability in making this distinction. But Nietzsche knows that human intellect’s “fallibility” is *physiological*, since it has been acquired during the development of the organism. Intellectual *errors* have so great value as tools for the struggle for life that nowadays it is not possible to imagine a human being describing the world in a different way (see HaH I 9). Unfortunately, there is no space to deal with Nietzsche’s view of the relationship between knowledge and language, or to talk about the value of the intellectual errors in the struggle for life. Anyway, I believe that these brief remarks can be sufficient to show that Nietzsche’s later statements concerning the “true” world of metaphysics are in compliance with what he early argued on these topics. That is mostly clear in this note from 1888, titled *Origin of the “true world”*:

The aberration of philosophy is that, instead of seeing in logic and the categories of reason means toward the adjustment of the world for utilitarian ends (basically, toward an expedient falsification), one believed one possessed in them the criterion of truth and reality. The “criterion of truth” was in fact merely the biological utility of such a system of systematic falsification; and since a species of animals knows of nothing more important than its own preservation, one might indeed be permitted to speak here of “truth”. The naïveté was to take an anthropocentric idiosyncrasy as the measure of things, as the rule for determining “real” and “unreal”: in short, to make absolute something conditioned. And behold, suddenly the world fell apart into a “true” world and an “apparent” world [...]. Instead of employing the forms as a tool for making the world manageable and calculable, the madness of philosophers divined that in these categories is presented the concept of that world to which the one in which man lives

does not correspond... The means were misunderstood as measures of value, even as a condemnation of their real intention... (NL 1888, 14[153], KSA 13, p. 336).

In this excerpt Nietzsche defines the *true world* as the dimension in which all the conceptual forms that played an unavoidable role in the development of human beings can be found. Since human beings had *faith* on their truthfulness, they never carried on a critical analysis of them, and soon these thought symbols denying the becoming nature of the world has been hypostasized. Thus, according to Nietzsche, the metaphysical plane is the universe of fixed, unchanging shapes (thoughts, symbols, bodies, subjects, and things) in which *existence* men *believe*. The characters that Nietzsche attributes to these entities are exactly the same as those of Mach's metaphysical concepts: they all are mere products of the human intellect whose origin has been forgotten. Therefore, Nietzsche's suggestion to get rid of metaphysics is in compliance with Mach's ideas:

What distinguishes us in the deepest way from all the Platonic and Leibnitzean way of thinking, is this: we do not believe in eternal concepts, eternal values, eternal shapes, eternal souls; and philosophy, as far as it is science and not legislation, is for us just the broadest extension of the concept of "history". By proceeding from the etymology and the history of language, we assume any concept to be become, and many of them still in becoming; and this all the more so, that the most general concepts, the most illusory, must also be the oldest. "Being", "substance" and "absolute", "identity", "thing" -: these are the first and oldest schemes the intellect invented, which actually contrasted the world of becoming at the most, but which seemed to correspond to the latter from the very first, because of the dullness and one-sidedness of our initial, still under-animal consciousness (NL 1885, 38[14], KSA 11, p. 613).

Nietzsche's description of the "true world" directly follows from his view of human knowledge. According to him, the only way to stop believing in the fixed forms generated by our intellect is to become historians and, therefore, to carry on a genealogical analysis that leads to the origin of these hypostatized ideas. Then, it is not surprising to find that in *Twilight of the Idols* Nietzsche states the same ideas first presented in *Human, all too Human*, and repeats the critical remarks about the philosophers published in the first pages of this book.¹⁹ In particular, he deplores their "lack of historical sense", and criticises their being unable to see human knowledge as part of a still becoming process.

Lack of historical sense is the family failing of all philosophers; many, without being aware of it, even take the most recent manifestation of man, such as has arisen under the impress of certain religions, even cer-

You ask me what are all the idiosyncrasies of the philosophers?... For one thing their lack of historical sense, their hatred of the very idea of becoming, their Egypticism. They think they are doing a thing an

¹⁹ That must not surprise, all the more so because in 1886 Nietzsche worked on a new edition of HaH, and thus many notes from the late 1880s are in compliance with his early thoughts.

tain political events, as the fixed form from which one has to start out [...] The whole of teleology is constructed by speaking of the man of the last four millennia as of an eternal man towards whom all things in the world have had a natural relationship from the time he began. But everything has become: there are no eternal facts, just as there are no absolute truths (HaH 2, KSA 2, pp. 24f).

honour when they dehistoricize it, *sub specie aeterni* – when they make a mummy out of it. All the philosophers have been handling for thousands of years are conceptual mummies; nothing real has ever left their hands alive. They kill things and stuff them, these servants of conceptual idols, when they worship – they become a mortal danger to everything when they worship. (...) Whatever is, does not become; whatever becomes, is not... Now they all believe, even to the point of desperation, in being (TI Reason 1, KSA 6, p. 74).

4. The Metaphysical Mechanism

In the above paragraph I tried to show how close the two definitions of the term “metaphysics” provided by Nietzsche and Mach are. That is of the greatest importance if we consider the early 20th century debate concerning philosophy and science, since many thinkers involved in the foundation of the *Vienna Circle* directly referred to Mach, and stressed the fact that he marked off the realm of meaningfulness of science.²⁰ Therefore, the deep similarity between some of Nietzsche’s ideas concerning scientific knowledge and the epistemology of Mach is the sign that the former forerun some of the most important topics of the following decades (even though Nietzsche’s aim and perspective were different from that of Mach and the philosophers who later referred to him). That can thus help to look at Nietzsche in a new way, and consider his thought not as the product of the history of Western thought before him, but rather as the expression of a quite new worldview. A worldview that has been the ground of the investigation concerning the philosophy of science of the early 20th century.

Let us now turn to other pages of the *Principle of Conservation* and stress the more detailed topic concerning the critical discussion of the mechanical worldview which both Nietzsche and Mach deal with in their writings, and which is strictly related with their anti-metaphysical remarks. The starting point is once more Nietzsche’s theory of knowledge. According to Nietzsche, science simplifies the chaos of sense data and “operates only with things which do not exist, with lines, surfaces, bodies”, etc. (GS 112, KSA 3, p. 473). All these notions have a mere *logical* value and a practical usefulness, even though one usually consider them to be absolute entities. In particular, in carrying on his analysis of science Nietzsche deals with the notion of *atom*, the material corpuscle which attributes has been defined by Descartes and, later, by

²⁰ The *Vienna Circle* rose from the Association “Ernst Mach”. See Frank 1950 and Stadler 1982.

Newton, and that 19th century physicists use without getting it rid of the gloss of the common sense which covers it. This is probably the most important example of how the metaphysical knowledge works, since the atom is a pure simplification and hypostatization of a thought symbol. Nietzsche defines it a “earth-residuum” (*Erdenrest*), a “particle-atom” (BGE 12, KSA 5, p. 26) revealing the “rudimentary psychology” of the physicists (TI Errors 3, KSA 6, p. 91), who are unable to get rid of the testimony of both eyesight and touch. Thus, the atom is the object one must refer to, to properly show that the physics of mechanics involves a metaphysical worldview (an idea that also Mach states many times).

In the section of his book on the *Principle of Conservation* devoted to *Mechanical Physics*, Mach is aimed at showing that the scientists working in that research field believe mere thought symbols to be fixed and unchanging elements. In doing this, he deals with the notion of *matter* (*Stoff*), and compares it with the reference point of any religious view: the soul.

Matter is a possible phenomenon, a convenient word for a gap in our thoughts. To us investigators, the concept “soul” is irrelevant and a matter for laughter. But matter is an abstraction of exactly the same kind, just as good and just as bad as it is. We know as much about the soul as we do of matter (Mach 1911 [1872], p. 48).

This observation follows from Mach’s idea according to which human knowledge has an *economic* value, and therefore scientific notions are only *names, labels* for complexes of elements. Both matter and soul have exactly this function, since they’re “words for a gap in our thoughts”, which allow us to work with something that does not exist. Obviously, these notions can be adopted, but one must admit the pure *logical* value of them, instead of claiming that there is something “real” filling this gap. On the contrary, Mach states that “what we represent to ourselves behind the appearances exists *only* in our understanding, and has for us only the value of a *memoria technica* or formula, whose form, since it is arbitrary and irrelevant, varies very easily with the standpoint of our culture” (Mach 1911 [1872], p. 49). According to Mach, the fallibility of the mechanical worldview in physics follows from these remarks, since this discipline (that should be a knowledge of higher level) reveals its dependence on the common sense:

It is a bad sign for the mechanical view of the world that it wishes to support itself on such preposterous things, which are thousands of years old. If the ideas of matter, which were made at a lower stage of culture, are not suitable for dealing with the phenomena accessible to those on a higher plane of knowledge, it follows for the true investigator of nature that these ideas must be given up; not that only those phenomena exist, for which ideas that are out of order and have been outlived are suited.

But let us suppose for a moment that all physical events can be reduced to spatial motions of material particles (molecules). What can we do with that supposition? Thereby we suppose that things which can never be seen or touched and only exist in our imagination and understanding, can have the properties and relations only of

things which can be touched. We impose on the creations of thought the limitations of the visible and tangible (Mach 1911 [1872], p. 50).

These claims are quite similar to Nietzsche's critical remarks. Moreover, in a note from 1888 devoted to a *Critique of mechanistic theory*, Nietzsche argues that the substantial entities are only thought symbols, and that their origin lies in our senses' testimony (Mach expressly talks about eyesight and touch, as Nietzsche does!):

We need unities in order to be able to count: we should not therefore assume that such unities exist. We have borrowed the concept of unity from our concept of "I" – our oldest article of faith. If we did not consider ourselves to be unities, we would never have created the concept of "thing". (...) In order to sustain the mechanistic theory of the world, we always have to include a proviso about the use we are making of two fictions: the concept of motion (taken from the language of our senses) and the concept of the atom = unity (originating in our psychological „experience“). Its prerequisites are a sensual prejudice and a psychological prejudice.

The mechanistic world is imagined the only way that eye and fingertips can imagine a world (as "being moved") in such a way that it can be calculated – that unities are invented, in such a way that causal unities are invented, "things" (atoms) whose effect remains constant (– the false concept of subject is transferred to the concept of atom) (NL 1888, 14[79], KSA 13, p. 259).

According to Nietzsche, the fundamental idea of the mechanical worldview is a metaphysical statement claiming mere products of thought to be real entities; an idea that lies on the unjustified switch from the *logical* plane to the *ontological*, since it is commonly believed that the sense organs provide the inner qualities of the world. The result of this operation is the notion of atom, the core of the materialistic mechanism, which Nietzsche claims to be the archetype of any substantial entity. In *Beyond Good and Evil* Nietzsche writes some important remarks concerning the atomic theory, with the aim of showing that one usually supposes much more than what is needed to provide a scientific investigation of the natural world, since one attributes to the atom qualities that it does not have in itself. Thus, the science of mechanics is not different from any other metaphysical world-interpretation, such as the religious one, with its *souls* and *substances*.

As for materialistic atomism, it is one of the best refuted theories there are, and in Europe perhaps no one in the learned world is now so unscholarly as to attach serious significance to it, except for convenient household use (as an abbreviation of the means of expression) – thanks chiefly to the Pole Boscovich: he and the Pole Copernicus have been the greatest and most successful opponents of visual evidence so far. For while Copernicus has persuaded us to believe, contrary to all senses, that the earth does not stand fast, Boscovich has taught us to abjure the belief in the last part of the earth that "stood fast" – the belief in "substance", in "matter", in the earth-residuum and the particle-atom: it is the greatest triumph over the senses that has been gained on earth so far. One must, however, go still further, and also declare war, relentless war unto death, against the "atomistic need" which still leads a dangerous afterlife in places where no one suspects it, just like the more celebrated "metaphysical need": one must also, first of all, give the finishing stroke to that other and more

calamitous atomism which Christianity has taught best and longest, the soul atomism (BGE 12, KSA 5, pp. 26–27).

Materialistic atomism can thus be a useful description of the world, but in no way it can be claimed to be a good explanation of it. The name of Boscovich, here, recalls the note from 1884 in which Nietzsche (in compliance with Lange) looked at the *dynamical* world-conception as the development of the physics of mechanics. This new paradigm would be as scientific as the old one, but – supposedly – free from the reference to a metaphysical ground. Apart from that, what interests me at the most, in order to outline Nietzsche’s critique of mechanism, is that in presenting the guiding lines of the new world view that could finally get us rid of the belief in the ocular evidence, Nietzsche focuses on the relationship between the physical notion of “atom” and the world description build up by any religion, and thus argues that the “metaphysical need” is the root of the mechanism itself. The same remarks can be found in Mach’s works, since he writes several times that the image of the world resulting from the investigations of modern science can be compared with the mythological view peculiar to the old faiths. This is quite clear in an excerpt of Mach’s lecture on *The Economical Nature of Physical Inquiry* (held in 1882, and published many years later in his *Popular Scientific Lectures*):

It would not become physical science to see in its self-created, changeable, economical tools, molecules and atoms, realities behind phenomena, forgetful of the lately acquired sapience of her older sister, philosophy, in substituting a mechanical mythology for the old animistic or metaphysical scheme, and thus creating no end of suppositious problems. The atom must remain a tool for representing phenomena, like the functions of mathematics (Mach 1897 [1896], pp. 206–207).

In that lecture, Mach deals with the notion of atom, as he did in 1872, and shows once again his view of the mere logical value of the scientific notions. In particular, he stresses that “atom” is only a name, a mere product of our thought, and therefore argues that we cannot claim it to be *real*. According to him, this misunderstanding leads us to a false evaluation of the explanatory power of science, and furthermore to the belief that the essence of the external world can be *known*, and not only *described*. Mach strongly criticizes the idea that through science we can reach the unattainable plane of the thing in itself, a popular belief which Mach claims to be shared by many physicists of his era. According to him, science is not different from the old metaphysical views, since it is only another way of looking at the world stating the existence of an unchanging and stable ground under its becoming surface. Obviously, this closing remark directly follows from Mach’s idea that scientists never provided an analysis of the notions they used, a study that would show them that these concepts are mere thought symbols changing together with the outcomes of their investigations.

5. Conclusions

At the end of this investigation the similarity between Nietzsche's view of science and that of one of the fathers of the modern philosophy of science is clear. We can therefore argue that Nietzsche's critique of mechanism is in compliance with the outcomes of late 19th century physics. Since Mach has not been a direct source of Nietzsche's thought, we must say that they found the fundamental ideas of a quite new worldview in the cultural debate they both referred to. 19th century thinkers actually dealt with the crisis of the scientific knowledge – whose grounds were not seen as stable anymore – and started searching new basis for it. Despite the strong rejection of the explanatory power of science, it is not possible to argue that this crisis led to any kind of *irrationalism*. At the end of the 19th century the scientists simply become aware of the limits of a paradigm that could not be fully meaningful. Thus, the critique of scientific knowledge finally led to a strengthening of science itself, of its capability to provide a useful world-description. This has been possible only because a quite new, *relativistic*, perspective (uphold by thinkers such as Poincaré, Kuhn, and Einstein) has been adopted in science. That is not different from what Nietzsche did. He, too, dealt with the main epistemological questions of his time, and argued that all our concepts are only void containers, and therefore “truth” is just a word for something that does not exist. But when Nietzsche reached the boundaries of nihilism, he developed a “positive” philosophy, and outlined a worldview grounded on the rejection of absolute and substantial notions, i.e. on a pure relativistic knowledge.

Furthermore, the new perspective of the late 19th century science, with which Nietzsche's thought was in compliance, followed from another important outcome of both the philosophical and the scientific debate of that era: the idea of the development of both human race and its culture, derived from the popularization of the new born Darwinian evolutionism. The idea that everything has become, and is actually still becoming, deeply influenced Nietzsche, as well as many scientists of his time, who then started thinking at the role played by the historical studies in their own discipline. The development of 19th century science cannot be properly understood without referring to this topic, and we can say the same for what concerns Nietzsche's philosophy, with special regard to his critique of the science of mechanics. That of a genealogical development of human thought is indeed the “dangerous idea” which during the second half of 19th century has been adopted against the mechanistic world-description, in order to show its limits and lack of meaningfulness. “History has made all; history can alter all”, wrote Mach in 1872 (1911 [1872], p. 18); we can consider these words as the principle of the criticism towards any metaphysical worldview that started disseminating during his era. Thus, in carrying on his remarks against the scientific knowledge, Nietzsche was in compliance with a fundamental idea of his time, an idea peculiar not only to pure “philosophical” investigations, but also to those carried on by the scientists who outlined the early 20th century worldview.

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