MICHAEL FOUCAULT ABOUT WORDS AND THINGS

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Abstract: It seems that one of the functions Science performs permanently in human culture consists in unifying practical skills and cosmological beliefs, the episteme and the techne. What seems of specific interest are the historically variable interactions and dependencies between these two roles of science. In Les Mots et les Choses Michael Foucault characterizes the development of modern episteme by two great discontinuities: the first inaugurates the so-called Scientific Revolution and the second, at the beginning of the nineteenth century, marks the beginning of the Industrial Revolution and of the modern age. When we talk about science today, we mostly think of the modern science that has emerged since Galileo and Newton. But Galileo's name is mentioned, but once in Foucault's whole book, and his achievements are put as of little importance. And Newton, the greatest scientist of the Classical Age, remains equally absent. So how are we supposed to understand Foucault's argument? Foucault's book is not a history of science or of knowledge but deals with the rules of knowledge formation and representation. Therefore, Condillac seems more important than Galileo or Descartes and Novalis and Nietzsche more than Hegel and Marx or Sartre. Because all thinking occurs in terms of signs, and all knowledge must be represented, we are led to taking a semiotic perspective. This approach is justified as Foucault himself describes the door to the Classical age as being characterized by a transformation of the sign from a means of knowledge to an element of representation as such.

Keywords: Episteme. Representation. Enlightenment. Romanticism. Human subject.

MICHEL FOUCAULT SOBRE PALAVRAS E COISAS

Resumo: Afiguramos que uma das funções que a ciência desempenha permanentemente na cultura humana consiste em unificar habilidades práticas e crenças cosmológicas, a episteme e a techne. O que apresentar ser de interesse específico são as interações e dependências historicamente variáveis entre esses dois papéis da ciência. Em *Les Mots et les Choses,* Michael Foucault caracteriza o desenvolvimento da episteme moderna por duas grandes

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descontinuidades: a primeira inaugura a chamada Revolução Científica e a segunda, no início do século XIX, marca o início da Revolução Industrial e da era moderna. Quando falamos de ciência hoje, pensamos principalmente na ciência moderna que surgiu desde Galileu e Newton. Contudo, o nome de Galileu é mencionado apenas uma vez no livro inteiro de Foucault, e suas realizações são consideradas de pouca importância. E Newton, o maior cientista da Idade Clássica, permanece igualmente ausente. Então, como devemos entender o argumento de Foucault? O livro de Foucault não é uma história da ciência ou do conhecimento, mas lida com as regras da formação e representação do conhecimento. Portanto, Condillac parece mais importante que Galileu, Descartes, Novalis e Nietzsche do que Hegel, Marx ou Sartre. Como todo pensamento ocorre em termos de signos e todo conhecimento deve ser representado, somos levados a adotar uma perspectiva semiótica. Essa abordagem é justificada, como o próprio Foucault descreve, a porta para a era clássica como sendo caracterizada por uma transformação do signo de um meio de conhecimento para um elemento de representação como tal.

Palavras-chave: Episteme. Representação. Iluminismo. Romantismo. Sujeito humano.

INTRODUCTION

It seems that one of the functions *Science* performs permanently in human culture consists in unifying practical skills and cosmological beliefs, the *episteme* and the *techne,* and that this is its permanent and specific function which differentiates it from other products of human intellectual activity. What seems of specific interest are the historically variable interactions and dependencies between these two roles of science[6].

When we talk about science today, we mostly think of the modern science that has emerged since Galileo and Newton. But Galileo's name is mentioned but once in Foucault's whole book. And Newton, the greatest scientist of the Classical Age, remains equally absent. So how are we supposed to understand Foucault's argument? Because all thinking occurs in terms of signs, our answer to this question consists in taking a *semiotic* perspective. Semiotics is a methodology, not a philosophical doctrine. Whereas the rise of modern science brought about the conditions requiring a new kind of specialization that gradually has led to an atomization of research and fragmentation of intellectual community, *semiotic* can establish new conditions of a common framework and cross-disciplinary channels of communication that will provide new possibilities of research and discussion.

This approach is very much justified as Foucault himself describes the door to the Classical age as a transformation of the sign from a means of knowledge to an element of representation as such (1973, p.64). The break which Foucault describes has finally since the 19th century led to a *principle of complementarity* of sense and reference. Sense and reference

[6] See: AMSTERDAMSKI, 1975, p. 42-43.

of symbolic representations are distinguished by their complementary roles in the development of knowledge[7].

SECTION 1

In the book, *The Order of Things*[8] that made him instantly famous, Michael Foucault characterizes the development of modern *episteme* by two fundamental ruptures. He writes in his preface:

> This archaeological inquiry has revealed two great discontinuities in the *episteme* of Western culture: the first inaugurates the Classical age (roughly half-way through the seventeenth century) and the second, at the beginning of the nineteenth century, marks the beginning of the modern age. The order on the basis of which we think today does not have the same mode of being as that of the Classical thinkers. Despite the impression we may have of an almost uninterrupted development of the European *ratio* from the Renaissance to our own day, […] all the quasi-continuity on the level of ideas and themes is doubtless only a surface appearance; on the archaeological level, we see that the system of positivities was transformed in a wholesale fashion at the end of the eighteenth and beginning of the nineteenth century. Not that reason made any progress: it was simply that the mode of being of things, and of the order that divided them up before presenting them to the understanding, was profoundly altered (FOUCAULT, 1973. p. xxii).

We shall characterize these ruptures in semiotic terms and provide some illustrations using the history of mathematics and logics as a main reference. Foucault himself is not concerned with mathematics at all, although the names of Descartes and Leibniz serve him as important illustrations of his claims. But one should remind oneself that the so-called *Scientific Revolution* of the 16th and 17th century cannot even be described, without making extensive excursions into the realm of mathematics and mathematical physics.

> Whoever speaks of empirical science, should not forget that observation and experiment were only able to establish modern science, because they could rely on mathematical deduction. […] A mere collection of observational facts would never have led to the discovery of the law of attraction. Mathematical deduction in combination with observation is the instrument that accounts for the success of modern science (REICHENBACH, 1951, p.102).

Foucault wrote a very stimulating book, but a rather one-sided one too. The story he tells sounds at places as if coming from very remote times, times that have little connection

[7] See: OTTE, 2003.
[8] *Les Mots et les Choses*

with our present situation. We hope that the present contribution will improve this situation adding some new perspectives to Foucault's brilliant essay.

SECTION II

Knowledge before the *Scientific Revolution* of the 17th century was completely determined by its object. Thinking meant thinking of being itself, that is, thought was determined by its object. The nature of scientific thinking lied in the very comprehension of what there is. "The Aristotelian logic and methodology, in its general principles, is a true expression of the Aristotelian metaphysics" (CASSIRER, 1953, p.4) and the methods of inquiry had always to be congruent to the objects investigated.

Then at a certain period in history it happened that words and things parted ways and the common interpretation of our sense impressions seemed to become utterly unreliable. Mathematical method was attractive because it promised reliability. It is a merit of Michel Foucault to have brought this turn to the center of our attention. At the beginning of the 17th century:

> […] writing has ceased to be the prose of the world, resemblances and signs have dissolved their former alliance, similitudes have become deceptive. […] Thought ceases to move in the element of resemblance. Similitude is no longer the form of knowledge, but rather the occasion of error. […] 'It is a frequent habit', says Descartes, in the first lines of his *Regulae*, 'when we discover several resemblances between things, to attribute to both equally, even on points in which they are really different, that which we have recognized to be true of only one of them'. The age of resemblance is drawing to a close. […] And just as interpretation in the sixteenth century […] was essentially a knowledge based upon similitude, so the ordering of things by means of signs constitutes all empirical forms of knowledge as knowledge based upon identity and difference (1973, p. 47 -57).

This transformation strikingly reconfigured the conceptual framework: for Aristotle and up to the period, we call the *Baroque* things, had essences, later words have meanings. And their meanings could be discovered only by constructing new signs and representations. Hermeneutics became an essential element of culture since Luther's confrontation with the Emperor at Worms in 1521.

Arguably most important embodiment of the new spirit is to be found in Cartesian rationalism and individualism, although Foucault does not give too much importance to "the particular fortunes of Cartesianism" (1973, p.56).

The main impact of the Scientific Revolution of the 17th century came from a change in the habits of thought and, in particular, from a campaign for individual certainty. It was the central problem of Descartes and the general purpose of his *Discourse on Method.* “The one activity in the world, which really does concern Descartes, is thought and the pursuit of truth. Had he composed the Lord's Prayer, it would no doubt have contained the invocation ‘and lead us not into error’” (GELLNER, 1992, p.7).

Descartes’ rigorous distinction between *res cogitans* and *res extensa*, between mind and matter offers possibilities of – and at the same time creates demand for – establishing new connections between the operative and the receptive side of our knowledge. The idea of calculating with the famous unknown *X* of common algebra exemplifies the new *open* role signs acquired. Since then, thinking about signs has become a centerpiece of epistemology.

We use our symbols and concepts in a twofold sense, both attributively and referentially. Bertrand Russell illustrates the point by means of the distinction he draws between names and descriptions. We have, he writes,

> […] two things to compare: a *name*, which is a simple symbol, directly designating an individual which is its meaning (or referent), and having this meaning in its own right independently of the meanings of all other words; a *description*, which consists of several words, whose meanings are already fixed, and from which results whatever is to be taken as the ‘meaning’ of the description (1998, p. 174).

Consequently, there are two basic signs that seem not conventionally established and therefore play a privileged role in the search of new insight and certain knowledge: *Index* and *Icon.* Think of a geometrical diagram representing a certain triangle, for example. The letters indicating the vertices of the triangle are nothing but indices, while taken as the elements of the whole diagram form an icon.

In his work, *Geometrische Analyse* (1847), Hermann Grassmann constructs space as a structure of geometrical quantities. Each such quantity consists of a geometrical point weighed according to a certain multiplicity. So, the space consists of geometrical quantities, *A, B, C, D….* The product *AB* just means the segment that connects *A* with *B*. The sum $A + B$ designates the midpoint *M* of this segment, counted twice, that is, with the mass value *2* attached to it. So M is an *Index* of this point, while $(A + B)/2$ is an *Icon* and a description of it.

The position of $M = A+B$, for instance, results from the commutative law, $A + B = B + A$, that is, the location of *M* must be symmetrical with respect to *A* and *B*. And Grassmann describes how a formal indication may become a *description* and attain a concrete meaning by looking for all such expressions that have equal references to the one given.

It seems that Descartes became early in his life aware of the importance of these questions. In an important letter to Beeckman of March 26, 1619 (ADAM; MILHAUD, 1936). Descartes, still a young man, formulated a program for his future investigations. Beeckman interprets this as Descartes' desire to neatly bring together physics with mathematics by establishing a productive analogy between arithmetic and geometry. Descartes writes:

> In arithmetic, for instance, some questions can be solved by rational numbers, some by surd numbers only and other can be imagined but not solved. For continuous quantity I hope to prove that similarly certain problems can be solved by using only straight or circular lines, that other problems require other curves for their solution, but still curves which arise from one single motion and which therefore can be traced by the new compasses […] and finally that other problems can only be solved by curved lines generated by separate motions. […] (apud SHEA, 1991, p. 44).

Descartes is looking for a general method whose roots he believed in the ancient geometry, but being more general, in fact, than either geometry and arithmetic. Descartes writes:

> […] as to the analysis of the ancients and the algebra of the moderns, besides that the embrace only matters highly abstract, and, to appearance, of no use, the former is so exclusively restricted to the consideration of figures that it can exercise understanding only on condition of greatly fatiguing the imagination; and in the latter there is so complete a subjection to certain rules and formulas that there results an art full of confusion and obscurity calculated to embarrass, instead of a science fitted to cultivate the mind (1637, Part II).

Algebra is, in fact, something like meta-mathematics or meta-arithmetic. Algebra is a part of mathematics and of logic as well. This ambiguity became essentially important, but it also troubled the minds during the Classical age. When Descartes mentions the algebra, he often means the geometric constructability of the solutions of algebraic equations.

But on the other hand the separation of words and things, or of signs and objects that Foucault hat shown to be so essential to understand the break which initiated the *Classical* age, introduced the idea of mathematics as meta-mathematics and the possibility to act on mere possibilities. And this was essential also to Descartes' project.

> In 1631, Jacob Golius, a professor of mathematics from Leiden, sent Descartes an ancient geometrical problem, that "of Pappus on four straight lines". The ancient solution was unknown in the seventeenth century, so the problem became a test-case for Descartes. The resolution of the Pappus problem would have been unworkable without analytical tools and symbolic notation (SERFATI, 2008, p.51-52)

As Salomon Bochner observes:

> In Greek mathematics, whatever its originality and reputation, symbolization […] did not advance beyond a first stage, namely, beyond the process of idealization […] However […] full-scale symbolization is much more than mere idealization. It involves, in particular, untrammeled escalation of abstraction, that is, abstraction from abstraction, abstraction from abstraction from abstraction, and so forth; and, all importantly, the general abstract objects thus arising, if viewed as instances of symbols, must be eligible for the exercise of certain productive manipulations and operations (1966, p. 18).

Foucault, being more interested in the new empirical fields of scientific activity then in the exact sciences, privileges Leibniz over Descartes, as being the essential spirit of the Classical age. But Descartes became much more important to classical rationalism in general and in particular to an understanding of the limitations of representation. Let us see what Foucault has to say:

> Under cover of the empty and obscurely incantatory phrases 'Cartesian influence' or 'Newtonian model', our historians of ideas are in the habit of confusing these three things and defining Classical rationalism as the tendency to make nature mechanical and calculable […]. The fundamental element of the Classical episteme is […] a link with the mathesis which, until the end of the eighteenth century, remains constant and unaltered. This link has two essential characteristics. The first is that relations between beings are indeed to be conceived in the form of order and measurement, but with this fundamental imbalance, that it is always possible to reduce problems of measurement to problems of order […]. In this sense, analysis was very quickly to acquire the value of a universal method; and the Leibnizian project of establishing a mathematics of qualitative orders is situated at the very heart of Classical thought; its gravitational center. However, this relation to the mathesis as a general science of order does not signify that knowledge is absorbed into mathematics, or that the latter becomes the foundation for all possible knowledge. On the contrary, in correlation with the quest for a mathesis, we perceive the appearance of a certain number of empirical fields now being formed and defined for the very first time (1973, p.56).

Foucault's favorite, that is, the philosopher most mentioned in his book, is Etienne Bonnot de Condillac (1715-1780), a major figure of Enlightenment France. Condillac presents an empiricist account of knowledge more or less in the tradition of Locke. But Condillac's empiricism took a completely new twist in comparison to the British empiricists, because of his semiotic conception. Condillac saw mathematics (algebra) as an analytical language and considered language as essential to mental development and to knowledge Condillac was relentlessly Anti-Cartesian. And he stresses the social nature of signs and of semiotic activity: "Before social life natural signs are properly speaking not signs" (AARSLEFF, 2001, p. xii - xvii).

And while algebra remained an "analytical Language" (Condillac) throughout the 18th century, biologists like Buffon (1707-1788) or Linné (1707-1778) described things in terms of symmetry, structure and analogy. So Foucault is right to a certain degree. Many important philosophers of *Enlightenment*, like Condillac or Diderot did appreciate mathematics only as long its direct practical applications remained visible. Denis Diderot saw already in 1754, the end of theoretical mathematics coming. He wrote**:**

> We are at the dawn of a great revolution in the sciences. To judge from the inclination men's minds appear to have for ethics, literature, natural history, and experimental physics, I would almost dare to assert that within the next hundred years there will hardly be three great geometricians in Europe. This branch of science will just cease at the point, where Bernoulli, Euler, Maupertius, Clairaut, Fontaine, d'Alembert and Lagrange have left it. They will have laid the pillars of Hercules and no-one will pass beyond. Their works will endure in the centuries to come, like the pyramids of Egypt, massive and laden with hieroglyphics, an awesome picture of the power and resources of the men who raised them (2000, p.37).

The general feeling at the end of the 18th century was, that the traditional means of justification and organization of knowledge have become as insufficient as the given methods showed themselves as incapable of producing new results. And this led in fact to the revolution that produced the science of pure mathematics and theoretical physics.

Geometry, it is assumed, to having arisen from the activities of measurement. But it became geometry only as soon as humans learned to measure things that are not directly accessible. A "new light" (says Kant) must have flashed on the mind of people like Thales, when they perceived that the relation between the length of a flagpole and the length of its shadow enables one to calculate the height of the pyramid, given the length of its shadow. "For he found that it was not sufficient to meditate on the figure as it lay before his eyes, […] and thus endeavor to get at knowledge of its properties, but that it was necessary to produce these properties, as it were, by a positive a priori construction" (KANT, 1787, Preface to the Second Edition).

Immanuel Kant, whose *Copernican Revolution of Epistemology* endd the Classical age, has fundamentally portrayed the connection between knowledge and subjective activity, which is particularly characteristic of mathematics and of the modern age in general. Kant emphasizing the fundamental significance of activity in the constitution of knowledge, has thereby at the same time opened the door to the modern age.

SECTION II

At the end of the *Classical Age* begins the modern age with its focus on the human subject and its history. The common philosophical description of this second break at the beginning of the 19th century refers to the contrast between the Enlightenment and Romanticism. The ideologies that sprang forth from these two philosophical movements became essentially the most drastically important ideologies that have been created in modern history. From them has developed just about every political, social, economic, industrial, and cultural movement that exists today.

From a semiotic point of view, the difference between them becomes perceived by the difference between analytical and synthetic knowledge[9]. In Germany the writings of Kant, Fichte, Novalis, Schlegel, Schelling and Goethe set the stage for a Romantic Revolution. This revolution would simultaneously erupt in the English poets Byron, Shelly, Blake and Coleridge.

The greatest of the Romantic Philosophers was Friedrich Nietzsche (1844-1900). In his *The Birth of Tragedy* (1872) he writes: "Here we have our present age […] bent on the extermination of myth. Man today, stripped of myth, stands famished among all his pasts and must dig frantically for roots […]." (p. 136). Gilles Deleuze comments on this:

> Nietzsche intègre à la philosophie deux moyens d'expression, l'aphorisme et le poème. Ces formes mêmes impliquent une nouvelle conception de la philosophie, une nouvelle image du penseur et de la pensée. A l'idéal de la connaissance, à la découverte du vrai, Nietzsche substitue l'interprétation et l'évaluation. L'une fixe le sens […] d'un phénomène ; l'autre détermine la valeur hiérarchique des sens, et totalise les fragments, sans atténuer ni supprimer leur pluralité. […] Cette image du philosophe est aussi bien le plus vieille, le plus ancienne. C'est celle du penseur présocratique. […] Comment comprendre cette intimité de l'avenir et de l'originel ? Le philosophe de l'avenir est en même temps l'explorateur des vieux mondes […] et ne crée qu'an force de se souvenir de quelque chose qui fut essentiellement oublie. Ce quelque chose, selon Nietzsche, c'est l'unité de la pensée et de la vie (1965, p.17).

Last not least we have to mention Lady Victoria Welby (1837-1912), a founding 'mother' of semiotics and well known because of her correspondence with Charles Sanders Peirce (HARDWICK, 1977).

Michael Foucault himself starts his description of the beginning modernity as follows:

> The last years of the eighteenth century are broken by a discontinuity similar to that which destroyed Renaissance thought at the beginning of the seventeenth; then, the great circular forms in which similitude was enclosed were dislocated and opened so that the table of identities could be unfolded; and that table is now about to be destroyed in turn, while knowledge takes up residence in a new space - a discontinuity as enigmatic in its principle, in its original rupture, as that which separates the Paracelsian circles from the Cartesian order (1973, p.217).

[9] See: BOUTROUX, 1920.

Contrary to Foucault's belief we record a partial return of the Romantics to Paracelsus. In other words, we observe the appearance of a complementarity between the ideas of Paracelsian and Cartesian origin, between metaphor and structure. This complementarity is already built into our language itself. The rules that govern syntax in a language have nothing to do with the meaning that is conveyed, but are necessary to make communication at all possible. Syntax and semantics are complementary to each other.

"Colorless green ideas sleep furiously", is a sentence composed by Noam Chomsky in 1957 as an example of a sentence whose grammar is correct but whose meaning is nonsensical (1957, p. 15). Chomsky's sentence may even appear as a completely acceptable phrase within a piece of poetry. In 1985, a competition was held at the *University of Stanford*, in fact, the purpose of which was to present Chomsky's sentence as part of a poem, giving it a meaning as a metaphor.

It is interesting, in fact, to observe that you cannot be too demanding when asking for the meaning of individual words. Still put together in a sentence one might be able to produce very subtle nuances of meaning. Look at the following:

The ball was rolling along the grass.

The ball kept on rolling along the grass.

The rather subtle difference of wording suggests all the differences between an Aristotelian conception of mechanical motion and a Newtonian modern one. That is, "the second sentence makes us think of an agent exerting force to overcome resistance or overpower some other force" (PINKER, 1997, p.354).

The complementarity of structure (syntax) and metaphor (predication) does appear clearly when dealing with patients whose language capacities are impaired. Roman Jakobson has described patients with various types of linguistic aphasia and has classified, in fact, all linguistic behavior as referring to either *code* or *context*. One could call one type of aphasia a loss of metaphor or loss of meta-language and the other a loss of structure, that is, the syntactical rules of organizing words into higher units are lost[10].

We suggest understanding the grammar of a language, as a basic form of theory in the same way as Peano's axioms present a modern formal theory of arithmetic. Some scholars considered the modern axiomatic method to be incomplete, as unspecified terms occur within the axioms[11]. These uninterpreted terms must indeed be specified when trying to establish a

[10] See: JAKOBSON; HALLE, 1956.
[11] See: RUSSELL, 1998.

connection to an intended application. However, an absolute or ultimate interpretation of mathematical or scientific concepts is generally neither possible nor desirable. The foundations of a theory therefore lie in the future, that is, in its successful applications. To emphasize this situation Einstein chose the Kantian formula that the real object of science is *nicht gegeben, sondern aufgegeben* (not given, but put as a goal).

This formula has been used already by Cassirer when commenting on the fierce debate about the foundations of arithmetic. The formal-axiomatical approach of Grassmann and Dedekind or Hilbert and Peano stood against the views of Hölder, Kronecker, Frege, Russell and others (CASSIRER, 1969, p. 69-70).

It was in fact romantic philosophy which stimulated the structural view of theory (with respect to mathematics think of E. Galois (1811-1832) or H. Grassmann (1809-1878). The famous mathematician and scientist Norbert Wiener (1894-1964) elucidates these transformations, when characterizing the new intellectual individualism of the Romantics saying that:

> […] he who concentrates on his own mental states will concentrate, when he becomes a mathematician, on the proof of mathematical theorems, rather than on the theorems themselves, and will be compelled to object to inadequate proofs of adequate theorems. […] To us, nowadays, the chief theme of the mathematicians of the Romantic period may sound most unromantic and repelling. The new mathematics devoted itself to rigor, […] What the new generation in mathematics had discovered was the *mathematician*; just as what the Romantics had discovered in poetry was the poet and what they discovered in music was the musician. An 18th century musician, like Bach is not interested in telling us how Johann Sebastian Bach felt. He opens to our ear's vistas of pure beauty. A Chopin on the other hand, if he does not tell us about Chopin, tells us nothing. (1951, p. 92-96).

A very important figure of the romantic era was Friedrich von Hardenberg, called: *Novalis* (1772-1801). In his *Fragments and Studies* (NOVALIS, 1960), describes his philosophy of science as a kind of grammar or logic or compositional doctrine. And he points out ways in which seemingly exclusive opposites can be brought together in the process of romanticizing: the ordinary and the special, the limited and the ideal and infinite, mathematics and philosophy, says if the mathematician really does something right, he does so as a philosopher. In a sense, this results from a formal standpoint, as shown by the emphasis on the independence of syntax from semantics, an independence that arithmetic and algebra share with language.

The whole romantic movement was focused on semiotics and on the notion of sign. Novalis said famously:

> The designation by sounds and lines is an admirable abstraction. Four letters signify God to me; a few strokes a million things. How easy is the handling of the universe, how vividly the concentricity of the spiritual world! Grammar is the dynamics of the spiritual realm. A command word moves armies; the word freedom nations. (1960, p.412, our translation).

And many searched, like Paracelsus (1493-1541) for metaphors that reveal the human meaning in the things of this world. The writings of Victoria, Lady Welby (1837-1912) must be mentioned in this context, initially her interest was directed towards theological questions, which led to her awareness of the problems of language, meaning and hermeneutics. Lady Welby was also among those who lamented the empiricism of the Baconian sciences and of the Enlightenment. She writes:

> The fresh advance which now seems imminent, as it is sorely needed, should be no mere continuation of the Baconian search, the accumulation of data for a series of inferences regarding the properties of the material system as usually understood, but rather the interpretation, the translation at last into valid terms of life and thought, of the knowledge already so abundantly gained. While man fails to make this translation — to moralize and humanize his knowledge of the cosmos, and so to unify and relate it to himself — his thinking is in arrears, and mentally he lags his enacted experience. That we in this age do lag behind […] and that we have thus far failed to achieve a great and general act of translation, is a loss chiefly due to our unanimous neglect to understand Expression, its nature, conditions, range of form and function, unrealized potencies and full value of worth (1912, p.2-3).

If one looks at Lady Welby's writings one observes that she seems nearly exclusively concerned with the problems of the metaphorical, with spoiled or misplaced metaphors. She writes for example:

> We always tend unconsciously to make whatever we have expressed in images and through metaphor behave like the real thing, or the original we took as illustration or in analogy. Hence results endless confusion the real source of which is not detected and is therefore permitted to continue its mischievous work (1912, p. 22).

Philosophy, religion and literature or poetry must tell us the same things about ourselves in always new ways. In this consists their art as well as their duty and destiny. Mathematics, science and technology are trying to definitely unveil the secrets of nature and to promote technology. Consequently, both universes of discourse become dominated by two different semantical conceptions, namely sense (meaning) and information (truth), respectively. These conceptions play complementary roles in the process of knowledge development and human self-understanding.

The two elements, which Nom Chomsky tried to indicate by his famous phrase and which Roman Jacobson identified as the archetypes of linguistic competence and which we may call the poetic or philosophical on the one side and the mathematical or formal, on the other side troubled the minds of all the great scientists of the 19th/20th century. Take Albert Einstein (1879 - 1955) being the most well-known of them all. Many scholars have pondered about the question of whether Einstein was a positivist and instrumentalist or rather a realist philosopher of science.

In fact, Einstein initially considered the mathematical form of theories rather incidental. For example, Einstein's theory of special relativity created a fundamental link between space and time. The universe could now be viewed as having three space-dimensions and one time-dimension. This 4-dimensional space is referred to as the Minkowski's *space-time continuum*. Einstein's theory is nothing but the theory of geometrical transformations that leave a certain indefinite quadratic form invariant. This picture is completely analogous to the interpretation of ordinary Euclidean geometry as the theory of invariance with respect to the quadratic form by which the usual metric is defined.

In his collaboration with Hilbert and Minkowski on the presentation of the theory of special relativity Einstein himself initially neither appreciated nor used Minkowski's geometrical form. He called it *superfluous learnedness (überflüssige Gelehrsamkeit*). He considered the use of tensors in particular as a superfluous manifestation of erudition. Einstein preferred intuitive metaphorical language saying, for example that space, and time must be conceived of or seen as variable or evolving (WALLWITZ, 2017).

But, Einstein soon changed his mind after having intensively used tensors calculus when striving hard to develop the *General Theory of Relativity*. It is even questionable if he could have accomplished *General Relativity* in 1915, if Minkowski had not introduced the tensors. "As Einstein recalled in his 1933 Herbert Spencer Lecture at the University of Oxford, it was the success of general relativity that convinced him of the heuristic and creative power of mathematical simplicity" (GIOVANELLI, 2018, p.785).

The *simplicity* of the mathematical form is decisive. Einstein, in fact, later even denied the possibility of a theory-free standpoint from which what is real can be judged. Electrons, or even dogs are just what a certain theory says they are. However theories refer only attributively to reality not referentially. They make no existence claims. For example, Peano's axioms do not answer the question "What are numbers as objects. What is the number 1 or 2? Do they exist? Numbers could be anything, even games (Conway-Numbers, Hackenbusch-Games, Chessboard-Computer, Vectors, Sets, etc.). What the axioms describe are concepts or classes of objects, rather than particular objects themselves.

Theories of modern science are schemes of interpretation of objective and socio-historical reality, rather than images of it. Theories are always underdetermined by the data they try to explain, otherwise they would be superfluous. Truth and knowledge are results of the application of theories, rather than of the theories themselves. The foundations of a theory therefore lay in the future, that is, in its successful applications.

The analogous transformation of physics from empiricism to the hypothetico-deductive method and the establishing of the formal notion of theory, here described, had been studied extensively by Kenneth Caneva (1978).

Then came quantum physics and caused a new, more difficult crisis. The only scientifically fruitful way out seems to have been the formal mathematical presentation of Heisenberg, Born, Jordan and Dirac. Heisenberg demanded that only quantities observable in principle, that is, spectroscopical data, should be introduced into a physical theory (LENHARD; OTTE, 2018).

Again the situation apparently did not satisfy Einstein. And we may try to understand why this is so. The theoretical concept is the guiding principle of scientific exploration. The concept is also the goal of knowledge, however. To understand a theory means to conceive of it as the development or unfolding of some original hypothetically established concept. We have to understand the concept as the starting point as well as the goal of theoretical activity. This seems paradoxical.

The paradox has been described as the conflicting influences of two principles which C. W. Churchman has called the *minimum vs. maximum loop principle*: "The maximum-loop principle comes down to us from *Plato*. It is based on a monistic philosophy: There is one world of interconnected entities, not many. The most distant galaxies and the most menial worker somehow have a connection. The principle is also teleological" (1968, p.113-114).

The minimal loop orientation seems to have guided the intellectual efforts of the thinkers since the *Scientific Revolution* of the 17th century. "For Descartes the problem was to find a proposition that leads directly to its own validity" (CHURCHMAN, 1968, p. 113). The starting point for this problem is to find a proposition which immediately implies its validity. If I say *p* this means *p is true*. This immediacy principle could thus be expressed by an assumption of equivalence between *p* and *p is true*.

About 200 years after Descartes Bernard Bolzano, when composing his monumental Doctrine of Science, *Wissenschaftslehre*, (1837) replaced *truth* by the requirement of formal consistency. Bolzano also agreed with Kant`s rejection of the belief in a *pre-established* *harmony* between being and knowledge of Classical Rationalism. “It had exactly been Bolzano, who […] had completely anti-platonically distinguished between the structure of being and the structure of cognition (Denkstruktur)” (NEEMANN, 1972, p. 81).

CONCLUSION

The interest in the human subject which Foucault identified as a characteristic of modernity but considered the controversies modern humanism may have stirred up to be no more than “a few surface ripples” expresses itself in terms of the paradox mentioned and in the complementarity of all our thoughts and representations.

Mathematics and science are activities, which have since the 19th centuries increasingly liberated themselves from metaphysical and ontological agendas. Exactly his separation of world and sign had occupied the Romantics as much as it had worried Einstein. A representation always determines something. But by the same token it points to the yet undetermined and infinite. If I say *p* this means *p*. But it also negates all that is not *p*. It says that *p* is not *q* and not *r*, ad infinitum. So modern thought oscillates between the minimal and maximal loop agendas.

Foucault had obviously no interest in the *History of Ideas* movement founded in 1939 by Arthur Lovejoy. This is a pity, because Lovejoy had indicated the paradox and had aptly observed, that:

> […] the representatives of the Enlightenment of the 17th and 18th centuries […] were manifestly-characterized to a peculiar degree by the presumption of simplicity. [...] When on the other hand, you pass on to the Romantic Period, you find the simple becoming the object of suspicion and even of detestation (1964. p.57).

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