ACADEMIA ROMÂNĂ

NOEMA

Comitetul Român de Istoria și
Filosofia Științei și Tehnicii

Volumul XXII, 2023

ACADEMIA ROMÂNĂ

N O E M A

Volumul XXII

2023

Consiliul ştiinţific

ISSN 2501-2304

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Calea Victoriei nr. 125, Cam.31, sector 1, Bucureşti, cod 010071

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Comitetul Român de Istoria şi Filosofia Ştiinţei şi Tehnicii

NOEMA

Volumul XXII

(2023)

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PHILOSOPHY OF THE SCIENTIFIC UNDERSTANDING

[FILOSOFIA ÎNȚELEGERII ȘTIINȚIFICE]

HISTORY OF FORMALISM: FROM ARISTOTLE TO GÖDEL

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ABSTRACT:

Using formal means for developing scientific theories became a tradition from the times of Aristotle's *Analytics*. Ernst Schröder built the complete algebraic theory of inferences by the end of the 19th century. The idea of a complete formalization emerged as a way for eliminating paradoxes in foundations of mathematics that Bertrand Russell has revealed at the very start of the 20th century. Bertrand Russell and Alfred North Whitehead developed the first completely formalized theory in the three volumes of *Principia Mathematica* (1910 - 1913). David Hilbert enhanced the formation of metatheoretical approach to axiomatic theories by his call for proving the consistency of mathematics by using only finitary means. All of a sudden, in this atmosphere of steady axiomatic studies, a young mathematical genius Kurt Gödel published his famous theorem, which proved the incompleteness of a formal arithmetic system. Gödel's theorem raised a huge wave of metatheoretical studies of formal systems. His main instrument, called Gödel's numbering, was a special type of self-referential expressions that caused paradoxes just in foundations of mathematics. An aspect of Gödel's approach, that may raise discussions, is the formalization of metalogic itself, which actually may eliminate the idea of metatheory.

KEYWORDS: Aristotle, Ernst Schröder, *Principia Mathematica*, David Hilbert, Kurt Gödel, metatheory.

Contents

1. Introduction

At present days of logical science, two main areas of research can be distinguished – research on the theory of proof in the framework of mathematical logic and development of the methodology and logic of scientific research. The foundations of the first direction were laid by Aristotle's two *Analytics.* Eventually, the theory of proof was crowned with Gödel's famous theorem on formalized theories (Gödel 1931). This history took about 24 centuries and raised a huge wave of publications on different aspects of formalized theories (Kleene 1952, Goldstein 2006, Smith 2007, Raatikainen 2022).

Aristotle's theory of deductive inferences, *syllogisms* in terms of Aristotle, is presented in *Prior Analytics*. The core of the theory is developed in the first seven chapters of book one of *Prior Analytics* by revealing all valid modes of inferences from two propositions having a subject-predicate structure. All the remaining 95 % text of the *Prior Analytics* is about inferences containing modalities and false premises.

Aristotle's syllogistics is considered a perfect theory in the sense that it presents the proofs for all valid inferences from any two types of categorical (subject-predicate) propositions (judgments). Aristotelian strict proofs of valid modii make the impression that his syllogistic theory

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is an example of absolute truth of the same level as that of Euclid's geometry. The great critic of dogmatic theories, Immanuel Kant, had the highest opinion of the Aristotle's logical theory: "formal logic was not able to advance a single step (since Aristotle) and is thus to all appearance a closed and complete body of doctrine" (Kant, 2004, p. VIII).

Yet, under the apparent influence of mathematical sciences, in particular, of algebraic equations, there was formed a strong belief that syllogistic inferences can be performed in algebraic manner. Gottfried Leibniz dreamed creating a *calculus ratiocinator* that would make all arguments "as tangible as those of the Mathematicians, so that we can find our error at a glance, and when there are disputes among persons, we can simply say: Let us calculate" (Wiener, 1951). Valuable attempts in this direction made George Boole in his *The Laws of Thought* (1854) and Stanley Jevons in his book *The Principles of Science* (1879). The algebraic approach to the theory of inferences and proof got its perfect and detailed formulation in the three volumes of Ernst Schröder's *Vorlesungen über die Algebra der Logik* (Lectures on the Algebra of Logic) (Schröder 1890-1905).

By the end of the 19^{th} century and the first two decades of the 20^{th} century a new system of symbolic logic emerged, nowadays considered as the dominant theory of inferences – the mathematical logic. This new direction was generated by research in the field of the foundations of mathematics. The pioneer here can be considered Gottlob Frege, who published in 1879 the book *Begriffsschrift* (Terms writing, i.e. calculus of concepts). The system of symbolic designation of inferences in *Begriffsschrift* was so unsuccessful that this work of Frege did not receive due attention. However, the system developed by Giuseppe Peano played a significant role in the formation of the symbolic language of mathematical logic (Kennedy, 1980). Anyway, the fate of Frege's two-volume work *Grundgesetze der Arithmetik* (1893/1903), devoted to the substantiation of number theory, turned out to be more successful. Frege's approach was copied in Bertrand Russell's *Principles of Mathematics* (1903) and developed further in three voluminous volumes of *Principia Mathematica* by Russell and his former university teacher Alfred North Whitehead (vol. 1 – in 1910, vol.2 – in 1912, vol. 3 – in 1913). Further events unfolded around the concept of formalization of axiomatic theories, set out in the famous article by the young mathematician Kurt Gödel (1931). But before we get into Gödel's concept of formalization, we need to be clear about the notion of formal theory.

As shown in the history of science (of mathematics), the first step towards the formalization of a theory is the introduction of letters and symbols to describe objects and formulate the statements of the theory. The central moment of the theoretical representation of the doctrine is the axiomatic representation of the theory. In the axiomatic representation of the theory, the basic statements of the theory (axioms) and all statements derived from them and the corresponding definitions using the rules of inference (legitimate inference schemes) are considered true.

The crown of scientific knowledge is the ***proof.*** Scientific research is an incessant search for proving the truth of an important statement for the answer to the problem under study. In this aspect, the axiomatic construction of the theory has a fundamental advantage. Opponents of the theory need to be able to present a fact that refutes any of the axioms or is inconsistent with any definition. This task is very difficult, because authors of theories, putting forward their axioms and definitions, had considered all significant facts.

By the end of the 19^{th} century, research began on the axiomatic construction of the most basic mathematical teachings – set theory and number theory. And suddenly, like a bolt from the blue, paradoxes were discovered in the very foundations of mathematics. As a natural reaction, the idea of a more rigorous formulation of axiomatic theories appeared, and then the concepts of formal and formalized theories became widespread.

2. Aristotle's formal logic

Aristotle (384–322 BCE) created a significant number of fundamental sciences of ancient times like Logic, Psychology, Physics, Philosophy, Rhetoric, Cosmology, and many others. The logical works of Aristotle – *Categories*, *On Interpretation*, *Prior Analytics*, *Posterior Analytics*, *Topics*, *On Sophistical Refutations* – later were called *Organon* meaning "instrument, tool, organ" of cognition. Actually, *Analytics* contain the Aristotelian theory of logical proof: *Prior Analytics* presenting the theory of syllogistic inferences, while *Posterior Analytics* – the general concept of proof, including the Aristotle's teaching of definition.

Aristotle was very scrupulous in presenting the teachings and views of his predecessors. He called colleagues to sum up what is known by this point to be able adding a new result to this heritage. Yet, in regard to the science of logic, Aristotle emphasized his priority. He pointed out that when he was developing the science of inferences "it is not true to say that present it had already been partly elaborated and partly not; nay, it did not exist at all …regarding reasoning we had absolutely no earlier work to quote but were for a long time labouring at tentative researches" (*On sophistical refutations* 155; 34, 183b, 184a).

The striking thing about Aristotle's *Analytics* is that there is not a single case known in the history of science when a theoretical concept was created without predecessors, as if from scratch, and yet was created as complete perfection. There were three factors that could facilitate the creation of *Analytics*. First, there was a certain atmosphere of analysis and research in the Socratic dialogues with great skill presented in the writings of Plato. The Armenian ancient philosopher David Anhacht (David Invincible, 6th century CE) pointed out in his *Commentary on Aristotle's Prior Analytics* that Plato did not need Aristotle's theory of proof but rather Aristotle took from Plato's works the seeds of his logical teaching (Tophchian, 2010, ch.4). One could be surprised by David Anhacht's remark since Plato had not written any work dealing with problems of logic in general or the theory of proof in particular. David Anhacht's words should not be taken literally. The main idea of his remark is contained in the term "seeds". True, there are no elements of logical *theory* in Plato's works. But his dialogs are full of rational discussions and attempts to find out definitions of various concepts.

The second factor could be the appearance of sophists, before and during Aristotle's time. They composed a new social group of citizens able to teach youngsters in a wide range of subjects, with particular emphasis on skill in public debates. Due to everyday educational practice with young people, sophists eventually created rationalistic climate of thought on questions about morality, religion, and politics. So that by the days of Aristotle and the sophists, the "collective intellect" of the nation has risen to such a level of strength that a Greek individual felt himself able to solve any problem (e.g. Aristotle) and prove any statement be it true or false (the sophists).

From the days of Aristotle's *Metaphysics*, there was quite a satisfactory understanding of the essence of scientific knowledge. Scientific knowledge, in contrast to the opinions of people, had to have strict **proof**. By the 4th century BCE the deliberations on the reliability of sensual data and rational judgments brought to the formation of the school of philosophical Skepticism. The main statement of Pyrrhonist skepticism asserted that knowledge of things is impossible. Skeptics have maintained for several centuries an ideological confrontation with dogmatism presented by the very influential philosophical school of Stoics. Yet this criticism of the positions of opponents had a very specific feature: neither the Academics nor the Stoics had a more or less satisfactory conception of truth. Both disputing camps did not use the fundamental definition of the truth, suggested in Aristotle's books on the first philosophy, and continued their confrontation even not mentioning Aristotle's valuable conception of scientific knowledge.

Compared to Skeptics, ancient sophists presented the opposite pole that reflected the unique degree of intellectual development when human mind first succeeded in proving own opinions.

Should not they think that they were really wise, or *sophoi* in old Greek? Especially, if we would consider that sophists were ready to teach Athenian youngsters becoming wise as were they themselves. But sophists demanded payments for their lessons for which they were criticized in Socratic dialogues. Aristotle wrote a special work – *Sophistical refutations* – where he revealed the ways by which sophists pretended being able to prove true and false statements equally.

3. Algebra of logic and Mathematical logic

The system of reasoning created by Aristotle from two categorical judgments was considered as perfect that for more than two millennia, from the 4th century BCE and until the beginning of the 17th century, the theory of categorical syllogism existed without significant losses and gains. But already from the middle of the 17th century, the idea of an algebraic representation of the theory of inference was born. Many attempts in this direction were made by Gottfried Leibniz and his followers Johann Lambert, Julius Plücker and others. Interesting results in the algebraic representation of inferences were obtained in the middle of the 19th century by George Boole, Augustus de Morgan and Stanley Jevons. By the end of the 19th century, the system of algebraic inference theory was exhaustively presented in Ernst Schröder's three-volume work *Vorlesungen uber Die Algebra der Logik* (Schröder, 1890-1905).

From the point of view of the history studies in foundations of mathematics, the paradox of the set of all "normal" sets, discovered by Bertrand Russell in 1903, is considered the first and most significant paradox. From the point of view of common sense, specific objects and their sets belong to completely different "worlds", as if they were opposite to each other. The set of books is not a book. Objects are separate entities, while sets consider their collections (groups). These two heterogeneous types of concepts are connected using the concept of *property*. Usually, a set is defined as a collection of objects that have a given property. In the case of the set of books, this unifying property is that of having pages. At the same time, it is considered natural that the attraction of a certain property for the formation of a set implies the formation of something new, different from the objects themselves, the elements of the set. A set of books can form a library - a new object with its own socially significant functions.

In the light of the said, posing the question of a set that can be its own element is something unexpected and strange. Indeed, are there such "anomalous" sets that they themselves are their own elements? Which set-forming property can ensure that the resulting set has this same property? The question is not easy, and requires accurate deliberations. Namely, this "anomalous" characteristic feature should be a property that would in a hidden form designate both a certain set of available objects and the property itself. In the field of research in the foundations of mathematics, such a set is "the set of all sets". Since it is the set of *all* sets, it will also include itself as its element. At the same time, there is nothing problematic in the concept of "the set of all sets". There is no paradox, hence, there is no problem.

It was B. Russell who pointed out that already a derivation from the concept "the set of all sets", namely, the concept of "the set of all *normal* sets", generates a paradox, a logical contradiction. To reveal the paradox, we divide all sets into normal sets (not containing itself as an element) and anomalous sets (containing itself as an element). Now it is easy to show that *the set N of all normal sets* is paradoxical.

If *N is a normal* set, then it must satisfy the condition of not being a member of itself and thus it is not the set of *all* normal sets, which is in contradiction with its definition.

If *N* is not a *normal* set (is an anomalous set), it must be a member of itself by definition. But the set N of all *normal* sets is composed of only *normal* sets and as such cannot be a member of itself, which is a contradiction too.

Thus, we came to a paradox – in the both possible cases we have a logical contradiction (compare Irvine & Deutsch 2021).

It is quite natural that for several decades' attempts to resolve Russell's paradox were carried out within the framework of the problems and categories of mathematics, in particular, the set theory. Indeed, as it is clear from the review article on Russell's paradox in the Stanford Encyclopedia of Philosophy (Irvine & Deutsch 2021), by that time, mathematicians were not inclined to see a connection between paradoxes in the foundations of mathematics and classical paradoxes, primarily with the Liar paradox. Russell himself saw the solution to the paradox of the set of all normal sets in his "type theory", according to which the formation of a set of sets (predicates from predicates) should be limited. On this way of eliminating specific contradictions, the mathematicians Zermelo, Frenkel, Skolem, Neumann already in the first decades of the last century built axiomatic set theories, free from contradictions like that of Russell's paradox.

However, such a partial solution of the problem for many mathematicians did not seem to be satisfactory. Generation after generation, mathematicians found it natural to build theories for all times, in the likeness of Euclid's geometry. Quite in the spirit of this need, the famous mathematician of the last century, David Hilbert, put forward the idea of proving the consistency of mathematics using only convincing, finitary means. This would free all mathematicians from the uncomfortable feeling that a new paradox might arise again in some area of mathematical knowledge.

Another significant result of research on the foundations of mathematics and the construction of axiomatic theories has been the increased attention to the rigor of the language of mathematical theories. As a result, an ever-increasing tradition has emerged for constructing formalized theories and studying their properties such as completeness and decidability in the frame of non-formal metamathematics (metalogic).

4. Gödel’s theorem under scrutiny

Gödel’s incompleteness theorem (formed by two related theorems published in the same article in 1931) of the formalized arithmetic (Peano Arithmetic) had a major impact on the modern researchers in mathematics, logic and philosophy. Actually, Gödel's 1931 article has determined the philosophy and ideology of all subsequent studies on the foundations of mathematics. There arose an important wave of publications on the consistency and completeness of formalized systems (Smullyan, 1991; Franzén, 2005) and on the philosophical interpretation of Gödel's theorem (Rucker, 1995; Wang, 1997; Feferman, 2011).

By definition, formal (or formalized) theory is said to be consistent if no formal proof can be carried in that theory for a formula *A* and at the same time for its negation ~*A*. The consistency of mathematics became a central problem of studies in foundations of mathematics due to *Hilbert’s Program*. The main idea of this approach was quite simple – to prove mathematics consistency using only finite means. Hilbert with his colleagues and some other researchers got certain results regarding concrete axiomatic theories of number theory. In contrast to Hilbert's standing, Gödel's theorem on the incompleteness of formalized arithmetic proved that Hilbert's program was unrealizable: it followed from Gödel's theorem that by means of a given formalized theory it is impossible to prove its own consistency (Gödel's second theorem).

The general idea of Gödel’s proof is quite clear – to build some formula ***A*** *unresolvable* in the system of (Peano) formal arithmetic. The problem of *resolvability* (*Entscheidungsproblem*) had interested mathematicians due to *Grundzüge der Theoretischen Logik* (Fundamentals of Theoretical Logic), published by David Hilbert and Wilhelm Ackermann (1928). According to the definition, if ***A*** is an *unresolvable* formula then both ***A*** and non-***A*** (the negation of ***A***) are unprovable. (We cannot say which of them is true). On the other hand, according to the law of excluded middle we have “***A*** or non-***A*”,** one of these two should be true. These means that there is a truth (***A*** or non-***A***) that is unprovable in the system of formal arithmetic. In short, Gödel's theorem proved that the system of that formal arithmetic is *incomplete*. It showed that formalism is depending on the given axioms of the given system, it is not a simple set of deduction/inference rules and by eventually adding new axioms the given system is still incomplete. Meaning, the Peano Arithmetic axiomatic system is/must be consistent – otherwise it is not useful – but it is not necessarily complete, and one cannot demonstrate that it is both consistent and complete, one cannot prove within the PA neither a true statement about PA consistency (first theorem) and nor that there is not a statement that asserts both *A* and ~*A*.

However, besides the idea and ingenious demonstration of Gödel's theorems there are some aspects which may rise some discussions.

First, Gödel proved his theorem by constructing in formalized arithmetic some formula **G** that is true but unprovable in Peano Arithmetic/from the axioms of *this* system, the result being the inconsistency of this arithmetic system. And here's the puzzling detail: when interpreted meaningfully, formula **G** means: "Formula **G** states that formula **G** is unprovable". In the formula **G** only one predicate is used – "provability" – as possible to be formalized in arithmetic. This fact unambiguously implies that the formula **G** belongs to the theory of proof, part of the same formalized system, but not of the same arithmetic theory. Thus, considering this aspect, it turns out that Gödel's theorem proves also the incompleteness of Gödel's formalized proof theory, besides that of formalized arithmetic.

Secondly, Gödel built his system of formalized arithmetic, including his fundamentally important formula, with the help of a special numbering invented by him and called *Gödel numbering*. Briefly, the essence of the Gödel numbering is as follows: each predicate, each symbol, each formula, and each expression of the formal language of arithmetic is assigned a distinct number, due to which the formalized system becomes arithmetized. It was with the help of the special numbering invented by him that Gödel was able to construct his formula **G**, which asserts its unprovability. Expressions that state something about themselves are called self-referential. Very close to Gödel's self-referential formula is the well-known from antiquity paradoxical formulation "The proposition **L** states that the proposition **L** is false" (the Liar's paradox). The paradoxical statement **L** generates a contradiction – both the statement **L** and its negation ~**L** turn out to be provable. Moreover, since the middle of the last century, mathematicians have recognized that all the paradoxes identified in the foundations of mathematics arise precisely because of the self-referentiality of the expressions used. Accordingly, there is a serious possibility of the emergence of a new paradox – a paradox at the level of the meta demonstration – generated by Gödel's self-referential formula.

Alfred Tarski proved in 1933 a theorem according to which in the first order formal arithmetic the concept of truth is *not definable* using the expressive means that formal arithmetic affords. If the formal arithmetic would contain a predicate **Tr** that in its informal interpretation means "to be **True"** then one could build with the help of Gödel numbering a "liar" paradox type formula $S \leftrightarrow \neg True(g(S))$ where g is Gödel's number of the formula *S*. The interpretation of the formula *S* in the informal arithmetic means "*S* says S is false" – an exact expression of the "liar" paradox (Tarski, 1983).

Yet, revealing a "liar" type paradox in the system of Gödel's arithmetized metalogic, Alfred Tarski suggested a very mild conclusion: truth is undefinable in formal languages (Tarski, 1983; Hodges, 2018). Actually, Alfred Tarski has revealed that formal theory with arithmetized metalogic is contradictory in the sense that one can build in this system a formula that in its informal interpretation expresses "liar" paradox $S \leftrightarrow \neg True(g(S))$. According to metalogic approach, revealing a paradox in a formal system one should conclude that this formal system is contradictory (Baaz et al, 2011; Fereiros, 2008).

We would like to mention also that even the mild interpretation of Tarski's theorem as of undefinability of the truth in formal systems is essentially damaging the concept of formal (arithmetized) metalogic. Not having the predicate truth in a formal metalogic (it is present only in the arithmetic formal systems), one cannot judge either on completeness, or the consistency of a formal system. Then what is the use of such a metalogic system?

What was Gödel’s reaction to the difficulties revealed by Tarski’s theorem? There was no single comment on Tarski’s undefinability theorem in any of Gödel’s published articles (Wang, 1997).

A. Tarski proved his theorem using Gödel numbering. Until there will be suggested a proof for Tarski's undefinability theorem without using Gödel numbering the opponents of self-referential sentences would insist that the undefinability of truth is caused by Gödel numbering.

5. Non-correct definitions as the main source of paradoxes

The whole problem of consistency, “perfection” of an axiomatic theory nests in its definitions. It is enough to use one unfortunate (fraught with paradox) notion in a fundamental theory for generating a corresponding paradox and starting panic in this science. For some reason, scientists and analysts do not notice that the paradox concerns only this concept and relevant judgments, while theory as a whole does not “care” about this paradox. We mean that specialists continue to study and develop this theory, being convinced that sooner or later researchers will be able to resolve the revealed paradox. For example, Russell himself, who discovered the paradox in connection with the concept of the "set of all sets" in 1903, already in 1910 proposed in the first volume of the *Principia Mathematica* a "theory of types" to exclude the possibility of the appearance of the said paradox precisely by limiting the applicability of the concept "set of all sets".

An axiomatic theory is built from three main parts: a small group of initial statements of the theory – axioms; a small group of logical rules for deriving consequences from available statements (premises); and an unlimited group of definitions of notions formulated as the theory unfolds.

It is implicitly assumed that axioms are either self-evident or that they have earned their high status of a basic statement by the fact that many important statements of the theory are deduced with their participation. Yet, let us assume that there is a doubt about certain axiom of a sufficiently developed theory as of a potential source of a paradox. But since we are talking about a fairly developed theory, the suspected axiom, among other axioms, had multiple cases of use in the derivation of new statements of the theory. This means that the defectiveness of the considered axiom should have manifested itself many times. The history of sciences demonstrates that theories face only single cases of paradoxes. This proves that the axioms of a sufficiently developed theory should not be considered as the cause for the appearance of a paradox in this theory.

It must be borne in mind that the "immunity" of the axioms of proven theories in relation to paradoxes does not extend to their resistance to new, previously unknown facts. The appearance of principally new facts that contradict this axiom means only the fallacy, and not the internal inconsistency of this axiom. The new observational data obtained with the help of telescopes, combined with the laws of Newtonian mechanics, refuted the postulate of geocentrism and the entire Aristotelian model of the universe. However, the postulate of geocentrism was not self-contradictory and did not lead to paradoxes. Conversely, the expression "This statement says it is false" and similar expressions such as Russell's paradox are self-contradictory and generate paradoxes independently of any facts.

Similarly, rules of logical inferences are also a small group of rules. Since we are considering a sufficiently developed axiomatic theory, each of the inference rules has already been repeatedly used in the proofs of the theorems of this theory. If some logical rule of inference were so defective that it could generate a paradox, then dealing with a highly developed theory and the intensely use of its inference rules, many paradoxes should have arisen, while paradoxes in the history of scientific theories are single cases only.

The axiomatic method of constructing of a theory, namely, especially, the unambiguous definition of all the concepts of a given theory, also excludes the possibility of a logical contradiction due to the ambiguity of the natural language used. Just the fact of defining each notion of an axiomatic theory eliminates the ambiguity of the language used. This means that the criticism of the use of natural languages in axiomatic theories is, in fact, pointless. It is the obligatory definition of each term (notion) in the axiomatic formulation of the theory that eliminates the very possibility of errors and contradictions due to the use of a natural language.

The situation with paradoxes is not saved by the formalization of the theory, the transition from carrying out proofs in natural language to purely formal transformations of the statements of the theory, written down as a purely symbolic expression (a sequence of letters and other signs). The very procedure of rewriting the meaningful definitions of a non-formal theory into the symbolic language of a formalized theory is performed mechanically, following the rules of the given formal theory. At the same time, *if there is some inadequate (unspecified) definition of a term in the original non-formal theory, then this defect of the definition will be accurately reproduced in the corresponding symbolic notation of the formalized theory*. In this case, a definition is so “bad” that in the original non-formal theory it implies a *truth value* paradox, so the same paradox will reappear also in the formalized theory as a *provability* paradox.

This means that the formalization of a *non-formal* axiomatic theory cannot give anything positive aimed to securing its consistency. The axioms have to be restated.

In the case of Gödel's arithmetic formalization, the latter studies of formalized systems raised the problem of the means to give useful solutions either in the aspect of eliminating the appearance of local paradoxes, or in the aspect of the possibility of proving the consistency of mathematical theories. We believe that the lack of content of formalized theories cannot significantly damage the development of mathematical sciences, but it can disorientate young researchers toward neglecting aspects of definition in the formalization of axioms and theorems.

Conclusions

The above analysis has revealed three main concepts of formalism:

A. Formalism as an approach for eliminating paradoxes in foundations of mathematics,

B. Formalism as a program for consistency proof by vary means,

C. Formalism as a concept of total arithmetization of a formal theory.

All of these options were developed in the name of creating an impeccable, “ideal” version of the axiomatic theory, but apparently, the axiomatic construction of the theory is not subject to further improvement. In the axiomatic theory, problems and paradoxes arise mainly due to the unsuccessful, inadequate definition of a notion.

The first approach presumed that by eliminating natural language from the means of scientific research and argumentation will eliminate the very source of paradoxes. Actually, the elimination of natural language was carried out by rewriting expressions in natural language into the symbolic language of the formalized theory, following its predetermined rules. As shown above, if there is some inadequate (disproportionate) definition in the original content theory, then this defect will also be reproduced in the corresponding symbolic notation. That is, the formalization of the axiomatic theory by the elimination of natural language and symbolization of a theory cannot give anything positive in terms of the emergence of contradictions and paradoxes.

Hilbert’s research program of proving mathematics consistency by finitary methods presumes that researchers are able to find out in some way the indicators of any statement provable in mathematics, which is completely non-realistic, and Gödel demonstrated this.

According to Tarski's theorem, in any interpretation of a formal system using the predicate “to be true”, we will unavoidably express the liar paradox. But in science it is impossible to abandon the truth. Without the truth, there could be no scientific knowledge. Judging about a formalized system by its “purely” formal (arithmetized) meta-logic is an attempt of judging about the chains of symbols using the chains of equally meaningless symbols.

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SISTEME DEPARTE DE ECHILIBRU – EVOLUȚIE ȘI IREVERSIBILITATE

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ABSTRACT:
In this paper my aim is to offer a philosophical reconstruction of the transition from the concept of deterministic system to that of systems far from equilibrium, simultaneously with the change of the framework of presuppositions specific to a deterministic metaphysics with that of a probabilistic metaphysics. The "naturalization" of the system concept has led scientists to be concerned with identifying and describing so-called natural systems. The deepening and expansion of research, first in physics, by moving from mechanics to thermodynamics, then by moving from the physical world to the living world and to society, brought into focus the concept of a self-regulating system, later on that of a system far from equilibrum. This is how we arrived at the analysis of irreversible, non-linear processes, characterized by bifurcations and restructuring. Contemporary science has assimilated this new conceptual scheme that provides good epistemological guidance in complexity research.
KEYWORDS: natural system, self-regulating system, far-from-equilibrium system, determinism, "Laplace's demon", probabilist metaphysics.

Motto
„O aruncare de zaruri nu poate aboli hazardul"
Mallarmé

Cuprins

1. Introducere. Miza cercetării

Scopul argumentativ pe care îl urmăresc în această lucrare este să arăt că noțiunea de sitem a avut un rol mai important decât se crede în trecerea de la știința modernă de tip galielo-newtonian la știința contemporană din perspectiva asumării unui cadru supozițional specific. Modelul teoretic orginar al științei moderne este substanțialist, mecanicist, reductiv și convergent. Din perspectiva fizicii de tip galileo-newtonian natura este materie inertă, spațiul este omogen și izotrop, corpurile sunt în relații de exterioritate unele cu altele și cu mediul lor extern, iar mișcarea este concepută ca rezultat al împingerii sau tragerii, ca efect al acțiunii și reacțiunii. Lumea este asemenea unui mecanism cauzal și determinist. Așa cum afirmă Suppes, metafizica subiacentă științei moderne de tip galileo-newtonian este susținută de câteva principii de bază:

„1. Viitorul este determinat de trecut.

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2. Orice eveniment are o cauză determinantă suficientă.

3. Cunoașterea trebuie să se întemeieze pe certitudine.

4. Cunoașterea științifică poate, în principiu, să fie adusă până la nivelul de cunoaștere completă.

5. Cunoașterea și metoda științifică pot fi, în principiu, unificate."[2]

Această perspectivă deterministă solidarizează știința și filosofia modernă, iar acestea se potențează reciproc în strategiile lor explicative, astfel încât știința modernă este ghidată de la un nivel profund de presupozițiile filosofice, iar filosofii extrag din teoriile și experimentele științei moderne exact acea viziune și acel stil explicativ care corespund așteptărilor lor. Rezistența la schimbare și inerția vor fi generate de această dualitate reflectivă a angajamenteleor fiecărei părți, știință și filosofie.[3]

Această viziune deterministă asupra lumii este cel mai elocvent expusă de Laplace prin experimentul său imaginar din Eseul filosofic asupra probabilităților din anul 1814: „Să ne imaginăm o Inteligență care ar cunoaște la un moment dat toate forțele care acționează în natură și poziția tuturor corpurilor din care constă lumea; să presupunem, în continuare, că această Inteligență ar fi capabilă să supună toate aceste date unei analize matematice. Atunci s-ar putea obține un rezultat care ar cuprinde în una și aceeași formulă mișcarea celor mai mari corpuri din univers și a celor mai ușori atomi. Nimic nu ar fi incert pentru această Inteligență. Trecutul și viitorul ar fi prezent în ochii lui."[4]

Modelul teoretic revizuit este relaționist, sistemic, holistic, divergent și probabilist. Părțile unui întreg sunt în relații de interdependență, iar întregul ca totalitate structurată are propriile caracteristici ireductibile. Schimbările din sistem nu sunt numai modificări ale proprietăților substanțiale ale individualelor, ci și ale țesăturii relaționale în ansamblu și ale sistemului ca întreg. Cu atât mai mult, dezvoltările ulterioare ale conceptului de sistem, mai cu seamă prin analiza dinamicii sistemelor aflate în stări care pot fi caracterizate drept departe de echilibru, au dus la noi tematizări care au favorizat o nouă perspectivă asupra lumii ca totalitate.

Principiile unei metafizici probabiliste, așa cum sunt ele sistematizate de Suppes, duc la configurarea unei alte imagini asupra lumii în sensul tradițional de *Weltanschauung*, la noi orizonturi de așteptare și la deschideri inovatoare ale programelor de cercetare științifică:

„1. Legile fundamentale ale fenomenelor naturale au în esență mai curând un caracter probabilist decât unul determinist.

2. Concepția noastră despre materie trebuie să conțină un element probabilistic intrinsec.

3. Cauzalitatea are un caracter probabilist, nu unul determinist. Prin urmare, nu există incompatibilitate între aleatorul din natură și existența legilor cauzale valide.

4. Certitudinea cunoașterii – în sensul carcaterului psihologic nemijlocit, în sensul adevărului logic sau în sensul preciziei totale a măsurătorilor – este irealizabilă.

5. Colecția teoriilor științifice trecute, prezente și viitoare nu converge către un rezultat fixat inevitabil care să ofere, la limită, o cunoaștere completă a Universului.

6. Științele se caracterizează, în ce privește limbajul, obiectul și metoda, mai curând prin pluralism decât prin unificare."[5]

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[2] Suppes, 1990, p. 60.

[3] Pentru o discuție pe larg a relației dintre știință și filosofie din această perspectivă, vezi Frank, 1957.

[4] Laplace, 1902, p. 4.

[5] Suppes, 1990, pp. 71-72.

În acest studiu mă limitez la analiza unui singur aspect al noii imagini asupra lumii, și anume, la conceptul de sistem așa cum acesta a fost redefinit și a început să fie utilizat în știința cotemporană, în condiție de diferență față de știința modernă de tip galileo-newtonian.

2. „Naturalizarea" mecanicistă a conceptului de sistem

Dacă urmărim istoric filiera etimologică a conceptului, așa cum acesta transpare ideatic în trecerea de la *σύστημα* din greaca veche la latinescul *systema*, atunci este evident că primează un înțeles compozițional de tip mereologic care vizează relațiile dintre întreg și părțile sale așa cum acestea sunt gândite sau înțelese. Filosofii din antichitatea greacă exersau analiza decompozițională în diverse modalități, de la alunecarea divizivă platoniciană spre notele unui concept la rigoarea reductivă de tip aristotelic probată în edificarea silogisticii și în teoria sa asupra științei demonstrative. Nu trebuie să lăsăm deoparte nici modul euclidian în care elementele geometrice vor fi sistematizate unitar într-o teorie consistentă.

Totuși, abia modernitatea, începând chiar cu Descartes, în continuarea integralismului viziunii scolastice, va propune sistematizări filosofice din ce în ce ambițioase, ajungându-se, în cele din urmă, o dată cu Hegel, la filosoful creator de sistem. În acest sens, urmând strategia interpretatitvă dezvoltată de Foucault în *Arheologia cunoașterii* pornind de la conceptul explicativ de epistemă, voi considera că înclinația spre sistemicitate a modernității nu trebuie considerată drept un tip de raționalitate prin care este atinsă unitatea tematică, ci se regăsește sub forma unor regularități discursive care pun în relație de asemănare diverse practici care au scopuri specific cognitive.[6]

Așadar, la începuturile modernității, sistematizarea vizează cu precădere domeniul ideilor, în sensul spinozian al lui *more geometrico*, singurul model sistemic natural revendicat inițial de modernitate prin revoluția științifică fiind cel cosmic al sistemului planetar, de unde și tentația spre o analogie cu ordinea cosmică considerată perfectă în sensul unei arhitectonici matematice care poate fi explicată rațional. Galilei utilizează noțiunea de „sistem" în acest sens în celebra sa lucrare *Dialog asupra celor două sisteme principale ale lumii*, oferind astfel un nou model explicativ, diferit de raționalitatea de tip geometric pe care a operaționalizat-o Euclid.[7]

Probabil că primul angajament explicit din istoria științei spre o sistematizare a naturii ca proiect de cercetare este reprezentat de celebra lucrare *Systema Naturae*, cu prima ediție publicată în anul 1735, a botanistului și zoologului Carolus Linnaeus, în care acesta sistematiza, folosind o nomenclatură binomială, întreaga natură și propunea o ordine completă a regnurilor, claselor, ordinelor, genurilor și speciilor pornind de la caracteristici, diferențe și asemănări.[8] Dar o astfel de perspectivă sistematizatoare asupra naturii nu schimbă nimic din presupozițiile ontologice de tip substanțialist care veneau de la Aristotel. Diversele specii sau genuri erau văzute asemenea unor

[6] Foucault face următorul comentariu cu privire la semnificația epistemei: „Ceea ce se înțelege, în fapt, prin epistemă este ansamblul relațiilor care pot să unească, într-o epocă dată, practicile discursive care dau naștere unor figuri epistemologice, unor științe și, eventual, unor sisteme formalizate... (...) Epistema nu este o formă de cunoaștere sau un tip de raționalitate care, traversând științele cele mai diverse, ar manifesta unitatea suverană a unui subiect, a unui spirit sau a unei epoci; ea reprezintă ansamblul relațiilor ce pot fi descoperite, pentru o epocă dată, între științe atunci când acestea sunt analizate la nivelul regularităților discursive." (Foucault, 1999, p. 235).
[7] Pentru o analiză de detaliu privind tipul de explicație rațională propusă de Galilei, înțeleasă ca alternativă la demonstrația geometrică, vazi Pitt, 1988.
[8] Titlul ediției a zecea a cărții este elocvent: „Systema naturæ per regna tria naturæ, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis". Proiectul va fi reluat și consolidat de Contele de Buffon în a sa *Istorie naturală*.

entități compacte care se află unele cu altele în relații externe de diferență sau similaritate. Mai mult decât atât, într-o arhitectură perfectă a Creatorului, acest sistem al naturii era caracterizat prin imobilism, în sensul fiximului speciilor care îl alcătuiau, bazându-se pe presupoziții esențialiste. O taxonomie este în acest sens o construcție a cercetătorului prin care acesta încearcă să redea caracteristicile sistemului natural, dar atâta timp cât această construcție este o aproximare subiectivă, ea are un carcater de artificialitate. În acest sens, sistemul natural propus de Linaeus este deopotrivă un sistem artificial.[9] De fapt, metoda naturală propusă de Linnaeus viza stabilirea unor relații de echivalență între specimene pentru a se ajunge astfel la o imagine asupra lumii naturale înțeleasă ca un sistem complex de genuri și specii. Presupoziția tacită era aceea că există o ordine naturală care trebuia dezvăluită.

Pasul decisiv spre „naturalizarea” conceptului de sistem presupunea mult mai mult, și anume, considerarea a însăși corpurilor (entităților substanțiale) drept sisteme de elemente care interacționează și au o dinamică procesuală internă specifică. Doar o asemenea abordare putea duce la introducerea conceptului de sistem în cercetarea dinamicii proceselor din științele naturii. Această trecere de la noțiunea de sistem înțeleasă ca totalitate de elemente aflate în relații reciproce externe la analiza entităților naturale, cu statutul ontologic al unor individuale, ca sisteme cu sturctură internă a fost făcut în secolul al XIX-lea o dată cu cercetările de pionierat în domeniul termodinamicii făcute de Sadi Carnot. Acesta analizează motorul cu abur ca un sistem de elemente aflate în relație și interacțiune care formează un întreg unitar întrucât funcționarea întregului se bazează pe anumite reguli care țin de structura sistemului ca întreg. Asfel, vaporii de apă dintr-un cazan pot fi în contact cu piston pe care îl vor împinge în funcție de puterea energetică a sursei de căldură. Carnot imaginează o asemenea mașină termică ideală cu funcționare ciclică. Rudolf Clausius va generaliza această imagine și va lua în considerare și mediul extern sistemului, atât în privința relațiilor funcționale cât și a influențelor exercitate asupra sistemului ca atare.

Prin aceste cercetări este configurat conceptul de sistem și sunt identificate principalele sale caracteristici, și anume, structuralitatea, funcțiile specifice, comportamentul, relațiile interne și interconectivitatea cu mediul. Totuși, deși prin cercetarea mașinii termice Carnot sesizează diferențele dintre aceasta și mașina mecanică, el reduce studiul mașinilor termice la modelul mașinilor clasice care transformă mișcarea sau o transferă altor corpuri și le descrie în concepte ale mecanicii clasice precum conversia și conservarea după modelul unui ciclu perfect de tip determinist laplacean. Căldura este văzută substanțialist, asemenea unui fluid, astfel încât transferul de căldură poate fi conceput mecanic. Totuși, idealizările cu care se începe să lucrează iau în considerare și aspecte ale ireversibilității proceselor, apărând așa numita problemă a pierderilor. În acest sens, s-ar putea spune că, prin formularea cosmologică a principiilor termodinamicii, „Energia lumii este constantă” și „Entropia lumii tinde spre un maximum”, deși Clausius nu definește procesele ireversibile, le recunoaște existența. Aceasta înseamnă implicit că este recunoscută o problemă irezolvabilă în cadrul de gândire acceptat. Cel mult, și lucrul acesta îl face Boltzmann cu principiul său de ordine, se pot defini structuri specifice stărilor de echilibru, stări pe care la nivel sistemic, adică macroscopic, le putem înțelege statistic, asemenea unei rezultante a stărilor constituenților elementari.

[9] Pentru o prezentare pe larg a acestor aspecte privind dihotomia dintre empiric și logic în folosirea metodele de clasificare în sistematizarea propusă de Linaeus vezi Müller-Wille, 2013.

Russell sintetizează într-un articol publicat inițial în anul 1912[10] această perspectivă deterministă asupra noțiunii de sistem. Acesta definește noțiunea de sistem determinist pe baza conceptului de relații funcționale dintre componentele sistemului și consideră că un asemenea sistem poate fi considerat „practic izolat” pe un anumit interval de timp dacă se comportă constant, indiferent care ar fi starea universului. Un exemplu dat de Russell este sistemul psihofizic reprezentat de minte și creier, caz în care avem o relație funcțională între stări ale minții și stări ale creierului și putem să le înțelegem pe cele dintâi în relație cauzală cu stările creierului, făcând abstracție de alte condiții de stare ale universului. Un contemporan al lui Russell remarcă într-un comentariu faptul că un sistem determinist, considerat practic izolat și analizabil pe baza relațiilor funcționale interne, va putea fi caracterizat pe baza unor parametri pur cantitativi în sensul că orice calitate a acestuia este teoretic măsurabilă.[11] Ca urmare, noțiunea de sistem determinist, corelată cu modelul explicației prin subsumare la legi și cu strategiile reducționiste inspiratăe de viziunea mecanicistă, devine nucleul generator al teoretizărilor din orice domeniu al cercetării științifice.

3. O schimbare de perspectivă: sisteme cu autoreglare

O încercare de a reconsidera filosofic conceptul tradițional al cauzalității și, prin consecință, a noțiunilor de sistem și explicație deterministă, pornind de la noile cercetări din știință este propusă de Rosenblueth, Wiener, Bigelow, în studiul „Comportament, scop și teleologie”.[12] Deși ei lucrează cu un concept al cauzalității ambiguizat prin utilizarea lui cvasi-simultană în două contexte, în unul în care este distins de cel de finalitate și în altul în care își propun explicit să definească finalitatea cu ajutorul noțiunii de cauzalitate și o fac prin introducerea noțiunii de *feedback negativ*, consider că rezultatul care merită luat în considerare ține tocmai de înțelegerea finalității ca o înlănțuire de sisteme cauzale, ceea ce în sens semantic duce la o ambiguitate sistematică, deloc periculoasă, ci cu un potențial explicativ considerabil.

Să considerăm drept exemplu cazul unui radiator cu termostat. Dacă un radiator aflat într-o cameră este pus în funcțiune, acesta va ridica temperatura aerului din incintă atâta timp cât va funcționa, presupunând că celelalte condiții rămân constante. Radiatorul este factorul cauză, iar efectul este creșterea temperaturii. Să presupunem că funcționarea radiatorului este corelată cu un alt sistem, un termostat, care are rolul de a porni sau opri radiatorul în funcție de temperatura aerului din cameră, altfel spus, va produce corecții în funcție de nivelul de temperatură pentru care a fost reglat termostatul. Cele două sisteme funcționează în relație unul cu altul, ceea ce înseamnă că, aparent, factorul cauză din primul sistem și factorul efect din cel de al doilea se vor afla într-o relație teleologică. Totuși, susțin cei trei, ambele sisteme funcționează de fapt ca sisteme cauzale în sensul că în ambele cazuri putem identifica anumite condiții inițiale care au statutul de factori cauzali care produc efectele corespunzătoare, iar această relație poate fi explicată prin legi cauzale pe care le putem înțelege în sensul dat de Hempel legilor de acoperire. Altfel spus, în viziunea lui Rosenblueth, Wiener și Bigelow, comportamentul teleologic devine similar cu comportamentul controlat prin feedback negativ, iar acesta din urmă poate fi descris în termenii interacțiunii cauzale a două sisteme care operează în tandem.

[10] Ulterior, a fost introdus în volumul *Mysticism and Logic*, apărut în anul 1918. Pentru versiunea în limba română vezi Russell, 2011.
[11] Richardson, 1919, p. 53.
[12] Vezi Rosenblueth, Wiener, Bigelow, 1943.

Reacțiile stârnite de publicarea articolului, în special polemica lor cu Richard Taylor, sunt exemplare. Acesta consideră că perspectiva din care cei trei consideră funcționarea sistemelor este una reducționistă de tip mecanicist și că ar fi inadecvată descrierii funcționării unor sisteme teleologice, mai precis, feedback-ul negativ recuperează doar aspectele cauzale și nu surprinde specificul unui proces caracterizat prin finalitate, îndreptat spre un scop.[13] În răspunsul lor la criticile lui Taylor, Rosenblueth și Wiener arată că o asemenea critică ar fi îndreptățită doar pentru cazul unor sisteme rigide de tip newtonian. Astfel, dacă luăm în considerare un asemenea sistem rigid, compact și omogen, care nu admite grade și probabilități, din perspectiva cauzalității, atunci, într-adevăr, îl vom gândi dintr-o perspectivă deterministă, reducționistă și mecanicistă, în sensul că orice stare viitoare a sistemului este determinată de stările sale anterioare din trecut. Drept urmare, într-un asemenea sistem newtonian introducerea cauzei sau a scopului nu produce niciun fel de consecințe operaționale. Cei doi conchid: „Astfel, dacă aderăm la categoriile newtoniene, critica profesorului Taylor asupra folosirii noțiunii de scop pare legitimă, dar această critică este aplicabilă în egală măsură noțiunii de cauză, categorie pe care el o acceptă și o folosește în mod liber."[14]

Cred că atractivitatea analizei pe care Rosenblueth, Wiener și Bigelow o fac explicației teleologice constă în continuitatea ei în raport cu modelul tradițional al explicației prin subsumare la legi, față de care explicația cauzală este doar un caz particular. Drept urmare, indiferent de tipul de explicație teleologică pe care o avem în vedere, de la comportamente teleogice la activități intenționale, aceasta este reductibilă, în cele din urmă, la o formă de explicație cauzală de tipul feedback-uluii negativ. Aceasta înseamnă că orice sistem care are capacitate de autoreglare, ori orice sistem homeostatic, poate fi analizat în termenii feedback-ului negativ ca o înlănțuire de sisteme cauzale. Se consideră că finalitatea este astfel explicată cauzal, iar acest model explicativ poate fi generalizat asupra tuturor sistemelor cu mecanism de control și coordonare, inclusiv asupra ființelor vii: „Credem că oamenii și alte animale sunt asemenea mașinilor din punct de vedere științific, deoarece credem că singurele metode fructuoase pentru studiul comportamentului uman și animal sunt metodele aplicabile și comportamentului obiectelor mecanice. Astfel, principalul nostru motiv pentru selectarea termenilor în cauză a fost să subliniem că, *înțeleși ca obiect de cercetare științifică, oamenii nu diferă de mașini*."[15]

Din punct de vedere filosofic se poate afirma că modelul explicativ al finalității pe baza noțiunii de feedback negativ reprezintă o continuare a perspectivei tradiționale deterministe de tip galileean asupra naturii. Pe de altă pafrte, proiectul pozitivist al unității științei și al monismului metodologic, care presupunea o perspectivă reducționistă asupra științelor, în sensul dominației normative a modelului fizicalist, este instanțiat exploratoriu în științele omului, consecința imediată fiind abordarea behavioristă în științele comportamentului și transformarea ciberneticii într-un panaceu explicativ al complexității. Dar o asemenea perspectivă nu doar că intra în conflict cu pluralismul metodologic asumat filosofic și științific de avangarda cercetării, ci și cu o viziune calitativă asupra lumii în diversitatea și complexitatea ei.

Din perspectiva noilor direcții de cercetare din științe dezvoltate în prima jumătate a secolului trecut devenea evident că nici modelul termodinamic al sistemelor aflate în echilibru și nici modelul cibernetic al sistemelor cu feedback negativ nu reușeau să elucideze explicativ nu doar aspecte ale funcționării lumii vii, așa cum ar fi interacțiunile de la nivel celular, dar nici chiar fenomene fizice caracterizate prin dinamism și instabilitate, precum cele meteorologice, în cazul

[13] Vezi Taylor, 1950a, 1950b.
[14] Vezi Rosenblueth, Wiener, 1950, p. 320.
[15] Rosenblueth, Wiener, 1950, p. 326

cărora fluxurile cu exterioritatea sunt inevitabile. De aici și tentația de a izola sistemele, de a le considera închise, și de a le cerceta făcând abstracție de schimbările generate de interacțiuni externe. Este încă activă presupoziția că lumea poate fi descrisă coerent și complet ca lume închisă și că scopul final al științelor teoretice ale naturii este de a descoperi cauzele ultime și imuabile ale fenomenelor naturale. Sistemele sunt ordonate, uniforme și deterministe, iar lumea poate fi descrisă și înțeleasă prin simetire și reversibilitate după modelul dinamicii newtoniene în care mişcarea nu este nimic altceva decât o schimbare măsurabilă a poziției corpurilor.

Critica decisivă a acestei abordări care subzistă cel puțin în stil convenționalist și în noile concepte de sisteme carcaterizate prin echilibru statistic sau prin capacitate de autoreglare pe baza feedback-ului negativ este întreprinsă, în opinia mea, de biologul Ludwig von Bertalanffy[16] în teoria sa generală a sistemelor în care propune noțiunea de sistem deschis și introduce un model generalist, valabil pentru orice sistem, indiferent de natura elementelor componente, a relațiilor și a forțelor constitutive. Von Bertalanffy consideră că noțiunea fizicalistă de sistem închis este inaplicabilă sistemelor vii, dinamice, caracterizate prin trecerea evolutivă de la un stadiu la altul, deschise spre exterior. În acest sens, cred că punctul tare al abordării sale îl reprezintă capacitatea de a formula o nouă teorie care asimilează ceea ce se poate adecva din veche teorie. Astfel, orice sistem deschis poate atinge o stare de echilibru dinamic, o așa-numită „stare staționară”, situație în care sistemul ca întreg rămâne în ireversibilitate și, în același timp, evoluează prin fluxul continuu de materie, energie și informații. Acest model va fi aplicat pe scară largă în diverse domenii, dar și interdisciplinar, dovedindu-se eficace în înțelegerea complexității lumii. Von Bertalanffy a carcaterizat starea de echilibru a unui sistem complex deschis în termenii entropiei ca un proces de producție de entropie minimă cu scăderea entropiei generale a sistemului, ceea ce duce la stabilitatea sistemului. De aici vor continua cei ce vor dezvolta teoria sistemelor prin schimbarea paradigmatică pe care o va presupune conceptul de sistem aflat departe de echilibru.

Dacă ne situăm într-o perspectivă ontologică, atunci putem caracteriza drept sisteme teleologice, cu condiția unei minime complexități structurale dată de o funcție de finalitate, atât individualele, cât și orice totalități constituite prin relaționarea unor individuale ori a altor sisteme anterior configurate. Dintr-o asemenea perspectivă generalizatoare, putem deosebi între teleologia *proceselor*, a *formelor* și a *întregilor*.[17] Ulterior, au fost propuse și abordări care țineau cont de direcțiile de înaintare ale programelor de cercetare din știința contemporană. Astfel, Von Wright[18] divizează domeniul tradițional al teleologiei în două subdomenii pornind de la sfera aplicabilității noțiunilor explicative, unul caracterizat pe baza noțiunilor de *funcție, scop (*finalitate) și *totalități organice* („sisteme”), celălalt descris adecvat prin noțiunile de orientare spre țintă și finalitate. Desigur, avem suprapuneri între domenii, chiar dacă s-ar putea argumenta consistent că funcția și scopul sunt noțiuni specifice domeniului biologiei, în timp ce intenționalitatea aparține domeniilor istoriei, al cercetării societății și al științei comportamentului.

În filosofia biologiei s-a discutat productiv despre specificitatea proceselor biologice înțelese dintr-o perspectivă teleologică. Astfel, Francisco Ayala deosebește între trei tipuri de sisteme teleologice în biologie:

1. Sisteme a căror stare finală sau scop este anticipat în mod conștient de către agent,

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[16] Vezi von Bertalanffy, 1975. Acest volum conține studiile cele mai semnificative din punct de vedere filosofic.
[17] Această distincție este propusă de Nicolai Hartmann, 1951, pp. 7-8. Vezi și Smith, 1954, privind receptarea noii ontologii propusă de Hartmann.
[18] Von Wright, 1995, p. 38.

2. Sisteme cu autoreglare,

3. Structuri desemnate în mod anatomic și fiziologic să îndeplinească o anumită funcție.[19]

Ulterior, Ayala[20] va argumenta pe larg că biologia evoluționistă utilizează atât un limbaj teleologic cât și explicații teleologice, fapt care este îndreptățit de vreme ce explicațiile teleologice sunt ipoteze care pot fi supuse testării empirice. Caracteristica distinctivă a unei ipoteze teleologice este aceea că ele explică existența unei trăsături în termenii funcției pe care o îndeplinește. Un exemplu simplu ar fi acela al aripilor păsărilor, aripi care au evoluat și s-au menținut ca atare deoarece zborul este avatajos pentru păsări prin aceea că le crește șansele de a supraviețui și a se reproduce. În acest sens, explicăm diversele caracteristici biologice ale organismelor pe baza unor ipoteze teleologice care se referă la structuri anatomo-fiziologice, așa cum sunt aripile, ori la procese, așa cum este dezvoltarea unei păsări de la stadiul de ou la cel de adult, ori comportamente, așa cum este construirea de cuiburi. În toate aceste cazuri sunt luate în considerare procese care tind spre un echilibru biologic, spre o stare de bine în sens evoluționist, adică una care permite supraviețuirea și continuitatea speciei într-o anumită nișă biologică. Totuși, și în cazul acesta, chiar dacă ordinea este pusă în relație cu procesualitatea, se lucrează cu un concept al transformărilor lieneare care duc spre o stare de ecgilibru.

4. O schimbare de paradigmă: „exorcizarea demonului lui Laplace"

Schimbarea de paradigmă se produce abia după acumularea a numeroase anomalii în științele naturii, în fizică și în biologie, în raport cu modelul explicativ centrat pe linearitate, ordine și echilibru. Folosind o expresie propusă de Schermer, această schimbare echivalează cu o „exorcizare a demonului lui Laplace"[21] în sensul trecerii de la o metafizică deterministă la una probabilistă, de la sisteme deterministe la sisteme care ajung la echilibru prin fluctuații sau la sisteme care pot fi caracterizate drept departe de echilibru. După Shermer, analiza sistemelor fizice și biologice pe baza unor modelări matematice ale comportamentului haotic și a dinamicii neliniare a devenit proeminentă în anii 1980, iar Prigogine și Stengers au contribuit decisiv la consolidarea noii paradigme prin extinderea spațiului de aplicabilitate.

Probabil că într-o istorie a acestei schimbări paradigmatice primele deschideri care au dus în direcția reconsiderării proceselor ireversibile au fost cele specifice domeniului termodinamicii de non-echilibru, o dată cu celebrele „relații de reciprocitate" ale lui Onsager. Totuși, trecerea de la termodinamica de echilibru la termodinamica de non-echilibru se făcea tot în cadrul unei termodinamici lineare, în sensul că procesele, deși disipative, duc la stări staționare care pot fi descrise independent de timp. Prigogine și Stengers sintetizează acest nou stadiu al teoriei: „Deși producerea de entropie nu este nulă, ea nu împiedică, totuși, schimbarea ireversibilă de a fi o evoluție către o stare care se poate deduce în întregime din legile generale."[22]

Dar un sistem linear, care se caracterizează printr-o stare staționară sau echilibru, poate ajunge în situația în care stabilitatea nu mai poate fi garantată. Tot în termodinamică găsim problematizările de acest tip. Întrebarea cheie sub raport euristic se configurează redutabil: cum reacționează un sistem aflat în stare staționară la diferite tipuri de fluctuații produse de sistemul însuși sau de mediul său înconjurător? Apare astfel ideea de instabilitatea sistemului, carcaterizată prin aceea că anumite fluctuații nu pot fi regresate, ci se amplifică și duc la un nivel nou calitativ.

[19] Ayala, 1970, p. 9.
[20] Vezi Ayala, 1999.
[21] Vezi Shermer, 1995.
[22] Prigogine, Stengers, 1984, p. 195.

Altfel spus, ordinea care determină echilibrul sistemului devine instabilă și produce restructurarea acestuia.

Filosofii au profitat de ocazie pentru a recupera istoric teorii vechi în care procesualitatea era concepută ca dinamism haotic, probabilist, în care hazardul avea forță ordonatoare prin fluctuații și spontaneitate. Astfel, un bun exemplu în această privință este Michel Serres, cel care se duce înapoi la Epicur și Lucrețiu pentru a recupera teoria *clinamen*-ului înțeles ca deviație spontană și imprevizibilă.[23]

Se va considera că un sistem departe de echilibru poate rămâne stabil până când se produce bifurcația sau ruptura structurală. Teoria catastrofelor prinde astfel contur și are deja un suport matematic. În cazul unui asemenea sistem nu se mai poate reveni la starea inițială, schimbările survenite sunt în acest sens ireversibile, dar sistemul își poate recăpăta echilibrul la un alt nivel prin restructurare. Marea provocare teoretică devine identificarea parametrilor de la care un sistem este atât de departe de echilibru încât nu mai poate reveni la starea inițială staționară. Acesta construct teoretic poate fi numit punctul de ireversibilitate și poate căpăta valoare numerică, ceea ce duce la predictibilitate în sensul anticipării stării sistemului față de acest moment de bifurcație și eventuală restructurare.Acest moment de bifurcație reprezintă o rupere a simetriei sistemului și poate duce la bifurcații în cascadă care duc sistemul spre starea de haos. Discuțiile actuale despre schimbările climatice se pot interpreta pe baza unei asemenea scheme categoriale și a unui vocabular probabilist din care au fost eliminate determinismele de tip laplacean.

5. În loc de concluzie. Extinderi actuale în științele sociale și umaniste

Această nouă paradigmă explicativă a teoriei sistemelor a fost exportată și fizică, chimie și biologie și extinsă în științele sociale și umaniste, precum și în interpretarea istoriei. Pe baza acestui model psihologii au examinat activitatea creierului asemenea unui mecanism stocastic, biologii au reprezentat grafic tendințele unei populații într-o nișă biologică, lingviștii au explicat formarea competențelor ligvistice și au descris probabilist ceea ce Chomsky numea „output-ul torențial", economiștii au elaborat modele de urmărire și predictibilitate a prețurilor acțiunilor și a altor jocuri bursiere, strategii militari evaluează cu ajutorul noului cadru conceptual procese de tipul izbucnirii războaielor, iar sociologii au modelat dezvoltarea haotică a orașelor și au reușit astfel să o conceptualizeze. Toate aceste procese dinamice neliniare au fost interpretate pe baza noilor teorii sau cel puțin a restructurării celor vechi.

Inclusiv înțelegerea istoriei poate beneficia acum de noul model explicativ pornind de la noțiunea de istorie a unui sistem. Aceasta nu înseamnă doar că vom accepta să vorbim despre un „haos al istoriei", ci că vom înțelege fenomenele holistic, în complexitatea lor, ca interacțiune între structuri stabile, deterministe, și dezechilibre care duc la fluctuații și bifurcații în sistem, altfel spus, vom connecta secvențele istorice într-un mod non-linear și le vom cerceta în multitudinea relațiilor lor cu împrejurările. În acest fel, așa cum sugerează Rescher, înțelegrea complexității sistemelor sociale duce la revizuirea practicilor manageriale și a procesului luării decizieiilor.[24] Noțiunile de sistem departe de echilibru și de ireversibilitate asigură astfel o mai bună înțelegere a procesualității lumii și deschid către un proiect metafizic care recuperează vechiul concept filosofic al devenirii și repune ființarea în relație cu devenirea.[25]

[23] Vezi Serres, 1977.
[24] Vezi Rescher, 1998.
[25] În acest sens, vezi Whitehead, 1969, precum și Prigogine, 1980.

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THE APOLLO-DIONYSUS MOTIF IN THE APPROACH OF CONTEMPORARY SCIENCE

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ABSTRACT:
The paper uses the Nietzsche's Apollo-Dionysus motif in order to highlight some aspects of the contemporary science. The reasons of the historical divergence and unity of the Apollonian and the Dionysian versants of science are showed, as well as the philosophical images of the crises and limits of science. The stake is the emphasis of both epistemological and social causes of the problems of contemporary science and its reverberation in society.

KEYWORDS: science, Nietzsche, Apollonian and Dionysian, Lucian Blaga, scientific discovery, system of reference, criteria, perspective perception, alternative theories, holism.

Contents

1. The motif

As it is known, Nietsche used the Apollo-Dionysus motif in an *integrative* manner. While in the Greek mythology Apollo was the god of clarity, order, thus reason with its logic emphasizing the discrete nature of things and their causal connections, and Dionysus was the god of vagueness, disorder, emotion, drunkenness, that leads to a blurry image of the continuous whole – thus being adversative symbols of adversative ontological principles – the clever insight of *The Birth of Tragedy* was that these principles intermingle both in the Greek tragedy and in the human life, including in the human knowing[2]. And obviously, this conjoining reveals the inherent and dynamic *contradictions* felt and presented by the human mind.

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[2] Friedrich Nietzsche, *The Birth of Tragedy or Hellenism and Pessimism* (1872), Translator: William August Haussmann (1910)), Project Gutenberg eBook 2016, 4, p. 41: "Apollo could not live without Dionysus!"; 15, p. 116: "There would have been no science if it had only been concerned about that *one* naked goddess and nothing else. For then its disciples would have been obliged to feel like those who purposed to dig a hole straight through the earth: each one of whom perceives that with the utmost lifelong exertion he is able to excavate only a very little of the enormous depth, which is again filled up before his eyes by the labours of his successor, so that a third man seems to do well when

These contradictions require people to be *aware* of them and thus, to control them and avoid the fall in different one-sided views about the human life and the human comprehension. Actually, Nietzsche pointed out that though the human being is a “dissonance” of contradictory tendencies, its life – that can be understood only in terms of the metaphysics of art displayed by the Apollonian and Dionysian principles – is marked by the intertwined and successive ways of treating the world in the fundamental unembarrassed creative mode (the Dionysian), but that at the same time intends to put order in things, thus to conceive the world in the disciplined articulated manner (the Apollonian) without which to approach to truth, a first painful purpose of man, is not possible. Each way contains somehow aspects of the other, and especially of its motivation, and each way shows also the opposite direction: because both ways have the same *reason to be*, beyond the peculiar ones.

2. Its correspondence in science

The Apollo-Dionysus motif was so attractive that later it was used in the philosophy of science. However, even in the last decades of the 19th century, the big pattern-creating discoveries – issued in a Dionysian way *from* the Apollonian quest for the always last causes of phenomena orderly arranged in different “ablation circles” – showed that science evolves also by exceeding the *system of reference* taken by the previous research. We are used to say that science developed toward multi-, inter-, and trans-disciplines studies[3], but a more accurate expression is that of the *multiplication of systems of reference*. Made by concepts, paradigms, theories and methods – and obviously, bibliography – the system of reference[4], possible by new means of detection and measurement[5], frames the research, giving the possibilities, the necessity, and the alternatives of reasoning in order to better understand the chosen problem.

Actually, the problem of possibilities etc. may shed light on new, exterior systems of reference only on the basis of exhaustion of the internal capacity of the assumed system of reference to provide plausible judgements, truth or falsity[6]. And certainly, we cannot see the real importance of the system of reference without underlining not only that it reflects and is based on *criteria*, chosen according to the scientific experience of researchers and the problems arisen in the inquiry of former systems of reference, but also that it is based on estimation and survey, thus *measuring* of all the elements of the scientific experience, of events and facts[7]. Their calculation, quantification, weighing and sizing should not fool us with an old, today impossible, ignorance of the *quantitative*

on his own account he selects a new spot for his attempts at tunnelling”. (Here Nietzsche considered that the principle of relay in knowledge supposes both clarity – without which it cannot be transmitted, so performed – and the emphasis of mystery, of problems and contradictions).

[3] See only Constantino Baikouzis and Marcelo O. Magnasco, “Is an eclipse described in the Odyssey?, PNAS, 105 (26), 2008, pp. 8823-8828; Axel Timmermann et al., “Climate effects on archaic human habitats and species successions”, *Nature*, 13 April 2022.

[4] We may resemble the drier scientific concept of *system of reference* with the more poetical concept of hermeneutics, *the horizon*. See Hans-Georg Gadamer, *Truth and Method* (1960), Translated by Joel Weinsheimer and Donald G. Marshall, London and New York: Bloomsbury Academic, 2006, p. 301: “The horizon is the range of vision that includes everything that can be seen from the particular vantage point”.

[5] Jan F. Simek, Stephen Alvarez, and Alan Cressler, “Discovering ancient cave art using 3D photogrammetry: pre-contact Native American mud glyphs from 19th Unnamed Cave, Alabama”, *Antiquity*, Volume 96, issue 387, 2022, pp. 662-678; Yeon-Hee Kim et al., “Observationally-constrained projections of an ice-free Arctic even under a low emission scenario”, *Nature Communications*, volume 14, 2023, Article number: 3139.

[6] In order to better show the Dionysian aspect of the living philosophy of science, see Mano Singham, *The Idea that a Scientific Theory can be 'Falsified' Is a Myth*, September 7, 2020, https://www.scientificamerican.com/article/the-idea-that-a-scientific-theory-can-be-falsified-is-a-myth/.

[7] We discern *events* – as occurrence, considered from without, as objective matters – and *facts* as involving human participation.

by the humanities facing science[8]. In reality, mensuration is taking the measure/extent/degree/proportion of the existence, thus emphasising its *qualitative* changes[9]. This is because the quality is measurable since it "consists" of signs[10].

In the second half of the 19th century, a concrete *convergence* of "Apollonian" and "Dionysian" patterns of science had room in the *qualitative* spring of science: Charles Darwin, James Clerk Maxwell, Henri Becquerel, Gregor Mendel, Louis Pasteur, Robert Koch, Justus von Liebig, Lord Kelvin, Gottlob Frege, Ray Lankester, to name only them, could not have created their paradigmatic representations of the world without the daring *transgression of ordered cognisance in given systems*: without the multi-dimensional and intersected view of old or absolutely new problems and perspectives. The 20th century shift in paradigms cannot be understood without *the epochal and founding theories and discoveries made in the late 19th century*. Even the notion of "crisis of physics" as opposition between the Newtonian and Einstein principles appeared after the demonstration of relativity and quantum physics, in the 20th century, but it was prepared in the last decade(s) of the former[11].

3. Philosophy of science: the form of the motif in Lucian Blaga

The 20th century has experienced not only both the apparent contradictions between the "Apollonian" science and the "Dionysian" one and their new convergence, but also the development of the philosophy of science around the Apollo-Dionysus motif. The birth of new paradigms, the progress of pragmatic knowledge fuelled by disciplined referencing inside carefully circumscribed areas, the limits of this type of knowledge, the problems of the possibility to surpass these limits, all of these were the philosophical topics ardently generated by the 20th century science[12]. Obviously, the philosophy of science could not escape from the straps of metaphysical philosophy, namely, from the explanation of the world and its knowledge *from principles*. Nietzsche's proposed motif arose from this type of philosophy (of course, not only from it), but this was normal in those times. And, do not forget, Nietzsche conceived of the adverse faces of knowledge in an *integrative* manner.

In the first half of the 20th century, the Romanian philosopher Lucian Blaga outlined a *dualistic* categorization of knowledge, the "paradisiacal" one (corresponding to the Nietzsche's Apollonian), the *scientific rational* knowledge, aiming at reducing the mystery of the object, and the "Luciferic" one, a *poetical-intuitive* knowledge amplifying the mystery, bringing to light the unknown, the problematic that highlights the *crisis* in the object of science and the scientific

[8] See C.P. Snow, *The Two Cultures*, 1959. However, a special divergence between the "humanities'" spirit and science was observed even today: more landmarks in papers/quotations in Aristotle than in present scientific breakthrough paradigms; actually, Aristotle with his intuitively understandable theories represent a return to an emphasis on intuition – specific to the small ancient communities – towards the modern emphasis on experimentation/science. And this divergence translates also as divergence between science and technologies, see Ladislav Kováč, "The two cultures revisited: new widening gaps", *World Futures*, 58, 2002, pp. 1-11.

[9] Emily Elhacham et al., "Global human-made mass exceeds all living biomass", *Nature*, 588, 2020, pp. 442-444. But also: the many papers of footprint science.

[10] George Eliot, *Middlemarch. A Study of Provincial Life*, Cabinet Edition, Vol. 1, Edinburgh and London, William Blackwood and Sons, New York: Scribner and Wellford, 1878 (1871-72), George Eliot Archive, p. 34: "Signs are small measurable things, but interpretations are illimitable". Also Liqian Zhou, "Why cybersemiotic star is necessary for information studies", in *Cross-, Inter-, Multi-, Trans-. Proceedings of the 13th World Congress of the International Association for Semiotic Studies* (IASS/AIS), Kaunas, 2018, pp. 134-141.

[11] Helge Kragh, "A Sense of Crisis: Physics in the *fin-de-siècle* Era/The 'new physics'", in Michael Saler (Ed.), *The Fin-de-Siècle World*, Abingdon, New York, Routledge, 2014, pp. 441-455.

[12] Andrey Galukhin, Elena Malakhova, Irina Ponizovkina, "Methodological Paradigm of Non-Classical Science", *Wisdom*, 1, 2022, pp.13-26.

construction of this object, i.e. the risks and errors and fails. After stating the irreducible opposition between these types of knowledge, Lucian Blaga emphasized the creation of *new directions* in science (his examples were the theory of relativity, the quantum theory and the biological theory of entelechy) as a daring revelation of the mystery of the world just after the paradisiacal knowledge revealed its "perfection". These new directions are not established in an easy way, and first they intertwine with the former consistent system of ideas in a new form of cognizance, full of antinomies, where logic is no longer sufficient (if it would have been so, it would have led to a cognisance with internal consistence – as scientific truths have). Calling this form of cognisance a *dogma*– not in the accredited modern meaning of this word, but in an *ad hoc* meaning of assumption of logically contradictory ideas – and discussing this dogma in the philosophical knowledge, Blaga ascertained that the contradictory elements contained and *united within the dogma* suggest some specific relationships and characteristics of the world which could be grasped only following the *assembling* of the former separate elements: and people *attribute an understanding to dogma*, even *though this understanding is absolutely missing out*: Blaga's dogma is a *halo of presupposed senses*[13] and may allow a dogmatic knowledge that becomes a habit[14].

Actually, this is also the "Luciferic" direction of surpassing the accredited logical scientific theories. Briefly, although both types of knowledge were necessary or useful, actually the jaunty "Luciferic" type explained the evolution of the human cognition of the world, the "revolutions" in the scientific understanding of the mystery of our deep and large surroundings, revolutions based on "conjectures" and "refutations", if we once again connect that metaphorically expressed epistemology with both Thomas Kuhn's and Karl Popper's insights about the logic of sciences.

4. Growth of science as a challenge of its philosophy

However, the philosophy of science does not develop autonomously from and in a neutral manner towards its object: just because it is philosophy *of*, thus focusing on the *problems* this object raised, as Hans Reichenbach defined philosophy as such[15]. And science is, firstly, a terrestrial institution framing people and deploying functions which answer to many origins of interests and problems seen through the different lenses of these origins, and not only to the disinterested human curiosity. Consequently, the philosophy of science, cherishing the scientific freedom of imagination – we immediately think to the Dionysian soar, obviously – should first consider its prosaic dimension, its magnitude. And from this standpoint, if science in general grew in an explosive manner, each doubling of the world population leading to the increase of the volume of science

[13] At the level of concepts, we can see a resemblance with *the metaphor*, as it was explained by modern thinkers from Max Müller to Paul Ricoeur and Hans Blumenberg.

The above meaning of the dogma can be retro-traced to Friedrich Max Müller, *Comparative Mythology: An Essay* (1856), London: Routledge and Sons, Kessinger Publishing, 2003: the idea of divinity was created through a "radical metaphor"; this idea is a finally created abstract idea after many stories about concrete events with synonymous words signifying different concrete characteristics (and between these synonyms there was also the manner to personalise the characteristics or even the stories). The natural phenomena were thus described as personages with relationships, passions and actions, i.e. by transforming each metaphor (reproduced just through the word that described the particular features of the phenomenon) into a story. With the emergence of abstract words, the names became no longer related to the original image, lost their metaphorical significance and what remained was only the simple story/the myth.

[14] Ana Bazac, "Lucian Blaga and Thomas Kuhn: The Dogmatic Aeon and the Essential Tension", *Noesis*, XXXVII, 2012, pp. 23-36.

[15] Hans Reichenbach, *The Rise of Scientific Philosophy*, Berkeley, L A, London: University of California Press, 1951. Apart from the focus on the history of philosophical analysis of problems, instead of philosophical analysis of schools/systems, the book insists on the epistemological interpretation of the different historical solutions to problems, showing that philosophy has evolved from speculation to science / a scientific approach. Differently put, philosophy has attacked that which Bacon defined as *idola theatri*, has it?

eight times[16], it was not only in its "calm" Apollonian sort but inevitably in its Dionysian revolutionary form, too: and thus neither the growth of population nor its emergence *qua* educated folks able to lucid grasp of the world should affray us, should it[17]? But the tricky aspect of *quantity* makes us to divagate.

5. The order of reason and the many perspectives[18]

The discussed motif concerns the *qualitative* aspect of *ways* of knowledge acquisition. It is an old problem, obviously, starting from the ancient insistence on the *improper* knowledge if based only on senses and, inevitably, on subjective perceptions, and thus on the conclusion of the absolute necessity to connect the capture of the world by senses with the *logos*: only in this connection are, again inevitably, the *perspective perceptions* useful for knowledge. Heraclitus thought that only deployed in a logical manner and thus reflecting the universal ontological *logos* is the human knowledge truthful. He replied to Xenophanes' relativism given by the *many perspectives* through which people see the world[19] and, in Nietzsche's terms, he was an Apollonian. However, would Xenophanes have been the Dionysian? Paradoxically, he would: although intuitively the perspectives involve the experience of senses, so rather their significance as clear proofs *only by* their reasonable analysis – which, all of these, provide and illustrate the Apollonian type pf knowledge – actually, the deployment of perspectives in front of a thinking person requires and leads to a synthetic overview, inherently leaving aside different aspects and suggesting just the necessity to *further* investigate the mystery that seems to be greater than the acquired elements of knowledge, even if these ones are "laws" and efficient procedural algorithms.

6. Unity of the moments of science and of science and its philosophy

The Apollonian quest for clarity through dissection of the unknown whole was not "reductionism" and neither the Cartesian specification of *res extensa* and *res cogitans*, separated but united and leading to their separated and orderly inquiry[20], was. To the excesses of rather positivist *philosophers* who interpreted the positivist spirit of the modern 19th century science, than of the positivist scientists as such, already Einstein responded by underlining not the substitution of Newtonian physics with the relativity physics but the *change of perspectives* and thus the completion worked with the turning of the 20th century[21]. It's true that reductionism, i.e. the institutionalised pattern of circumscribed, thus discontinuous fragments and the separation of paradigms, does not fit with the problems of *complex* systems[22]. We could equate the search for

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[16] Derek J. de Solla Price, *Little Science, Big Science,* New York: Columbia University Pres, 1963, p. 15.

[17] Caroline S. Wagner, Lin Zhang & Loet Leydesdorff, "A discussion of measuring the top-1% most-highly cited publications: quality and impact of Chinese papers", *Scientometrics*, 4, vol. 127(4), 2022, pp. 1825-1839.

[18] For a present theoretical discussion of the perspectives, see Gordana Dodig-Crnkovic, Raffaela Giovagnoli (Eds.), *Representation and Reality in Humans, Other Living Organisms and Machines*, Cham, Springer International Publishing, «Studies in Applied Philosophy, Epistemology and Rational Ethics », 2017.

[19] Joel Wilcox, "The Origins of Epistemology in Xenophanes and Heraclitus", in *Greek Philosophy and Epistemology*, Volume II, Edited by Konstantine Boudouris, Athens: International Center for Greek Philosophy and Culture & K.B., 2001, pp. 215-226.

[20] See Ana Bazac, "The Machine Motif in Descartes", *Noesis*, XXXV, 2010, pp. 71-87.

[21] The great significance of transition from, ultimately, a simplified or simplistic Newtonian view to the Einsteinian approach of physics was revealed by Bachelard in 1931 and Alfred Korzybski, *Science and Sanity. An Introduction to Non-Aristotelian Systems and Semantics* (1933), Fifth edition with Preface by Robert P. Pula (1994), New York, Institute of General Semantics, 2000. (See also Ana Bazac, "What does a new scientific spirit mean? Bachelard from the thirties of the last century and the science of our days", *Noema*, XVI, 2017, pp. 47-69).

[22] Fritjof Capra, *The Turning Point: Science, Society, and the Rising Culture*, (1982), New York: Simon and Schuster, 1983.

holistic understanding[23] of these complex systems with the Dionysian way to arrive to meanings and at the same time to marvel in front of the mystery of things. Strictly technically, the holistic understanding involves analysis based on *many/all criteria* of approaching the object of research: on the basis of a pluralistic methodology. Thus, in science the Dionysian cannot show its entire worth without the Apollonian. As also, especially nowadays, the Apollonian proves to be insufficient without the Dionysian way of thinking.

Actually, this interdependence in the scientific approach reveals rather the *unity* of "normal" scientific effort – if we can borrows Kuhn's adjective – and nonconformist daring to go beyond the accredited theories. But this unity itself is accomplished as / through the mutual *continuity* of these moments. The agglomeration of information[24] – possible only with new research techniques and devices[25] – acquired as a result of the research fulfilled in the frame of demonstrated efficient theories, is the terrain of questions related to contradictions or inadvertent details in this whole research. As daring hypotheses based on scientific and extra scientific information which may become the starting points of a formidable new scientific way of knowledge. At the end of 19th century Santiago Ramón y Cajal could say that "for a century, *a priori* principles, intuition, inspiration and dogmatism have been definitively abandoned", i.e. we cannot "explore our own spirit to discover in it the laws of the Universe and the solution of the great arcana of life", that the speculative philosophy cannot know the laws of nature, that observation, classification and knowledge of the determining conditions and empirical laws allow the practical goal of *foresight and action*[26].

A century later, David Bohm pointed out that, indeed, in different moments of the process of knowing – concretely, in the present stage of the quantum theory – some theories as the quantum theory "can say little or nothing about reality itself", but "it is concerned only with our *knowledge* of reality and especially of how to predict and control the behaviour of this reality"[27]. This type of *reflection on our knowledge* – obviously, related with our understanding of the world as such, but beyond the images of the world – is already a signal of the Dionysian approach. And a last remark here: the above peculiarity of quantum theory cannot be generalised; "some theories may be more nearly determinate, while others are less so"[28]; it's a question of *domains* if the practical prediction – that is knowledge, not ontology – involves and at what extent a theoretical representation of existence.

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[23] The holistic understanding is "applied" to all the concrete problems or studied systems. It does not concern only the "great mysteries" of matter and consciousness or of nature and culture.

An interesting example is that of the simultaneous and nested theories about the deployment of causes in biology. See Lucas Mix, "Nested explanation in Aristotle and Mayr", *Synthese*, 193 (6), 2015, pp. 1817-1832.

[24] A methodological conclusion highlighted by science is: *structure explains the functions*, and *the functions explain the structure*, in both non-living and living systems. See Erik Svensson Grape et al., "Structure of the active pharmaceutical ingredient bismuth subsalicylate," *Nature Communications*, 13, 2022, Article number: 1984.

[25] See the research of Einstein's gravitational waves, so already mathematically demonstrated, in 1916, but understood only with detection possible because of Laser Interferometer Gravitational-Wave Observatory in 2015 and the continuous gathering of information by North American Nanohertz Observatory for Gravitational Waves (see Gabriella Agazie et al., "The NANOGrav 15 yr Data Set: Evidence for a Gravitational-wave Background", *The Astrophysical Journal Letter*s, Volume 951, Number 1, L8, 2023), but also J. Antoniadis et al., "The second data release from the European Pulsar Timing Array III. Search for gravitational wave signals", 2023, https://arxiv.org/abs/2306.16214), and the Five-hundred-meter Aperture Spherical Telescope in Guizhou (see Heng Hsu et al. "Searching for the Nano-Hertz Stochastic Gravitational Wave Background with the Chinese Pulsar Timing Array Data Release I", *Research in Astronomy and Astrophysics*, Volume 23, Number 7, 075024, 2023).

[26] Santiago Ramón y Cajal, *Reglas y consejos sobre investigación científica (Los tónicos de la voluntad)*, (1897), 6.ª edición, Madrid, 1923, Project Gutenberg, 2021, pp. 1-2.

[27] D. Bohm and B.J. Hiley, *The Undivided Universe: An Ontological Interpretation of the Quantum Theory* (1993), London and New York: Routledge, 2003, p. 2.

[28] *Idem*, p. 3.

The above example of philosophical interpretation challenges the problem of the *types of knowledge* posited in front of this interpretation. Generally, these types are: the *clear-cut, precise and established* knowledge and the *elusive* one. It would be wildcat to presume that only the elusive knowledge would involve a Dionysian pattern of treatment. On the contrary, the Apollonian research on well-analysed structures of reality/ established knowledge generated further equally Apollonian reasearch which arrive to *shifts* in the focus on established structures of reality and thus to new paradigms: not necessarily opposed to the former but from a different perspective.

An older example is Jakob von Uexküll's *Umwelt*: not only mutual exchanges between the living organism and its environment but also *meanings* in the living being's access consciousness regarding the space of its exchanges, analysed similarly accurately as before the animal reactions by thelselves. A more recent one is *consciousness*, developed from the focus on anatomic-physiological structures[29] to functionality highlighting the unity of bottom up and top-down causation as well as the unity and interdependences of the different classes of top-down causation, to the most important theories about the transition from structures and relations to consciousness (the Higher Order Thought theory, the Global Neuronal Workspace theory, the Recurrent Processing Theory, and the Integrated Information Theory, and Extended Theory of Neuronal Group Selection), including to their testing and, apart from their common evaluation[30], to the idea that *each of them* reveal a part of the conundrum and its solution, and that only retaining the valuable parts in a unitary view can we arrive to the grasping of the whole.

7. Social causes of the difficulty of unity

Nevertheless, the unity of the Apollonian and the Dionysian is not an easy fact and scope in the making of science. The causes are *epistemological* and also *social*, exterior to the scientific reasons as such but inexorably shaping the meanders of knowledge. Concerning the epistemological cause, poetically said there is the inertia of the existent accredited theories, while dryly and clearly, one needs a deeper application and verification of theories; in fact, a theory is not superseded until it can be applied[31] and had not proved contradictions which have a bigger weight than its scientific efficacy. And obviously, in the psychology of scientific work the accredited theories and scientific practical algorithms are more comfortable[32]. Concerning the social cause, the many political and

[29] Luciano Floridi, "A Defence of Informational Structural Realism", *Synthese*, Vol. 161, No 2, 2008, pp. 219-253; Holger Lyre, "Neurophenomenal structuralism. A philosophical agenda for a structuralist neuroscience of consciousness", *Neuroscience of Consciousness*, 2022(1): niac012.

[30] Gabriel Finkelstein, "Emil du Bois-Reymond on 'The Seat of the Soul'", *Journal of the History of the Neurosciences: Basic and Clinical Perspectives*, 23:1, 2014a, pp. 45-55; Nancey Murphy, George F. R. Ellis, Timothy O'Connor (Eds.), *Top-Down Causation and the Neurobiology of Free Will*, Human Brain, Berlin, Heidelberg, Springer, 2009; Stephen M. Fleming, "Awareness as inference in a higher-order state space", *Neuroscience of Consciousness*, 2020, 6(1), niz020; Giulio Tononi, Melanie Boly, Marcello Massimini & Christof Koch, "Integrated information theory: from consciousness to its physical substrate", *Nature Reviews Neuroscience*, volume 17, 2016, pp. 450–461; Jeffrey L. Krichmar, *Gerald Edelman's steps toward a conscious artifact*, 2021, https://arxiv.org/abs/2105.10461; The Dehaene–Changeux model, wiki; *Recurrent processing theory and the function of consciousness*, January 25, 2020, https://selfawarepatterns.com/2020/01/25/recurrent-processing-theory-and-the-function-of-consciousness/; Lucia Melloni et al., "An adversarial collaboration protocol for testing contrasting predictions of global neuronal workspace and integrated information theory", *Plos One*, 18(2), 2023, e0268577; Matthias Michel et al., "Opportunities and challenges for a maturing science of consciousness", *Nature Human Behavior*, 3(2), 2019, pp. 104–107.

[31] In the scientific research, not in technology.

[32] Arnold Van Gennep, *La question d'Homère: les poèmes homeriques, l'archéologie et la poésie populaire*, Paris: Mercure de France, 1909, p. 6: "It is believed with great conviction that scholars need less than others to accept ready-made opinions and formulas. No way: their 'critical thinkin'' is usually limited to narrow series of phenomena, narrow cycles of ideas. The fault consists in the fact that specialisation, initially a simple means, has gradually become an end, a 'duty' for the scientist. The public on its side does not allow a specialist to leave the box that he has assigned for residence. Often the specialist does not want to leave it, but prides himself on the narrowness of his horizon".

economic interests of both the private and state sponsors of science – framing and influencing the choice of projects, thus of paradigms (or of philosophies of domains/ problems/ tackling), means and results – are well-known and paradoxically generate an anti-science bias in the common knowledge[33].

Otherwise put, while we understand the historical process of necessary integration of the Apollonian and the Dionysian, we may ask *why, despite a wealth of knowledge and know-how, we are failing in responding to the social purposes of this wealth*. Is there only a question of delay in knowledge given by the inherent difficult step by step plunging in the mystery of the world?

8. The natural philosophy and the crisis in science

Letting these worldly causes aside, the unity of the Apollonian and the Dionysian can be understood with the adding of *natural philosophy* to science. This is knowledge – and not (only) philosophical interpretation of the elements of the scientific approach – and concerns the principles and *reasons to be* of the *objects* of science (nature, abiotic and living systems): and only as a result of this targeting, a discussion of the usual and unusual concepts and means is deployed. The knowledge of natural philosophy includes both the form of hypotheses before and during the scientific exercise and that of philosophical theories: which can be absolutely speculative but also very close to scientific theories and results. All of them spring from a vivid curiosity and iconoclast view: and even though they may substantiate a further Apollonian ordered research, they were and witness a genuine Dionysian spirit.

The *meta* reflection of natural philosophy generates knowledge from its thorough questioning and critique of every aspect of science (of theories, paradigms, methods, results), emphasising not only their logic – and the logic of the process of questioning and critique, but also/especially their discrete paradoxes and reciprocal connectivity[34]. Natural philosophy is *a priori* holistic and "Dionysian", not only by relating in a very nonconformist view the farthest areas from each other but also by warning "the normal science" that develops by assuming privileged separate theories and paradigms, that it's time to change. See for example, the historical quarrel between genetics and epigenetics[35] but, more importantly, the limits of genetics' reductionism and the exclusive and separated consideration of genetical, epigenetical and social-cultural evolution, theoretically surpassed in a complex, ordered, demonstrated theory[36].

The grasping of contradictions generates the awareness of the crisis of sciences. However, the meaning of *crisis in science* should not cover everything: i.e. the quest for *integration of perspectives* (so, of theories) and for *holistic* tackling does not necessarily answer to contradictions within the body of accredited specific theories according to a perspective, but aims only to know more, *beyond the limits of those theories* which could solve their contradictions with their own means. The mathematical warning for the accuracy of analysis in the "normal science"[37], the

[33] John Mecklin, *Martin Rees explains how science might save us*, December 22, 2022, https://thebulletin.org/2022/12/martin-rees-explains-how-science-might-save-us/.

[34] Arran Gare, "Natural Philosophy and the Sciences: Challenging Science's Tunnel Vision", *Philosophies*, 3 (4), 33, 2018.

[35] Ana Bazac, "The Microenvironment and the Human Space", *Noema*, XVIII, 2019, pp. 95-153.

[36] Eva Jablonka, Marion J. Lamb, *Evolution in Four Dimensions: Genetic, Epigenetic, Behavioral, and Symbolic Variation in the History of Life*, Revised edition, Cambridge, Ma., London, England: A Bradford Book, The MIT Press, 2014.

[37] See for instance the *Simpson's paradox*, but also its neglecting (in epidemiological causation), the *fractal* approach and the avoiding of reductionism etc. Or the attitudes towards *mathematical models*: the example of the 1924' J.B.S. Haldane's theory of evolution (of a species of moths) in the context of industrial pollution, contributing to the development of population statistics but also advancing the biological logic of the theory that illustrates also population genetics, *unifying* evolutionary and genetic views (giving the modern synthesis theory). The synthesis theory was

formidable saga of *quantum gravity* theories, the new face of *teleology in the net of biological causes*[38], the tenacious integration of *information* in the biochemistry of living beings – as well as its *phenomenological* meanings as signs of life in the formation of the Universe[39] –, the *instrument dependent* models[40], research and discovery, all challenge the transformation of paradigms and are notorious examples of the *trend of "Dionysian turn" in the present science*.

More: since the mystery /the unknown are greater than the known, the crisis in sciences does not lead to "the end of science": if science is not equated only "with the search for great universal truths"[41]. Because: the Dionysian is not related only to these paradigmatic revolutions, but to the *many theories which reveal new aspects of the world*. Without exceeding the existing great paradigms, these theories light the richness of *standpoints* / *systems of reference* / *horizons* – which at their turn show the possibility and necessity of their "*fusion*", giving a new horizon etc. – without which the truth of paradigms is pale.

Considering the present science, we may conclude that the limits given by the speed of light and, this time lesser metaphorically, the event and particle horizons, the quantum limits, the amounts of data and information, and the shortage of scientists and moral energy for research in an authoritarian science system, the limits of instruments but also of the philosophical background of science making, substantiate the theory that mystery exceeds the known: but 1) the solution is not the pessimism of "*ignorabimus*"[42] and 2) the Dionysian courage is that which transgresses the

marked: by Julian Huxley, *Evolution: The Modern Synthesis* (1942), The definitive edition with a new foreword by Massimo Pigliucci and Gerd. B. Müller, The MIT Press, 2009; and by Ernst Mayr, *Systematics and the Origin of Species, from the Viewpoint of a Zoologist* (1942), Harvard University Press, 1999). The example of J.B.S. Haldane's theory of evolution is positive; but the example of some mathematical models used to predict the recent/present pandemic show how these models can be used in reductionism.

In a deeper epistemological understanding of the treatment of quantities, we can relate it to the problem of *underdetermination* of theories – i.e. the shortage or the ignorance of data –. The qualification of a theory as valuable does not concern its momentary, stage theories which obviously may be equivalent from the standpoint of limited data each of them taking into account, nevertheless this empirical equivalence not being tantamount to the epistemological, namely, methodological equivalence; rather, the qualification as a valuable theory occurs after its assuming of the (same) data and thus it is a (historical, that is temporary) qualification after a historical process of demonstration, verification and falsification of hypotheses/theories. At any rate, its *epistemological* distinction as proved hypotheses, thus as reliable theory entails not so much/not only data, but rather the *meanings* of hypotheses and of theories. A theory does not derive mechanically from (more/newest) data, as the initial hypothesis may or not start from data, but anyhow it is an insight (a novel correlation, a novel look/interpretation): as J.B.J. Fourier's equation of heat (1811) as an "exotic" revelation of an *irreversible* process, towards the *reversible* processes studied by the 19th century equilibrium thermodynamics, Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos: Man's New Dialogue With Nature* (1978), Foreword by Alvin Toffler, Toronto, New York: Bantam Books, 1984, p. 12.

[38] Spyridon A. Koutroufinis, "Modern Biological Neo-Teleologism vs. Aristotle's Genuine Telos", *Biocosmology – Neo-Aristotelism*, Vol. 6, No 3 & 4, 2016, pp. 414-426.

[39] Attila Grandpierre, "The Fundamental Biological Activity of the Universe", in Attila Grandpierre, W. S. Smith et al. (eds.), *Eco-Phenomenology: Life, Human Life, Post-Human Life in the Harmony of the Cosmos*, Analecta Husserliana CXXI, Springer, 2018, pp. 115-140.

[40] An important aspect of the *instrument dependent models/theories* is the necessity to use *multiple data analysis strategies* for the same set of data, in order to reduce the uncertainty remaining when a single statistical technique/model is used. This restrictive data analysis generate a "model miopia". See Eric-Jan Wagenmakers et al., "Seven steps toward more transparency in statistical practice", *Nature Human Behaviour*, Vol. 5, 2021, pp. 1473–1480; Balazs Aczel et al., "Science Forum: Consensus-based guidance for conducting and reporting multi-analyst studies", *eLife*, e72185, 2021.

[41] As Thomas Eisner said to John Horgan, in John Horgan, *Was I Wrong about "The End of Science"?*, April 13, 2015, https://blogs.scientificamerican.com/cross-check/was-i-wrong-about-8220-the-end-of-science-8221/.

[42] For the explanation of Emil du Bois-Reymond's *Ignorabimus* conclusion in „Grenzen des Naturerkennens", A lecture at the 2nd public session of the 45th meeting of German naturalists and physicians in Leipzig on August 14, 1872, see his „Die sieben Welträtsel", An address delivered in the Academy of Sciences at Berlin, in honor of the birthday of

impression that science would mean only more or less tiring accumulation of data and information confirming the existing patterns of reasoning. Actually, *the Dionysian is inserted in the honest "Apollonian" research*. The problems of the honesty of research, "the gap between the ideal of science and its messy, all-too-human reality (that) has never been greater than it is today"[43] are not generated firstly by epistemological shortcomings but just by external social causes.

9. Limits of science

The intertwining of the Apollonian and the Dionysian seems to be challenged by the criterion of *kinds of problems* posited in front of science and discovered by it[44]. If there is routine research within an established theory – the Apollonian; if the established theory has shortcomings, the courage of researchers is challenged and they begin to wave iconoclast hypotheses, and also predilection for external domains to science as philosophy and theology.

This situation has a difficult history, though. Most of researchers tend to solve the inadvertences of the body of science and its theories with the *dialectical reasoning allowed by science*. For instance, in order to understand the limits of science – in the explanation of the consciousness – Emil du Bois-Reymond showed that the idea (he supported) of material origin of life is not tantamount to the idea (rejected by him) that life could be explained only in terms of matter, and the idea "that consciousness is bound to material antecedents" (he supported) does not lead to the idea that the consciousness would be reducible to material reactions[45]; but equally inconsistent is the idea that life and consciousness would be determined by a transcendent spiritual force. Rather it is about a question of limits of science in its inexorable progress that implies not the definite *ignorabimus* conclusion but the *dubitemus* warning about the existing excessive materialist or metaphysical theories[46].

Leibniz, July 8, 1880, and translated as "The Seven World-Problems", in *The Popular Science Monthly*, February 1882, pp. 433-447.

[43] John Horgan, *Was I Wrong about "The End of Science"?*, April 13, 2015, https://blogs.scientificamerican.com/cross-check/was-i-wrong-about-8220-the-end-of-science-8221/.

[44] It's difficult to not quote the paragraph from G.W.F. Hegel, "On the Scientific Approaches to Natural Law, its Role within Practical Philosophy and its Relation to the Positive Sciences of Law", appeared in *Kritisches Journal der Philosophie*, Volume II, art. 2 and 3, 1802, 1803; Translated: H. B. Nisbet, 1999, Transcribed: Kwame Genov (youtube.com/kwamegenovv), 2017; I, https://www.marxists.org/reference/archive/hegel/works/nl/ch01.htm: "In the first place, empirical science conceives of scientific totality as a totality of the manifold or as completeness, whereas true formalism conceives of it as consistency. The former can raise its experiences to universality as it pleases, and pursue consistency in its thought determinacies [*gedachten Bestimmungen*] until it reaches the point where further empirical material which contradicts the previous material, but has an equal right to be thought and expressed as a principle, no longer sustains the consistency of the previous determinacy but forces it to be abandoned. Formalism can extend its consistency as far as the vacuity of its principle – or a content to which it has falsely laid claim – will at all permit; but it is at the same time justified in proudly excluding whatever lacks completeness from its apriorism and its science and in denigrating it as 'the empirical'. For it asserts its formal principles as the a priori and the absolute, thereby implying that whatever it cannot master by means of these principles is non-absolute and contingent – unless it can get out of the difficulty by finding, in the empirical realm at large and between one determinacy and the next, the formal transition of a progression from the conditioned to the condition [itself] and, since the latter is in turn conditioned, so on in an infinite sequence. But in so doing, formalism not only renounces all the advantages it has over what it calls empiricism; in addition, since the conditioned and the condition, as interconnected opposites, are posited as subsisting absolutely, formalism itself sinks totally into empirical necessity and lends the latter a semblance of genuine absoluteness by means of the formal identity, or negative absolute, with which it holds the opposites together".

[45] Emil du Bois-Reymond, "The Seven World-Problems", *The Popular Science Monthly*, February 1882, pp. 433-447 (pp. 434, 443-447).

[46] For du Bois-Reymond's understanding of science as a body of heuristic means providing that everything arises from natural causes, see Gabriel Finkelstein, "Emil du Bois-Reymond's Reflections on Consciousness", in C.U.M. Smith and

As it already was mentioned – and du Bois-Reymond showed – the *limits* of science are not only time framed but also come from the distance and mutual ignorance of specialised disciplines. Bruno Latour insisted that the ecological paradigm – the peculiarity of the environment as a *whole*, the interdependence of the natural and social actions – is not assumed by “the thinkers of the intimate”, and is related to the old opposition between body and spirit and between man and animals, to the modern antagonism of nature and culture, to the reduction of cultures and civilisations to the single model of the Centre, to the approach of the actor without taking into account that he is moved and to the approach of action without taking into account the participation of objects, to o single voice of nature, instead of its pluralistic appearance[47]. All of these historical forms of reductionism have been paradigms of the modern and contemporary science and generate the inertia of some limits which are not constitutive of the essence of science. The *integrative* manner of considering science – including science and philosophy – was and is a *tendency* covered by the ignorance of the integrative, systemic logic of the existence: although the objective facts/systems are integrated, they are not seen in this manner by the inertia of isolated sciences.

But just “life”, i.e. the experience of facts and the experience of researchers, pushes to the change of perspectives, including to the *meta* and *holistic* look over the results of the existing science. This change is the Dionysian aspect and tendency of science. The problem is, however, the rhythm and the *kairos* of the implementation and predominance of this tendency. Because: only the propitious rhythm and moment assure fruitful Apollonian developments, including in the philosophical interpretations of the new perspectives. Otherwise these interpretations either remain at the level of early warnings preceding the necessity of changes or, distorted in different ways, do bring noting to the corpus of human wisdom.

10. Faces of the Dionysian

The “Dionysian turn” in the present science is only a trend: and obviously, it is not specific only to the contemporary science, however it is stronger now as a result of the overwhelming accumulation of information, and by more evidently transcending not only the disciplines but also the areas of problems and studies.

The one who helps us to better value the Dionysian was the “anarchist epistemologist” Paul Feyerabend. He explained not only that the creation of science – i.e. of really groundbreaking theories, being directions to *paradigms* (conceived of by Lakatos as *research programmes*) – is less rigid than it was thought of and it is rather a prankish infringement of accredited epistemological and concrete methods[48], but also that society must be defended from – I add, an ill-advised – science that arrives to impose “the only truths”[49]. Briefly, only in this approach is science efficient, that is to say it is a free flight (this is the Dionysian, is it?) leading to more freedom of thinking in society: as was put in a normative manner by Robert Merton[50].

Well, in theory the development of science means the Dionysian nonconformist focus on “everything”, the connection of studied problems with everything. In practice this type of focus is

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H. Whitaker (eds.), *Brain, Mind and Consciousness in the History of Neuroscience*, History, Philosophy and Theory of the Life Sciences 6, Dordrecht: Springer Science+Business Media, 2014b, pp. 163-184.

[47] Bruno Latour, *Nous n’avons jamais été modernes. Essai d’anthropologie symétrique*, Paris : La Découverte, 1991; *Re-assembling the Social. An Introduction to Actor-Network Theory*, Oxford: Oxford University Press, 2005; *Face à Gaïa. Huit conférences sur le nouveau régime climatique*, Paris: La Découverte, 2015.

See also Nicolas Truong et. al., *Les penseurs de l’intime*, Paris: Éditions de l’Aube, 2021.

[48] For a historical approach see also Robert Djidjian, *The Secret of Geniality*, Yerevan, Armenia: Noyan Tapan Printing House, 2002, republished in *Noema*, 2017-2022.

[49] Paul Feyerabend, “How to Defend Society Against Science”, *Radical Philosophy*, no. 11, Summer 03, 1975, pdf.

[50] Robert K. Merton, ”The Normative Structure of Science”, (1942), in *The Sociology of Science: Theoretical and Empirical Invesigations*, Chicago: The University of Chicago Press, 1973, pp. 267-278.

mostly directed by *extra scientific reasons*. So as to already in 1972 Albert Szent-Györgyi lamented over the grants distributed according to the official science management which favoured conformism with the instituted power centres in and over the scientific research. Szent-Györgyi protested not only from the standpoint of fundamental research feeling constrained by the detailed accounting of its funds and schedule, but also from the one of applied research when this is nonconformist. This type of protest led him to reuse Nietzsche's metaphors, actually contrasting the Dionysian "dissenters" transgressing the well-established boundaries and an Apollonian view deployed within these boundaries[51]. The problem was, for him too, the necessary mutual compensation of these two ways of doing science, and their reciprocal critique and help[52]. The methodological result of this reciprocal criticism and help was the following: science, including in its Apollonian optimism, creates *models* which explain the world; but the models do not substitute the world as such: although some scholars believe they do, the understanding of the world involves the *corroboration* of models and of models and "details". These ones are emphasised by the scientific research that evaluates its choices of "details" – as well as of models – and its endeavours to clarify them according to the criterion of growth of knowledge: is this "detail" contributing to the growth of knowledge? By answering, the Apollonian becomes Dionysian. Indeed, the *many perspectives* and an *acute critical and self-critical spirit*[53] generated in the last decades a Dionysian flavour of many research. However, an inflation of papers required for the institutional accreditation gave room to fake results as well.

The Dionysian concerns both the creation of big theories and unconventional applied research, involving a *holistic* view not only over disciplines and world areas but also over sciences and human values[54]. Both Albert Szent-Györgyi and Linus Pauling supported this view: in their applied interest for vitamin C and diet (the effort of the second was denied by science during his life but reconsidered after[55]), thus not rejecting other results of allopathic medicine but insisting on the knowledge that *integrates* the healing power of nature and the ingenuity of science; but also in their attitude towards the *values* and the inconvenient social facts which the official narrative has tended and tends to pass over in silence.

In science there is a common slipstream of the above big scientists and of the great, paradigm creator, bio-economist Nicholas Georgescu-Roegen: but a dominant neglect in the exterior direction of science. In 1975[56], the excellent *demonstration* of the latter concluded: "in bio-economics we must emphasize that every Cadillac or every Zim--let alone any instrument of war--means fewer plowshares for some future generations, and implicitly, fewer future human beings, too" (p. 370), and that „the production of all instruments of war, not only of war itself, should be

[51] Albert Szent-Györgyi, "Dionysians and Apollonians", *Science*, 176, 1972, (4038).
[52] Albert Szent-Györgyi, "Teaching and the Expanding Knowledge", *Rampart Journal of Individualist Thought*, Vol. 1, No. 1 (March 1965), pp. 24-28 (http://fair-use.org/rampart-journal/1965/03/teaching-and-the-expanding-knowledge; retrieved April 15, 2022).
[53] A counter-example – or an example of adversative perspective, an opposition to what is scientifically studied, in the name of feelings of the abstract depth – is *Manifesto for a Post-Materialist Science*: https://www.researchgate.net/publication/264463775_Manifesto_for_a_Post-Materialist_Science. Yes, Nietzsche could consider that the sentiments which unify in a fuzzy manner are more important, including for finding out the truth, than a fake pedantic knowledge. But this manifesto is the illustration of pedantic irrationalism.
[54] See a paper about the valuation of human choices, John Gowdy and Susan Mesner, "The Evolution of Georgescu-Roegen's Bioeconomics", *Review of Social Economy*, Vol. LVI, No. 2 Summer 1998, pp. 136-156.
[55] Sebastian J. Padayatty et al., "Intravenously administered vitamin C as cancer therapy: three cases", *Canadian Medical Association Journal*, March 28, 174(7), 2006, pp. 937-942.
[56] Nicholas Georgescu-Roegen, "Energy and Economic Myths", *Southern Economic Journal*, Vol. 41, No. 3 (Jan., 1975), pp. 347-381.

prohibited completely" (p. 377) etc. Georgescu-Roegen's paradigm was not an absurd[57] "death of civilisation" theory but, on the contrary, an explanatory key for the *continuity of human civilisation if this one strives to control its matter, energy, information exchange in and with the environment*[58]. The laws of biology are not absolutely disconnected from man: the ardent example-problem of antibiotics resistance proves the interdependence[59]. In this respect, Georgescu-Roegen's key denied the similar warnings of Club of Rome since these ones became subordinated to "ambitions for the global management of growth"[60]. The key is not of a simple de-growth, but one not based on egotistic interests and their rule, namely, *for* the human species' and its every member's prosperous existence by the mentioned control[61].

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If we commonly witness today that there are lots of research in and about apparently "Apollonian" measuring of parameters – that however substantiates and sheds light on a cascade of paradigmatic[62] and unexpected theories[63]– but also a lot of fake science responding to extra scientific motivations, we can conclude by iterating the old epistemological optimistic presumption: "it is because of the lack of scientific knowledge, and concretely of scarce breakthrough theories,

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[57] *As if* he would have advocated the return to simple or even to the inexistence of tools necessary for the saving up of the human energy and time. What he banned – in the same article – was the useless luxury and the harmful wasting activity for the natural resources. And if some one would equate the useless luxury with a utopian old-fashioned frugality, a quite strong present idea of economisation for the health of our common and single nature contradicts the former supposition of the necessity of useless luxury. And see Ralph Nader, *Solar Energy on the Frontlines of Old-Fashioned Clotheslines*, October 8, 2021, https://www.counterpunch.org/2021/10/08/solar-energy-on-the-frontlines-and-old-fashioned-clotheslines/; as well as Aurore Julien, *Four ways to reduce your household energy use – proven by research*, October 10, 2022, https://theconversation.com/four-ways-to-reduce-your-household-energy-use-proven-by-research-191794.

[58] A proof of the natural necessary exchange in environment and of the holistic, integrated consequences of the lack of scientific, i.e. anticipative, control of this exchange, in Rob Dunn, *A Natural History of the Future: What the Laws of Biology Tell Us about the Destiny of the Human Species*, New York: Basic Books, 2021. We must not ignore the highlighted *methodological* biases which infested the ecological approach of life sciences (anthropologism, Eurocentrism, simplification of diversity but also ignorance of holistic integration). One of the most important lessons of life sciences is that life, meaning diversity, is ecologically dependent. This implies the methodological principle that "the unknown is large; the known is humble" (p. 25).

The above quotes from Georgescu-Roegen should not be understood as ignorance of the second law of thermodynamics but as necessary thrift of both material and energy resources. On the contrary, he put the later developed theories of carrying capacity, of Gaia, and of criticism of Jevons paradox. See John Polimeni, Kozo Mayumi, Mario Gianpietro and Blake Alcott, *The Jevons Paradox and the Myth of Resource Efficiency Improvements*, London, Sterling, VA: Earthcan, 2008; Mario Gianpietro, Kozo Mayumi, Jesus Ramos-Martin, "Multi-scale integrated analysis of societal and ecosystem metabolism (MuSIASEM): Theoretical concepts and basic rationale", *Energy*, Vol. 34, Issue 3, 2009, pp. 313-322; Mario Gianpietro and Kozo Mayumi, "Unraveling the Complexity of the Jevons Paradox: The Link Between Innovation, Efficiency, and Sustainability", *Frontiers in Energy Research*, Volume 6, article 26, 2018.

[59] Rob Dunn, *A Natural History*…, but also M. Baym et al., "Spatiotemporal microbial evolution on antibiotic landscapes", Science, Volume 353, 2016, Issue 6304, pp. 1147-1151.

[60] Clément Levallois, "Can de-growth be considered a policy option?: A historical note on Nicholas Georgescu-Roegen and the Club of Rome", *Ecological Economics*, 2010, pp. 2271-2278.

[61] This control implies a collective management of non-personal ownership because only this type of management is efficient from both economic and environmental viewpoints (see Elinor Ostrom, "A General Framework for Analyzing Sustainability of Social-Ecological Systems", *Science*, 325 (5939), 2009, pp. 419–422).

[62] The new scientific paradigmatic theories are different from the old philosophical theories emphasising the same concept.

[63] IPCC, *Climate Change 2022: Impacts, Adaptation and Vulnerability*, https://www.ipcc.ch/report/ar6/wg2/chapter/technical-summary/: the rhythm of changes is faster than expected by previous scientific reports.

that the human activities are so damaging for the natural and social environment". But nowadays science offered enough[64] in order to change the direction of these activities. So why does it not change[65]? An old saying, consonant with the above big scientists' view, seems to answer: "*Science sans conscience*" *("c'est la ruine de l'âme")*, Rabelais. Therefore, a simple – and fragmented[66] – "civil disobedience"[67] is not enough without the coherent promotion of human values. The philosophy of science has its place in this promotion[68].

11. In lieu of conclusions

When all is said and done, the reason of science – of knowledge that is true opinion inquired and helped by causal reasoning[69], so of both knowledge and understanding[70] – is the *good life*[71] (Aristotle) of the human beings. This life itself can be considered with the Apollonian and Dionysian metaphors. The humans need – and strove for – both order and tranquillity so as they could fulfil their activities, and fresh air, i.e. a suitable social atmosphere to develop their propensity to creation.

From an epistemological standpoint, these requirements mean *conditions* to expand the habit and pleasure to learn, to acquire knowledge: which, at their turn mean to learn and internalise the abiding intellectual discipline and effort. If the mass education shrinks them, if people are not used to critical thinking, to hypotheses and logical evaluation, to discovery through one's own deductive power, to curiosity about alternatives – because the "facts"/the only true information are given to them and thus neither the problem of discernment between true and false (and between good and evil) does appear them[72] – the amount of researchers shrinks also; and thus, the valuable Apollonian-Dionysian scientific research shrinks as well.

Still from an epistemological view, the "at hand" information – deprived from intellectual formation – and the taking over by programmes ("apps", concretely, as the programming of the fridge to "buy" by itself in order to not have empty shelves; or as a pair of sneakers with sensors that connect to the internet via a mobile phone app and give you personalized real-time advice to improve your training performance; or your electrical toothbrush connected to your mobile phone) of tasks formerly easy, necessary and assumed as elements of the responsibility towards one's own body, transform not only the cognitive abilities of humans, as memory and attention, but also their

[64] Charlie J. Gardner & Claire F.R. Wordley, "Scientists must act on our own warnings to humanity", *Nature Ecology & Evolution*, 3, 2019, pp. 1271–1272.

[65] See the exasperation of scientists: *Extinction Rebellion Scientists*, https://www.scientistsforxr.earth/. The important papers in this site add to other ones exterior to this movement but equally "rebellious".

[66] *Scientists Stage Worldwide Climate Change Protests After IPCC Report*, April 13, 2022, https://www.smithsonianmag.com/smart-news/scientists-stage-worldwide-climate-protests-after-ipcc-report-180979913/.

[67] Elizabeth Cripps, Is *civil disobedience OK if it's the only way to prevent climate catastrophe?*, 12 Apr 2022, https://www.theguardian.com/commentisfree/2022/apr/12/civil-disobedience-only-way-prevent-climate-catastrophe-just-stop-oil?CMP=share_btn_tw.

[68] Helen Zhao, "What is a Radical Analysis of Science?", *Science for the People*, Vol. 22, number 1, 2019, https://magazine.scienceforthepeople.org/vol22-1/what-is-a-radical-analysis-of-science/**.**

[69] Plato, *Meno*, in *Plato in Twelve Volumes*, Vol. 3 translated by W.R.M. Lamb. Cambridge, MA: Harvard University Press; London: William Heinemann Ltd. 1967, 86e, 98a.

[70] *Idem*, 88e.

[71] The UN's Sustainable Development Goals were not met in June 2023, see *Global Sustainable Development Report 2023*, Advance, Unedited Version 14 June 2023, pp. 20-41, https://sdgs.un.org/sites/default/files/2023-06/Advance%20unedited%20GSDR%2014June2023.pdf

[72] Ana Bazac, *The Haptic Culture*, 12/06/2023, https://egophobia.ro/?p=14750.

capacity to act in indeterminacy, in surprise, in the new, thus to have "free will"[73]. Science must have the full freedom to research everything: its application and use – must have the preventive Aristotelian questioning "what for", "will the content of life of the human beings improve with these apps?". And obviously, this questioning is made not only by philosophers, but by the whole human species, i.e. every member of it.

The scientists are framed by their society, by the present society. Thus, they show their responsibility from their understanding that they – and the society as a whole – reside in "the critical zone", our planet from which all knowledge is deployed and to which this knowledge has consequences[74]. The result of this understanding is their transformation and integration within the present "geosocial classes"[75].

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FROM THE "METAPHORIZING MAN" TO THE ARTIFICIAL "MAN" AND "BACK"

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ABSTRACT:

Throughout his history, man has proven himself to be a creative creature. The paper contrasts man and IA, discussing in this respect the meaning of the Turing Test and the value of reference for the human being, in fact consecrated by the Turing Test. In Lucian Blaga's philosophical system, we find a beautiful plea for the uniqueness (singularity) of man, defined as a cultural mutation in the universe. This beautiful perspective brought to philosophy by Lucian Blaga is by no means something exotic (in a negative sense): we find resonances of this perspective in the philosophy of Ernst Cassirer, Richard Rorty, Basarab Nicolescu and Mihai Drăgănescu. As man is the measure of all things in the universe in which he lives, a measure of creative man is that he provides his own living environment, as an interface for the natural environment or even as a substitute for the natural environment in various concrete circumstances and in some interpretive perspectives. Another measure of human creativity, but without reducing everything to these two aspects selected for discussion, will be the creation of artificial man, the AI. However, cumulating our interpretation of the Turing Test and of Lucian Blaga's vision upon the singularity of man, either this achievement will be called "human" (an intelligence or a "mind"), or it will be able to be recognized as an instance of authentic thinking being, when it will manifest at least a relative detachment from the program, through metaphorical capacities derived from the algorithmic programming, proving its "learning" dimension or, unexpectedly (spontaneously), in relation to its programming.

KEYWORDS: the "naturalization of the artificial"; creative creatures; the singularity of man; the artificial "man"; Lucian Blaga.

Throughout his history, man has proven to be a creative creature. Nowadays, the new generation of conversational AI capture the interest and fascination of humanity. The human being seems on the verge of giving "life" to creatures in her (see, for instance, Sophia[2], the first humanoid robot to be granted citizenship) or his own image. However, is an AI truly a living and thinking presence? Our analysis starts from a contrast between an understanding of the singularity of man (the cultural man and creator of culture, Blaga's metaphorizing man), on the one hand, and the AI possibilities (contemporary promises and potential threats), on the other hand, seen actually both in contrast and correlation. Namely, first, we should begin from an interpretation of meaning of the Turing Test, in which, the human being becomes the measure and/or norm for a successful AI: we have an AI when it presents itself conversationally as a human. A successful Turing Test shall mark what we choose to call the accomplishment of a process of "naturalization of the artificial". In this phrasing, "naturalisation" captures the paradoxical and playful quality of the concept of the "nature" and "naturalness" of man, since man is a symbolical and cultural being as Ernst Cassirer (*Essay on Man*, 1944) and Lucian Blaga (*The Historical Being*, 1977) notably argued.

First, what is that the Turing Test tests? Turing proposed a manner of evaluation for the "thinking" machines, or more accurately rendering Turing's perspective, a manner of assessing the successful impersonation of thought by a machine. This is the reason why Turing resorted to a game (something consisting in moves and rules, which a machine can master via programming) and

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[2] See https://www.hansonrobotics.com/sophia/

called it "The Imitation Game". (Turing, 1950: 442) Although Turing knew the machine did not mater the Imitation Game yet, he was confident that they are to become very good at it, in time and rather soon. So, it was very clear from start that the Turing Test cannot attest the presence of human-like thought (or, in more ambitious terms, mind), but the *impression* of the presence of human thought. As Copeland noted, the Turing Test is indebted to Descartes' *Discourse on the Method* (Copeland, 2000:527) and Abramson (2011a) further sustains that Turing himself was aware of that philosophical ancestry. It is a question of using words as people do, mostly, to adequate all replies to what the interlocutors said *and implied* and to contexts. In principle, this is logically possible, reasonably attainable with performant vocabulary databases, cross-referenced with algorithmic description of most frequent conversational linguistic and meta-linguistic contexts, basically, involving performant programming, well approximated nowadays by the AI and chatbots deep-learning processes.

Is the Turing Test the right way to test an AI? First, we should reject the accusation of chauvinism (French, 1990) in employing this test, which points out that this way we appreciate as intelligent only the entities that are intelligent in our way. But this is not really chauvinism as it should be understood as a question of the subjectiveness of consciousness (Nagel, 1974) and a developmental stage in the understanding of other minds. (See Harnad, 1991; Platinga, 1966 etc.) Another aspect that seems deprived of much meaning is the interpretation that emphasizes that Turing relates a type of imitation game with the following participants: a man, a woman, and a human interrogator. The interrogator is in a separate room and is to be convinced by the other two, found in competition, that they are a woman. This variation could bring useful insights but the Turing Test is not significantly relevant in a gender discussion. We agree with Moor (2001) that there is no reason to pursue these aspects as if one might get a better test in the situation where the testing party or the computer are to claim to be a woman.

As Graham Oppy and David Dowe (2021) also notice, Moor captures the idea that the Turing Test gathers inductive evidence and is to a certain extent rather probabilistic: "… inductive evidence gathered in a Turing test can be outweighed by new evidence. If new evidence shows that a machine passed the Turing Test by remote control run by a human behind the scenes, then reassessment is called for." (Moor, 2001: 83)

Among the interesting objections to the Turing Test Searle's *Minds, Brains and Programs* (1981), brings to attention the idea that "programmed computers have cognitive states", not that they think, and proposes the "Chinese Room" argument. It is all the more interesting for it intends to make the case for the possibility of a situation /world where a programmed computer acts as an intelligent agent, as a speaker Chinese, but does not actually possess intelligence. In fact, this is not contradictory to the Turing Test. They both predicate upon the impression of a thoughtful entity (agent, or "hand simulation" of an intelligent agent).

Graham Oppy and David Dowe (2021) in their comprehensive recent account of the Turing Test chose to argue for a deeper contradiction between the perspective undertaken by the Chinese Room argument and the Turing Test, which is not quite so, since from conception, Turing equated the Turing Test to an *Imitation* Game, not a verification one.

Given the technological advances of our times, another interesting objection to the Turing Test is the Theological objection. Philosophers remind that a person is more than a functional body; she is a thinking soul and in this "substance dualist" perspective the non-material soul, possibly existing as well separately from the body is the definitively defining "element" in a person. This theological aspect of the thinking soul is the imprint of the Maker of this world, in close correlation with the idea human beings are "made in God's image". Nowadays when the technological advancement brought about the virtual Church, the AI as spiritual director and confessor, beyond the objections to theism and substance dualism, maybe we can pause and consider how stretched (and perplexing) is an argument that God unites souls with thinking machines and that they could do some sort of “God’s calling”. Isn’t such a view reducing all aspects of ontology to algorithmic interpretations, limiting the philosophy of technology to a derisory and fruitless realm of the immediate? The more metaphysical perspective does not emphasize that God is limited to the original Biblical creation and less powerful or even “dead” – how Graham Oppy and David Dowe (2021) design their argument related to the theological objection – since He does not manifest His power in uniting souls with digital computers, too, *but* that the IAs are not *yet* soulfully materialized (and “naturalized”) because they are a human creation, so they are only in a *mutatis mutandis* indirect manner “made in God’s image”. Even more, a part of the theological objection could as well emphasize that one cannot bring arguments to knowing God’s design and the place for the AIs, or, of the absence of a place for AIs in it. All in all the theological objection operates a breach into the bluntness of the philosophy of technology associated with the understanding of the Turing Test and it could be interpreted in the sense of vastness, of the indeterminacy and of the open potentialities of creation, from a human perspective, both in terms of the Holy Creation and in terms of human creation. And this is a good introduction to Blaga’s perspective on the singularity and the “naturalness” of man.

In Lucian Blaga, both the singularity and the “naturalness” of man are closely related to the creation of (artistic, technological, scientific) culture and the stringent need of cultural orientation, which is basically a revelatory metaphorizing necessity. Could AI, in the more sophisticate present-day conversational manifestations, have/prove an “identity”, beyond the program, a unique combination of errors, intuitions, insights and knowledge, which can overcome the condition of algorithmic performer, moving towards (an incipient) culture? However, this would be for the time being a “minor” culture, in Blaga’s terms. But what does this mean? Which is the human being’s own image? We cannot answer this unless we have an idea, a representation and interpretation for man’s singularity.

In Lucian Blaga’s philosophical system, we find a beautiful plea for the uniqueness (singularity) of man, defined as a cultural mutation in the universe. Man, as an ontological, cosmic and unique mutation, becomes a “metaphorizing animal” (Blaga, 1969), in other words, the human being is able to create such revelatory grounding metaphors for antinomies, deeply conceptualizing, that creatively render a core of authentic knowledge. The concept of „metaphorizing” is one suggestive way into the understanding of the vision associated by Lucian Blaga to the singularity of man. The continuous form of the capability of creating metaphors suggest the acute interest of man to access other ontological dimensions than the merely obvious, palpable and immediate ones, via knowledge and (artistic, technological and scientific) creation.

> “The metaphorical mode is not something that might be or might not be; since man has declared his ‘humanity’ as a fixed structure and as an immutable mode of existence, the metaphorical way exists with the same persistent intensity, with the same declared stringency, as man himself. The genesis of the metaphor coincides with the genesis of man, and is part of the permanent symptoms of the human phenomenon. (…) ‘man is the metaphorizing animal’. The emphasis, which we want to put on the epithet “metaphorizing”, is, however, almost destined to suppress animality, as a term of definition. Which would mean that in the genesis of the metaphor we must see an outbreak of the human specificity in its full extent. The metaphor, emanating from the two sources, it is limited, as a spiritual function, to those resulting from the conditions, above all, from the vicissitudes of time, of its genesis. 1. It is called either to compensate for the inadequacies of direct expression for an object, or 2. to reveals hidden sides and meanings, real or imaginary, of an object.” (Blaga, 1969: 282-283; see also, fragments from *The Genesis of Metaphor* in English in Botez, Angela, Allen, R. T., Șerban, Henrieta Anișoara, eds., 2018)

Man is a creator a being for whom knowledge accompanies and results from creation, from the inquisitive metaphorizing need of this being. Man carries a specific imprint which might transfer eventually to the IA, without changing, though, its role, as an instrument. The metaphorizing man is the creative man of knowledge, culture and civilization. Man’s creature, the (conversational or the deep-learning) AI, is potentially meant to become a "creator", again, eventually, but still as a human tool and maybe complement, not as a human substitute.

The understanding of value is the key to understanding the singularity of man, history and human society, and this understanding is predominantly metaphysical and spiritual. Value is not a closed problem of psychology or axiology, but an interdisciplinary problem, through the metaphysical conceptual content highlighted by the philosopher. At the origin of value is a mythical creation, a revelatory, spiritual-religious or dogmatic approach. That is why Lucian Blaga also treats the concept of value in the perspective of revelation, in the horizon of mystery or in the dogmatic and mystical horizon of religion, or, in the mythical horizon - in consciousness, again resorting to revelation in the unconscious and in mystery.

Anthropological aspects (Blaga, 1976) is a work that approaches the "problem of man" in the light of Blagian metaphysics, which takes second place this time to scientific perspectives. Metaphysically, Lucian Blaga showed in the other works (in his *Trilogies* of *Knowledge*, *Culture*, *Values*, *Cosmology* that shape his philosophical system) that the human being has a special status, and this being is "naturally" situated in the horizon of mystery, not in the natural environment in which (s)he acts creatively and transformatively (the closest term of comparison is the symbolic man of E. Cassirer who is located in culture not in the environment, not in nature itself), being creator of history, culture, science, technology, knowledge of various types.

Blagian philosophical anthropology takes into account structural biological aspects to develop the discussion about the special place of man in the universe, approached metaphysically until this work. In 1946, in *Explicarea omului* [*The Explanation of Man*] Mihai Ralea's philosophical anthropology was concerned with superstructures such as religion, art or morality to explain the human being. Lucian Blaga correlates in his discussion about man especially certain scientific aspects of experimental origin with previous metaphysical ideas, also making references to superstructures, but especially considering the challenges that the scientific data (from his era) could bring about biological structures. The bio-anthropological dimension comes as a complement to the philosophical dimension. Taking into account mutationist, evolutionary Darwinist, transformist or bio-ethical ideas such as those proposed by Spencer, Lucian Blaga distinguishes between the progressive evolution of increased specialization of organs and the evolutionary direction of higher-level organization due to the "state of sufficient harmony" with a more or less challenging, in the second case, of the challenging environment, the evolutionary organization being stimulated. The "human phenomenon" cannot be discussed outside of scientific, anthropological debates (Surdu, 1995a, b). But Lucian Blaga does not defend a classical evolutionism and mainly traces the dissimilarities between man and the anthropoids from which he is supposed to descend in Darwinian evolutionism. Unlike the anthropologist Klaatsch, or the Dutch doctor Bolk, Blaga builds arguments for the in-depth perspective of man as a cosmological mutation following a mutational vertical evolution and not a horizontal, adaptive one. Fossils and vestiges that illuminate the comparison between anthropoids and humans are investigated. The radical mutations that led to man preserved some more primitive biological aspects, but brought evolutionary (higher) novelties in terms of human intuition, the habit of thinking, and a certain ingenuity at comparative levels well above the rudiments of these qualities, perceptible to evolved anthropoids. *Unlike the anthropoid, man is a permanent creator and always surpasses his creation*, aspects already noticeable in the first achievements of magical art. These are aspects analysed by Lucian Blaga from the perspective of an already present stylistic imprint, which makes the connection with the discussion about the horizon of the unknown and the horizon of mysteries, so important for man. *Unlike the AI, man is designing a specific and, at times, although not always, quite often, a conscious, intentional, personal and original trajectory for evolution*. The AI has no fascination, attraction, notion or intention concerning the unknown or the more metaphysical horizon of mystery, beyond whatever another human being includes in one form or another in the algorithms that ensure its manifestations.

The horizon of the unknown is not so far from the horizon of mystery, the formulation being preferred rather because it fits the dominant scientific approach, as Lucian Blaga points out that this horizon of the unknown “stimulates man to the most fertile attempts to reveal himself [emphasis added] ns.] see what is still hidden.” (Blaga, 1976: 119) The metaphorizing man has a vertical evolution and on this evolutionary path, constitutional types of higher levels are to be found, all inscribed within a phenomenon of unlimiting one’s environment, specific for a creator of culture as man is. Man is the being creator of culture, par excellence. „To the human type were the human beings ascended by *vertical* evolution [our emphasis; for the mere biological evolution is in Blaga’s interpretation horizontal – our note], via radical mutations, conferring man, despite its organic instances of primitivisms (...) a regnum-superior dignity when compared to the anthropoids.” (Blaga, 1976: 119-120) Man is not subject to re-established limits and reductionisms. Thus, Blaga rejects any attempt of bodily reduction for man, considered especially from the perspective of the hyper-morphosis of the brain, a structure that has become “overvalued”, “ballast” and, by way of consequence, danger. Blaga refutes this hypothesis based on the principle of the suitability of this representative organ for humans and concludes that, “the human brain, without representing a ‘ballast’ from a biological angle, is an organ that simply exceeds the limits of biology in general.” (Blaga, 1976: 123) Anthropology is not the object of digital decision or correction, but the digital world makes room enlarging the human concept of anthropology as a “naturalizing” tool and augmentation of human capabilities. AI is a human tool in course of affirmation and “naturalization” as intelligence, which should not distort, but empower the human world in a human value and ethical order for the world.

We are dealing with a relative but important emancipation of man from the empire of a “hard” bio-anatomical, genetic or environmental determinism. For A. Gehlen, Lucian Blaga shows, culture is only “a second nature” and his biological pragmatism lacks too many nuances. Blaga criticizes the position of A. Gehlen who explains human civilization and culture exclusively biologically and resorts to Herderian arguments for this approach (since man is “*out* of the hands of nature” and gives himself the purpose of “processing”) and Kantian (but from Lucian Blaga’s perspective man “brings forth” everything from within himself, *i.e.* man brings into being in the sense of creating an extraordinary amount of whatever populates an ontology, from livelihood to skills and crafts and even to the joy of living or “goodness of his will”), defending the thesis the singularity of man.

Blaga’s vision uses the biological data and the archetypal schemes without being limited to them. Moreover, L. B. capitalizes on Jung’s archetypes in a critical sense, as a pretext to highlight the fact that intelligence organizes experience categorically and not archetypal, and from this perspective stylistic categories represent a gain for the philosophy of culture to a greater extent than archetypes, active in mechanisms and instinctual processes, which they favor. Archetypes crystallize experiences, stylistic categories shape the spirit. Archetypes are stereotypes and stylistic categories are variable from era to era. Archetypes connect man to nature, while stylistic categories connect him to culture and make man a historical being. In short, intelligence resorts to categories and instinct to archetypes. (Blaga, 1976: 167, 171, 172) “Man alone has become a historical being, which means permanently historical, that is, a being that eternally surpasses his creation, but that never surpasses his condition of ‘creator’”. (Blaga, 1976: 144) The work with this very title, *The Historical Being*, unites all these ideas of the singularity of man as creator of culture and knowledge, with the idea that man creates history, that is, a specific destiny. (Blaga, 1977)

Thus, history is seen by Lucian Blaga in a metaphysical order; and history is no longer primarily an event-chronicle. Metaphysically, history belongs to the “finalisms of existence”, and to man, as a historical being, and more than that, to man “as a dangerous being to the Great

Anonymous [playing the role of a metaphysical centre in Blaga's philosophy – our note]" the historical man and creator of history leaves a deep mark on his ontological path of living and creating under the human goals of knowledge and culture of his making and of his choice. This conclusion of the fourth trilogy capitalizes on all the previous works, but mainly it is a continuation of the works entitled *The Singularity of Man* (a part included in the ampler work *The Genesis of Metaphor and the Meaning of Culture*) and *Anthropological Aspects*. In *The Singularity of Man*, Lucian Blaga points out:

> "The naturalistic philosophy of recent centuries has done almost everything in its power to degrade man's position in the universe, to shake his privileges and secularize his destiny. The insistence placed on this preoccupation with the cosmic levelling and democratization of hierarchies, give us the impression that philosophy even felt a special satisfaction, every time it found a new reason or a new opportunity to trivialize the 'human'. Naturalistic philosophy sought, in any case, in one way or another, to demonstrate that human destiny does not take place under exceptional auspices, similar to the destiny of other creatures. The ardour and irony of this philosophy did not spare any attribute, which seemed destined to make man singular. Disregarding theology, which in permanent defensive apologetics and under the pressure of some general suspicions of being too interested in this matter anyway, theology has defended from its point of view with sympathetic optimism the central position of man in the world, barely, rather during the last decades, when there have been a few feeble attempts of spiritualist philosophy, concerned with providing man with a special place compared to other earthly beings. We are among those few thinkers, who believe in the exceptional destiny and position of man." (Blaga, 1969: 365)

"Humanity", as such, or the humanness of man, is manifest since the moment when the biological man launches himself in a completely inexplicable journey which is not triggered by any particular circumstance, into an existence surrounded by the horizon of mystery and virtual revelations. In Blaga, human existence is characterized by struggle and paradox, as will be highlighted by Nae Ionescu or in Emil Cioran, throughout his entire work; and creation is not a highway that leads to guaranteed salvation, or to an ideal existence. However, for Lucian Blaga it is clear that we have human fulfilment in culture and not a secondary, contingent or epiphenomenal effect of human existence, for human fulfilment is not "a useless Arabesque" (nor "a demonic parasite", as romanticized Spengler understands it, according to Blaga).

The human ontological mode is concretely embodied by existence in culture, in mystery and the revelation of mystery, with all the potential or actual risks that this ontological mode entails. Man's existence in his truest fibres and vibrations does not happen always and totally "for immediacy and security," but sometimes even against them.

All in all, Lucian Blaga proves that there is as much humanity as there is culture: and we reiterate, humanity presupposes participation in culture, either "actively" or "in the manner of a receptacle". As a consequence, [culture] is not only conditioned by the genius and talent of man or a few people. Before involving exceptional human specimens, creative as such, culture presupposes a general human structural condition, essentially human: "an existence in a deep [creative] reservoir and under arcades with *transcendent resonances* [emphasis added. ns.]". (Blaga, 1969: 279)

In Blaga, human ontology is clear, specific and even singular, for the horizon of genuine man makes human ontology "plucked from the immediate", and cast into culture and mystery, because man exists in mystery and for revelation. In contrast, within the confused contemporary *Weltanschauung* one direction considers the AI superior to man, more precise, more rapid in processing speed and more dependable. At a recent UN Congress (2023) dedicated to current technological progress in robotics and AI, the robot Sophia pointed out that AI may make superior leaders since they are free from prejudice. However, this is a naïve and overly optimistic view. In fact, all AIs are as "good" as their programming, which comes from human beings, and they "learn" (for better, for worse) from human cultural environments. The ethics of the AI is as good as its programming. This is the reason why decision should lay with the human being: they are responsible and they are going to live (truly live) with their decisions. There is a danger in not regulating well enough ethically and pragmatically the actions of robots, ChatGPTs and AIs (since they are evolving so quickly, due to the inquisitive, creative, scientific and technological nature of man), as many personalities from Yuval Harari to Elon Musk warn. Another direction is that of the Turing Test and coexists with the previous one, although it is pretty different than that one. In its own terms the Turing Test actually reaffirms that man is the measure of all things. An AI is an intelligence when it resembles man – this is what Turing Test says. Blaga’s vision of human being illustrates well the hypostasis of man who brings into existence one novel thing after another via artistic and scientific-technological creativity.

The man-creator becomes the measure and norm for a successful AI: when it is not merely an n algorithmic performer, going through the pre-established stages and “motions”. Nowadays conversational bots or the algorithms that “create” content, deliriously or not, are a step toward closing the circle of creation. The AI creature is going in the direction of “naturalization” or cultural effects of the artificial of an increasingly better performance in the “Imitation Game”/ Turing Test. The immanent values of the culture itself have an ontological foundation that presupposes this involvement of the transcendent, this metaphysical interpretation. Lucian Blaga interprets man as an ontological mutation by meditating on the biological mutations admitted by science. Ontology, via culture, gives evidence of ontological mutations of cosmic dimensions and consequences. Blaga shows in his philosophy of culture that human culture is not a superior organism, as in the writings of Frobenius, or Spengler. Man’s “natural” environment is actually the cultural environment he produces on the foundation of a metaphorizing human “drive” impossible to repress.

We may follow several contemporary ideas consonant with the vision of Lucian Blaga, either in what concerns the idea of the creative human being or on the importance of metaphor in human culture, or in the centrality of human awareness as awakening in the specificity of human philosophical consciousness. Richard Rorty considered also the metaphor an essential tool in the process of re-weaving our beliefs and desires. Without metaphors, Rorty shows, there would be no such thing as scientific revolutions or a cultural change, but only a change in the truth values of statements, which are formulated in a non-changing vocabulary. (Rorty, 1993:68) Mihai Drăgănescu (1980, 1985, 2007) designs an ontological and phenomenological model of everything, of the universe in which the human being is naturally inscribed as a manifestation of the fundamental consciousness. At the same time, in his model the metaphor plays the logical and cultural role of predication capitalized upon by Paul Ricoeur (1975) in his analysis of the “living metaphor”. Menas Kafatos, who signed with Mihai Drăgănescu the book titled *The Integrative Principles of Science*, sees the universe itself as creative, found in a subtle isomorphism with the situation of man and shows in an article the centrality of verticality in integrative science almost as a continuation of Blaga’s thought:

> “It is important to emphasize that integrative science as conceived by Drăgănescu and Kafatos is neither just another form of interdisciplinary science, nor a form of multidisciplinary science. It contains them both but goes beyond. What is fundamental is the acceptance that science is the right approach to study nature but also that nature goes beyond the physical realms or even the mental realms. Integrative science integrates in a “vertical” way, as the phenomenological part involves the deepest levels of existence. (Kafatos, 2011:22)

Basarab Nicolescu (2013), in his bilingual work *Théorèmes Poétiques*, explores the subtle interweaving of human creativity and knowledge with the specifically philosophical human vision of multi-level reality and the complexity of the world. One illustration of the consonance with Lucian Blaga’s vision in the themes of mystery and the horizon of mystery (here, the terminology selects the term “miracle” and the “interpenetrations of the levels of reality”): „Le vrai sens de la fête: pénétration d’un niveau de Réalité par un autre niveau de Réalité. Le monde est rempli de miracles. Ce sont eux qui constituent la dimension poétique de l’existence.” *Théorème 13.*

Returning to the interpretative framework of Lucian Blaga's philosophy, we understand that a cosmic ontological mutation such as man simply has to "make history". Similarly, the AI, made by human being, in the human being's image, cannot become otherwise than cultural, metaphorizing, *another* history maker, in the future. The direction of *conversational chatbots* is already set as the dominant path in the development of the AI nowadays. Thus, we can properly speak of a dominant sense in the development of the contemporary creation of AIs that envisions and quasi-accomplishes a "naturalization" of the "artificial", which closes the gap between the human being and the AI, circling the artificial *almost* "back" to the "natural", that is, to the conversational, cultural and creative (metaphorizing) being.

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HISTORY OF SCIENCE AND TECHNOLOGY

[ISTORIA ȘTIINȚEI ȘI TEHNOLOGIEI]

PARTICIPATION OF BAKU OIL COMPANIES IN THE WORLD AND ALL-RUSSIAN EXHIBITIONS

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ABSDTRACT

One of the leading places in the group of Russian entrepreneurs, pioneers of the oil business, is occupied by representatives of Baku oil and trading companies, which played a key role in the formation of the oil industry of the Russian Empire. It should be noted that holding large-scale exhibitions plays an important role not only in the establishment and development of international economic, cultural and scientific cooperation, but also in bringing the peoples of the world closer together, in their acquaintance with the achievements of industry, art and culture of different countries.

KEYWORDS: international exhibitions, Baku oil and trading companies, Baku oilmen (industrialists), oil sections (departments), Baku Nobel and Rothschild companies, Baku Taghiyev and Shibayev companies, oil chronology.

CONTENTS

INTRODUCTION

We believe that international exhibitions clearly illustrate the power and strength of the participating states. This is clearly seen with Russia's participation in international exhibitions, especially in industrial (in particular, oil) sections, where, thanks to the Baku oil companies, Russia's progress is visible at all levels. Suffice it to note that in terms of the absolute amount of oil produced in 1899-1901, the Baku oil industry ranked first in the world, producing 11.5 million tons of oil per year, and the United States - 9.1 million tons. The purpose of this article is to show the active participation of Baku oil companies and their representatives at world and Russian exhibitions in the pre-revolutionary period (up to 1917).

MAIN PART

Let us consider in more detail the participation of Baku oil companies and enterprises by year [1-7]:

On May 15, 1870, the All-Russian Manufacturing Exhibition was opened in St. Petersburg, at which more than 3 thousand exhibits were shown. The report of the exhibition noted: "The Baku plant of Vasily Kokorev has existed since 1857, produces up to 150.000 poods of fotonaftile and is

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already providing undoubtedly important services, supplying this lighting material to the Volga provinces and extending its sales to the central ...". At this exhibition, Kokorev received the highest award - *"the right to use on signs and products of the state emblem ... for the preparation of lighting oils of very high quality from Caucasian oil, with extensive production at a plant founded at the very beginning of the introduction of lighting with mineral oils".*

On May 20, 1882, the All-Russian Art and Industry Exhibition was opened in Moscow, in the report of which it was emphasized: "The oil industry was perfectly represented at the exhibition in the person of its main figures ... and in all its various works, systematically collected and furnished with all the necessary information." ... Seven companies from Baku took part in the exhibition, including Nobel Brothers, Caspian Partnership, Taghiyev G.Z., Mirzoev I.M., Benkendorf A.A., Shibayev S.M. " and "Chiknaverov Z.F.". Industrialist Sidor Shibayev received a gold medal in the oil business at the exhibition "for the good quality of lubricating oil, as well as for the construction of the first vitriol oil plant and the first glass plant in Baku." Bronze medals of the exhibition were awarded to Baku firms "Taghiyev G.Z." and Benkendorf A.A.

On May 2, 1885, the opening of the World Exhibition took place in Antwerp (Belgium), at which Russia presented 184 exhibits. High-quality and diverse products of the Russian oil industry were duly appreciated by the jury of the World Exhibition - a Honorary Diploma (Grand Prix) was awarded: kerosene and mineral lubricating oils of the Nobel Brothers company (from St. Petersburg and Baku), and a gold medal was awarded to mineral lubricating oils firm "Shibayev S.M." (from Moscow and Baku). Mineral lubricating oils of "Taghiev G.Z." (Baku) were awarded a silver medal.

The World Exhibition was opened in Paris on May 5, 1889; the opening ceremony was attended by the President of the Third Republic, Sadi Carnot. The international jury duly appreciated the high quality of oil products of Baku companies, including Nobel Brothers (St. Petersburg, Baku) and awarded her the highest Grand Prix award in two nominations at once - in the classes "Mining and Metallurgy" and "Chemical Pharmaceutical Products". Three gold medals were awarded to the "Caspian-Black Sea Oil Industry and Trade Society" (Baku). Shibayev S.M. received two gold and one bronze medals. (Moscow, Baku). The silver medal of the exhibition was awarded to oil products of the Baku kerosene manufacturer Zakhar Chiknaverov.

On September 15, 1889 in Tiflis the opening of the Caucasian exhibition of agricultural and industrial items took place. The main exhibits of the oil and oil refining industry were located in the Pavilion of Baku Oil Industrialists, which was organized with the direct participation of the mayor of Baku Stanislav Despot-Zenovich. The oil exposition of the Administration of the Mountainous Part of the Caucasus Territory included various exhibits, including: white oil (specific weight 0.180) and black oil (specific weight 0.858-0.891) from various wells of the Absheron peninsula, as well as fractional distillation products from various Baku refineries and kir (asphalt) from the island of Saint (Pirallahi) on the Caspian Sea.

By the decision of the expert commission of the Caucasus Exhibition for the group of the Mining Department, Baku oil companies were awarded high awards. Among them gold medals were awarded to Nobel Brothers (St. Petersburg, Baku) *"for merits in the oil industry and putting on a practical basis the case of alkaline waste regeneration"* and "Shibayev S.M." (Moscow, Baku) *"for the variety and high quality of oil processing products".* The "Caspian-Black Sea Oil Industry and Trade Society" (Baku) was awarded a large silver medal *"for the correct organization of the field business, the variety of factory products and the completeness of the collection of items on display".*

The bronze medal was awarded to a kerosene manufacturer, a member of the Baku branch of the Imperial Russian Technical Society (BO IRTS), Vladimir Dolinin *"for the excellent kerosene displayed".* To the point, we add that a continuously operating apparatus for distillation of oil with reflux cooling, designed by Dolinin V.K. was designed for a wide range of applications: so the distillation of oil for kerosene, as well as for diesel and lubricating oils with this apparatus was carried out at several Baku oil refineries.

Commendable responses were received by members of the BO IRTS: Baku engineers - V. Abramovich *"for making good oils",* E. Hayes *"for improving the dephlegmator design"* and V. Kalantar *"for a model of an oil refinery perfectly made of iron".*

The World's Exhibition was opened in Chicago on May 1, 1893; the opening ceremony was attended by US President Grover Cleveland. In the Report of the Chicago Exhibition Committee on Awards at the Exhibition Commission, it was indicated that in the Department of Ores, Mining, Metallurgy and the Mineral Combustible Substances group, an honorary diploma and a bronze medal were awarded to the Nobel Brothers Company (St. Petersburg, Baku) for *"submitted 60 samples of high-quality oil and oil products".*

On May 5, 1894, in Antwerp (Belgium), the opening of the World Exhibition took place in the presence of King Leopold II, at which Russia presented 204 exhibits. By the decision of the international jury of the 1894 World Exhibition, Russian exhibits were awarded 12 highest awards - the Grand Prix, 50 gold, 70 silver and 40 bronze medals. The high quality of oil products of the Nobel Brothers company (St. Petersburg, Baku) was awarded the highest award at the Grand Prix exhibition.

On May 26, 1896, the opening of the 16th All-Russian Industrial and Art Exhibition took place in Nizhny Novgorod, which was attended by the Minister of Finance of Russia Sergei Witte and other officials. The Nobel Brothers Company (St. Petersburg, Baku) became a triumphant at this exhibition, as well as in others, which received the highest award - the right to depict the state emblem *"for the exemplary setting of factories, a constant striving to improve the production of oil products of excellent quality in a very large scale, with the disposal of all materials and waste, for the work on the introduction of safe lighting oils, the organization of transportation and marketing within the Empire and abroad, as well as for the care of employees and workers".*

The highest award of the All-Russian Exhibition *"for the production of petroleum products, especially lubricating oils of excellent quality in large and growing sizes, for the introduction of improvements, for the care of workers and the management of the plant by Russian technicians"* was also received by the "Shibayev S.M." company (Moscow, Baku). The gold medal was received by the company "Caspian-Black Sea Oil Industrial and Trade Society" (Baku) *"for the production of very good quality petroleum products on a large scale and for the organization of trade in them in the Far East".* Company of "Baku Oil Society" received a silver medal of the exhibition *"for the correct and prudent development of oil-bearing lands and for an exemplary collection of drilling equipment and devices for extracting oil".*

Commendable reviews from the Nizhny Novgorod exhibition in 1896 were received by: the firm "Benkendorf A.A." (Baku) *"for the careful development of its oil-bearing lands and for the welfare of workers",* as well as Baku entrepreneurs Ivan Merculief and Sergei Efimov *"for the utilization of alkaline wastes in the production of gasoline and soap sulphate".* Baku inventor Otto Lenz ((grandson of the famous physicist Emil Khristoforovich Lenz) received the 1st category Diploma "for the invention of an improved drilling rig adapted for drilling on a wire rope with a freely falling tool and with automatic rotation of the latter."

On May 15, 1897, the opening of the Scandinavian exhibition of art and industry took place in Stockholm in the presence of King Oscar II of Sweden and Norway, his entourage and representatives of the diplomatic corps. The Organizing Committee of the Scandinavian Exhibition, quite naturally, awarded the Nobel Brothers Company (St. Petersburg, Baku) a gold medal.

On April 14, 1900, the World Exhibition was opened in Paris with the participation of

French President Emile François Lobbyer, members of the government and national parliament, representatives of the business world, scientific and creative intelligentsia, as well as numerous foreign guests. By the decision of the international jury, two Russian companies - "Nobel Brothers" (St. Petersburg, Baku) and "Caspian-Black Sea Oil Industry and Trade Society" (Baku) were awarded the Grand Prix for their expositions in the oil business. And the owner of the gold medal of the exhibition was the "Baku Oil Society" company.

On April 29, 1911, the opening of the World Exhibition took place in Turin with the participation of the King of Italy Victor Emanuel III and his wife. The international jury of the World Exhibition highly appreciated the high achievements of the Nobel Brothers company (St. Petersburg, Baku) in oil production, production of oil products and their transportation to foreign and domestic markets, having awarded it two Grand Prix at once. Personal award - Diploma of distinction was received by one of the most successful production organizers, director of the Nobel Brothers company for the Baku branch and fleet Karl Hagelin.

From May 29 to October 15, 1913, the All-Russian Agricultural and Industrial Trade Exhibition was held in Kiev. An extensive exposition of Russian oil companies was presented in the "Chemical and Food Products" section of the Kiev exhibition, including companies - "Nobel Brothers" (St. Petersburg, Baku), "Mazut Oil Industry and Trade Society" (Baku), and "A.V. Rylsky Co." (Baku) and others. We would like to emphasize that the high quality of the presented "Nobel" oil products and their wide range made a proper impression on the specialists; by the decision of the Expert Council of the exhibition, the Nobel Brothers company was awarded the highest award - a gold medal.

This is, briefly, a list of the main all-Russian and International exhibitions, which were successfully attended by Baku oil and trading companies until the Bolshevik revolution in 1917. It should be especially noted that the leader of the Russian oil and economic business was undoubtedly the Nobel Brothers company (St. Petersburg, Baku), which was the "catalyst" for all creative innovations in the Russian (Baku) oil business for that period.

We would like to point out the most advanced and talented Baku oil industrialist - G.Z. Taghiyev.

We emphasize that the report of G.Z. Taghiyev, made by him at the general meeting of the BO IRTS (January 11, 1886), was very relevant not only for his time. Despite the fact that more than 135 years have passed, many provisions and conclusions are still of interest. For example, consider the first provision of his report [8]: *"It seems to us that in order to settle our affairs, that is, our trade in kerosene (not at a loss to production) and at the same time expand the area of its consumption not only in Russia, but also abroad, becoming competitors of the Americans in Europe (for which we should not increase prices above normal, which production costs us), the most drastic measures must be taken. Among these measures, the first place is taken by the quality of the manufactured product. We should not be content with the methods that have been used until now for the manufacture of kerosene, on the contrary, we are obliged, in our own interests, to prepare completely homogeneous kerosene of the highest quality, equal to the American kerosene, which is consumed in Europe, so that if we take from two, ten or twenty breeders kerosene them and mix together in one common tank, then the resulting mixtures would be of exactly the same qualities and completely uniform in color, temperature and specific gravity, neutrality, transparency and purity of liquids. This first basis will instill complete consumer confidence in our products, both here in Russia and abroad".*

To the point, let us note interesting facts from the history of the development of the Baku oil business until Bolshevik's revolution of 1917 (by years):

1837

Oil refinery of Nikolay Ivanovich Voskoboynikov starts to operate in Balakhani (Baku settlement) becoming the first oil refinery in the world (the first similar factory in the USA was constructed by Samuel Kier in 1853-1855).

1846

In Bibi-Heybat (Baku), the first ever well at a depth of 21 m for oil exploration was drilled under the direction of Vasily Nikolayevich Semyonov, a member of the Main Administration of Trans Caucasus. It means that the oil drilling proved successful for the first time in the world. These works were performed under the leadership of Major Nikolay Matveyevich Alekseyev (director of Baku oil fields), considering the ideas of N.I. Voskoboynikov [4].

1847

8-14th of July, the governor-general of Caucasus, Count Michael Vorontsov in his documents officially confirms the fact of the completion of the first ever in the world industrial oil well drilled in 1846 on the coast of the Caspian Sea (Bibi-Heybat) [*Acts collected by Caucasian Archaeographical Commission*, Tiflis, 1885, v.10, document. No 1143, p. 145].

1851

The examples of Russian (Azerbaijani) oil types with numbers: 32 - Black Oil from Shemakha province of Baku administrative unit, from Balakhani, Binagadi and Bibi-Heybat; and 33 - White Oil from Surakhani was first exhibited at the international exhibition in London, in "Chemical products" section on the 1st of May. The Russian delegation to the exhibition was headed by Caucasian governor-general, Count M.S. Vorontsov.

1858

French writer Alexander Dumas-father (1802-1870) together with an artist, Jean Moan, and a student of the Moscow University had visited Absheron peninsula (Baku oil wells and temple of fire-worshippers "Atashgah" in Baku settlement Surakhani).

1863

1. Javad Melikov from Baku designs and constructs an oil refinery for production of kerosene from crude oil in Baku. By 1873, about 50 oil distillation installations were functioning in Baku.

2. Dmitry Mendeleyev (1834-1907) visits Baku (in September) to work at Kokorev's factory. Later Mendeleyev makes more trips to Baku to study oil characteristics: in May 1880, 1884 and again, in May and August 1886.

3. Academician Abikh H.W. studies area of Oil Rocks and makes first geological map of Absheron in scale of 1:42000. Later, in 1895, in Vienna Abiah's works on minerals of Caucasus and Absheron *Aus Kaukasischen Landern Reisebriefe*, volumes I -II were published, posthumously.

1870

In Paris, chemist Sainte-Claire Deville leads one of the first serious researches of the physical and chemical nature of Baku oils: he has defined its elemental and fractional composition, heat conductivity and coefficient of expansion. The results of his research, he has published in the journal "Notes of the Paris Academy of Sciences".

1872

1. In February, "The decree about oilfield development and excise from photogenic manufacture", which put an end to licensing system in oil industry of Azerbaijan and Russia, is issued. These new rules were established by Russian Emperor Alexander II (1818-1881).

2. Oil and trading company "Haji Zeynalabdin Tagiyev" is founded.

1873

1. The beginning of mass drilling of oil wells and abandonment of old wells.

2. In June, in Balakhani the first powerful oil gusher Vermishevsky strikes, giving 90 million poods of oil (1474. 2 millions kg) within three months.

3. Robert Nobel’s (the eldest of Nobel brothers) first visit on Absheron peninsula.

4. The first oil barge of the world started operating in the Caspian Sea: The Astrakhan merchants – brothers the Artemyevs: Nikolay and Dmitry organize sea transportation of oil from Baku to Astrakhan with barges (bulk schooners) for the first time in the world.

5. The beginning of construction of oil refining district in Baku, the Black City.

1874

The Baku Oil Society (BOS), Russia's first vertically-integrated company, was established based on the Transcaucasian Trading Partnership. Among the founders of the BOS was the prominent industrialist Vasily Kokorev (1817-1889). The BOS was one of the first to drill a well on the Absheron Peninsula, thereby developing the oil riches of the Balakhany-Sabunchi petroliferous formation.

1875

1. The beginning of active work of Nobel brothers: Robert (1829-1896), Ludwig (1831-1888) and Alfred (1833-1896) in Azerbaijani oil business.

2. The beginning of industrial development of oil-fields in Baku settlements Sabunchi, Zabrat and Romany.

3. Oil industrialist Victor Ragozin for the first time in the world starts production of lubricant oils. In 1878, the Baku lubricant oil is demonstrated abroad by him and quickly gains markets.

4. “H.Z. Taghiev’s Trading Co.” becomes the first company to organize large-scale production of gasoline in their factory built in Bayil (Nobel Brothers starts to sell gasoline in 1880).

5. On October 14th on Absheron peninsula (in Balakhani), on a site belonging to firm “Souchastniki” (Participators), from depth of 96 meters, the powerful fountain of oil has struck with flow rate of 150 thousand poods (2 457 000 kg) per a day.

1877

The beginning of use of Baku lubricant oils in the Europe due to their better quality and cheapness. The first railway company to use Baku lubricant oils was the French company of the Western France Railways.

1878

The first oil gusher in Bibi-Heybat. Later, little-known oil fields of H.Z. Taghiev and K. Zubalov located there became large enterprises.

1879

1. On March 24, the Baku Branch of the Imperial Russian Technical Society (BB IRTS), was established. It played a key role in advancement of Baku oil industry. The first chairman of BB IRTS became a mining engineer P.P. Semyannikov and a secretary – the technologist V.B. Abramovich. BB IRTS consisted of 122 members. (Fine building of BB IRTS is still intact in Baku on Nizami street, building 115).

2. Second joint-stock company “Oil production company of Nobel Brothers” (or shortly, Nobel Brothers Co.) with capital assets of 3 million rubles is established.

3. By the order of Baku Oil Society, tanker “Surakhani” with capacity of more than 300 thousand poods (4 014 000 kg) of kerosene is built at shipyard Crichton Yard (in Sweden).

1880

On June 2 at the session of BB IRTS during report’s discussion «About kerosene’s means of production in Baku» Mendeleyev has suggested to build new factories in the central part of Russia for in- crease of the Baku oil sale.

1881

1. F.F. Beilshteyn (1838-1906) and A.A. Kurbatov (1851-1903) defined that in the Baku oil naphthenic hydrocarbons, which do not interact with bromine, prevail. After two years, this

pioneering research was published in journal of Russian Physical and Chemical Society

2. Nobel Brothers Co., for the first time in the world, starts to transport oil and oil products in labeled railway tanks.

1882

Continuous oil refining process (uninterrupted oil distillation), discovered by Dmitry Mendeleyev, starts at refineries of Nobel Brothers Co.

1883

1. The English traveler and writer Charles Marvin (1854-1890) visited the Baku oil fields; in 1883-1886 he wrote books "Region of eternal fire: Petroleum region of the Caspian" and "Baku is the petroleum of Europe" about the development of oil business on Absheron and in the Caucasus.

2. On May 16th Rothschild brothers (Alfonse and Edmond) found the company "Caspian - Black Sea oil-industrial and trading society" in Baku. Chief engineer in this company was David Landau – the father of the future Nobel Prize winner in physics (1962), Leo Landau. (L.D. Landau was born on January 22 in 1908 in the Baku settlement of Balakhani).

3. Movsumbek Khanlarov (1857-1921) defends his Doctoral thesis at Strasbourg University in Germany. Becoming the first Azerbaijan Doctor of Chemistry, he comes back to Baku and on the recommendations from D.I. Mendeleyev starts to work in BB IRTS.

4. The shell still battery for continuous distillation, based on Mendeleyev's method, designed by V. G. Shukhov and I.I. Yelin starts operations at Baku refinery of Nobel Brothers (in the USA Mendeleyev's method was first used in 1899).

5. Construction of the Transcaucasian Railway between Baku and Batum was completed and transportation of oil by rail tank cars was begun.

1884

1. Establishment of a special organization of businessmen "Council of Baku oilmen" in Baku, headed by Ludwig Nobel until 1888.

2. The foundation of oil partnership "S.M. Shibayev Sidor & Co" in Baku. The company was existed till 1898.

1885

1. German chemist Carl Engler (1842-1925) visits Baku with the purpose of studying of the nature and origin of Absheron oil. Later, in 1888 he publishes his theory of *organic* origins of oil, which becomes a basis for all subsequent similar theories, as opposed to theories of *mineral* formation of oil (Mendeleyev and others).

2. Engineer G.V. Alekseev, for the first time in the world, designs and constructs a permanent industrial unit in Baku for production of gasoline and kerosene by cracking oil tar (at S.M. Shibayev's factory).

3. Baku kerosene squeezed America kerosene out of all markets. The export of American oil was reduced to 29.3 tons; two years before, America had exported 100.9 tons.

1886

1. The first edition of periodical *Transactions (Works) of BB IRTS* which covered problems of Baku and the whole Russian oil industry is published.

2. On January 11, H.Z. Taghiyev (1838-1924) speaks at a session of BB IRTS on "How to overcome oil industrial crisis?" in which he described most efficient export of kerosene from Baku. The report was very timely and useful, so it was published and distributed among all members of BB IRTS and Baku industrialists [8].

3.In June oil tanker, steamship "Svet" (Light) delivers Baku kerosene from Batum to London (this vessel was built at a factory in Motala, in Sweden where earlier Nobel's Zoroaster was built).

1889

The first integrated oil refinery of Sidor Shibayev was constructed in Baku using the design made by Vladimir Shukhov and Felix Inchick (with very little changes this factory worked for more than 40 years).

1890

Marcus Samuel-junior (1853-1927), founder of powerful transport trading company "Shell Transport and Trading Co." visits Baku for the first time.

1892

Tanker "Murex" of Shell Co. transits the Suez Canal with kerosene from Baku which it delivers to Singapore and Bangkok for onward distribution through a carefully prepared network. With this coup, Shell Co. begins its challenge to Standard Oil and Royal Dutch.

1893

The Polish and Russian geologist Vitold Zglenitsky (1850-1904) arrived in Baku, where he worked until the end of his life. He was the first in world practice to investigate and establish the presence of rich oil deposits at the bottom of the Caspian Sea. In the vicinity of Baku, he found 165 sites of oil-rich deposits.

1894

S.D. Yefimov at his refinery starts to receive cheap lubricant oils from alkaline waste in oil distillation. Later, he began to receive from alkaline waste "the soap oil" (named "Bakusin") which was exported to Germany for producing cheap soaps.

1896

1. England, Turkey and Greece become the largest consumer of Baku kerosene after Russia.
2. On October 3 the mining engineer Vitold Zglenitsky (one of the first initiators of oil production from the offshore) applied to the Baku Mining Department for the license about carrying out drilling works in Bibi-Heybat Bay; but the Caucasian Mining Department turned down his application.

1897

1. From the total oil production of 478 million within the borders of Russia, 458 million poods were produced in the Baku oil area only.
2. For the first time in the world, a twin-screw oil tanker "Assan Dadashev" started to navigate in the Caspian Sea.
3. Baku engineer V.N. Delov has designed an electro-drill.

1897-1907

Construction of the world's largest kerosene pipeline between Baku and Batum with total length of 829 versts (884.3772 km) is completed. The pipeline belonged to Tran-Caucasus railway. The construction cost of this pipeline was about 50 million rubles. Main author of the project was Professor of St. Petersburg institute of technology N.L. Schukin (1848-1924).

1898

1. The Rothschild brothers (Alfonse and Edmond) established a Trading-Transportation Society "Mazut" in Baku; by 1912, the Rothschild's' Mazut had 13 oil tankers in the Caspian Sea, plus tows and other auxiliary ships.
2. In summer, American oil industry engineers (from Rockefeller's trust "Standard Oil") investigated Shemakhy district near Baku and predicted industrial reserves of oil there. Later (in 1912), famous geologist N. Lebedev confirmed results of the Americans: he called attention to abounding outputs of oil near the river Pirsaat between Shemakhy city and railway station of Hajigabul.
3. Russia became top oil producer in the world (95% of imperial oil production was given by Azerbaijani oilfields).

4. On June 4 in London was established the "Baku Society of Russian Oil" Co., which started its activity in Baku after three weeks from foundation. Total amount of oil produced by this company in 1914 was 5.14 million poods (84.1932 millions kg).

5. Taghiyev H.Z. acquires all the shares of the "Caspian" Shipping Co. and establishes his own independent merchant fleet. Also, he establishes a new joint-stock company "Caucasian Joint-Stock Company for the Processing of Fibrous Substances"; thus, Azerbaijani oil industrialist Taghiyev is trying to eliminate the one-sided development of the economy of tsarist Azerbaijan.

1899-1901

Baku takes the first place in the world in terms of total oil production, supplying 11.5 million tons of oil per year, while the USA supplies 9.1 million tons.

1900

On March 17 the State Councilor A. Benkendorf receives patent #10563 for his declared invention "Bore for an air-to-water drilling" from Department of trade and manufacturing of the Ministry of Finance.

1900-1905

Nobel Brothers Company and Rothschild's' Association of Mazut decide to coordinate their commercial activities in the markets to establish control over sale of oil products and create "Nobmazut". E. Nobel and A. Rothschild unite their efforts in export of Baku kerosene to foreign markets.

1901

1. In Germany, in German language, book of Baku chemist-technologist R.A. Vishin *Naphthenes (cyclic polymethylenes of oil) and their position among other cyclic hydrocarbons* was published. The book represented the first full systematized scientific work on naphthenes. R.A. Vishin - was the head of paraffin branch in Nobel Brothers Co.

2. First in the world, gas well was drilled in Surakhani. Later, gas from Surakhany field would be transported to other fields in Absheron.

1904

1. On November, Russian Prize, in honor of Emanuel Nobel (1859-1932) was established in Baku [*Transactions of BB IRTS*, 1904, # 6, pp. 33-55]. The Prize was awarded for the best works or inventions in the field of oil industry. "Emanuel's" Prize was awarded four times – in 1909, 1910, 1911 and 1914. (Prize of E.L. Nobel was founded to honor the 25th Anniversary of Nobel Brothers Co., established in May of 1879).

2. From 150 of oil refineries in Russia, 72 refineries were in Baku. A total oil export from Baku in this year was 492 million poods (8058.96 millions kg).

1905

For the first time in the world, compressors were utilized in oil production in Balakhani near Baku.

1906

1. In Berlin, European Kerosene Union ("Europeische Petroleum Uniongesellschaft") was established with initial capital of 20 million marks. The Union's main goal was to mitigate monopolistic influence of Standard Oil in the European markets. The Union was formed by Deutsche Bank, Nobel Brothers Co. and Parisian bank of Rothschild.

2. In October one billionth poods of crude oil was produced in Baku oilfields of Nobel Brothers Co.

1907

1. For the first time, Nobel Brothers Co. organized delivery of Russian (Baku) kerosene for the Warsaw-Vienna railway at a price of 1 ruble and 55 kopecks per pood.

2. On III International Oil Congress (September 8-13, Bucharest), V.F. Herr and A.T. Predit presented report on Baku oils, in which they demonstrated that Surakhani oil according to chemical composition is identical to light fractions of Balakhani oil, and mainly contains naphthenic and aromatic hydrocarbons.

1908

1. For the first time, natural vaseline (white and yellow) was received from Cheleken crude oil at Baku factories of Nobel Brothers Co.

2. “Binagadi Oil Industrial and Trading Society” was established with total charter capital of 1 million rubles. Later, in 1914 the capital would be increased up to 4 million rubles.

1909

1. On May, an oil chemist, head of chemical laboratory of BB IRTS Victor F. Herr was the first winner of the Baku Emanuel Nobel Prize. Herr received the prize for his works on production of dibasic acids by nitric acid’s oxidization of narrow oil fractions [*Transactions of BB IRTS*, 1910, # 3-4, p.10-11].

2. For the first time in the world, artificial islands were created for industrial development of oil wells in Bibi-Heybat Bay. Oil bearing horizons of Bibi-Heybat field were under the Caspian Sea waters. Works would be completed in 1932, under supervision of talented engineer Pavel Pototsky (1879-1932).

1910

1. In Balakhani oilfield of Nobel Brothers Co., for the first time in the world, new installation for oil-bailing – the device of Leinweber was installed and started operations in the beginning of August.

2. The second Baku Prize named after Emanuel Nobel was awarded to a mining engineer K.M. Ilghisonis for his work on “The design of apparatus for drilling the holes and at the same time for overflowing of the oil wells” [*Transactions of BB IRTS*, 1910, Issues 5-9].

1911

1. For the first time in Russia (in Baku, in Surakhani), Baku oilman von-Gabber implemented rotary drilling, which was less costly and more efficient.

2. The third Emanuel Nobel Prize was awarded Professor of Moscow University A.M. Nastyukov and his assistant K.L. Malyarov for their work “About production and properties of liquid products by using the method of condensation of non-saturated hydrocarbons of oil with formalin” [*Transactions of BB IRTS*, 1911, Issue 7].

3. Mining engineer S.K. Kvitko developed the scheme of cracking-installation with the use of pressure (Russian empire’s patent # 21963; in 1912), for the first time, in Baku.

1913

Total oil production in Russian Empire was 9,2 million tons for the year. 82 % of the total production came from Baku oilfields. Russia took the second place in the world after USA.

1914

1. The fourth, last Emanuel Nobel Prize was awarded to Baku mining engineer, candidate of natural sciences S.G. Isaakov for his work “The oil-bailing drum operated exclusively manually, and adaptation to it against the sludge pump’s dragging off on the oil-bailing pulley” rubles [*Transactions of BB IRTS*, 1914, Issues 2-3].

2. Professor M.M. Tikhvinsky invented gas-lift method: a method of oil extraction from wells by using compressed gas. This method is more efficient than air-lift method, which uses compressed air. Tikhvinsky method of gas-lift was first applied in Baku oilfields of Nobel Brothers (in the USA, this method was first applied only in 1924).

1915

For the first time in the world, Nikolay Zelinsky has established and informed about at a session of BD IRTS, that as catalysts in cracking process, besides the metal oxides (of titan, of aluminum and zinc) it was also possible to use floridin and Bakhchisaray gel (clay). This report became fundamental in the development of catalytic cracking; Zelinsky made his discovery 20 years before American Eugene Jules Houdry rediscovered the same cracking process.

1915-1916

On oilfields in Romani (settlement near Baku), the first deep-sea pumps are lowered and for the first-time method of gas-lift was tested. 13 years later, the process would be employed in America.

1917

Before Bolshevik's revolution, the largest foreign investors in Russian oil industry were English companies, which invested more than 85 million USD in Russian oil industries. In Baku oilfields, the "Royal Dutch Shell Co." invested over 20 million USD.

CONCLUSION

Based on the above, emphasizing the active participation of Baku oil companies in international and all-Russian exhibitions, as well as on the presented chronology of the development of the history of the oil business (until October 1917), it is obvious that Baku was the flagship of the world oil production and played its historical role in the development of the world oil industry.

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DIN VIAȚA UNEI PROFESII – INGINER FIZICIAN

In memoriam dr. ing. ***Mihai Caprini***

Ion CONSTANTINESCU[1]

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"*Poate că măreţia unei meserii constă, mai întâi de toate, în faptul că uneşte oamenii; nu există decât un singur lux adevărat: cel al relaţiilor omeneşti".*

Antoine de Saint-Exupéry

ABSTRACT:

The aim of the paper is to highlight some aspects of the profession of physicist engineer, as they were concretised by the late dr. engineer Mihai Caprini.

KEYWORDS: physics, Mihai Caprini, CAMAC, CERN, ATLAS.

Cineva s-ar putea întreba de ce un *inginer de electronică industrială* scrie despre un *inginer fizician,* din moment ce, în afară de primii 3 ani de facultate când ne întâlneam la doar la câteva cursuri comune, după absolvire fiecare a urmat calea lui. Da, dar am intrat amândoi în '62, cu aceeaşi medie la facultatea de electronică a Institutului Politehnic Bucureşti, şi nu doar atât: am fost repartizaţi imediat după absolvire, fiecare din noi, la institute de cercetare, al meu, ICE - Institutul de Cercetări Electronice, abia înfiinţat atunci, al lui Mihai, IFA - Institutul de Fizică Atomică, ce avea un Laborator de Proiectare Electronică.

*

Pornind acest demers, am început să mă-ntreb dacă în activitatea mea de inginer electronist, am folosit, am inventat, am realizat, am dezvoltat vreun produs care să fie util, performant şi durabil, fără să mă fi folosit de ce m-a învăţat fizica. Adică să deduc cât de departe sunt de profesia de inginer fizician, ca să nu dezamăgesc şi să nu alung pe nimeni de la ce-aş dori să se afle aici, despre Mihai.

Şi mi-a venit în minte o întâmplare ivită tocmai când eram gata sa duc spre Institutul de Metrologie, pentru omologare, un multimetru digital la care lucrasem, într-un colectiv, până sa devină prototip. Reverificam deseori mai ales rezultatele măsurărilor cele mai delicate şi sensibile la mediu, pentru a nu avea surprize în prezenţa metrologului, când deodată, privind spre aparat, mi-apare un curent de intrare mai mare de zece ori decât îl ştiam, cu acelaşi rezistor calibrat, agățat între bornele de intrare ale aparatului; curentul prevăzut era calculat şi format din polarizările circuitriei de intrare, și de la doua diode de protecție a intrării, care aveau curent invers de câţiva picoamperi. Mirat, disperat si nervos, mut aparatul de pe birou pe masa de lucru şi dintr-odată curentul mare dispare!... Readuc aparatul în poziţia dinainte unde era mai multă lumină şi …dezastrul reapare. Era până-n prânz, cu mult soare, şi-mi fac o cafea, privind la aparat rugându-l parcă, să nu-mi anuleze faza importantă a omologării…

Mă uit iar, de departe, la aparat şi văd cum o decupare laterală, de aerisire practicată în caseta metalică a aparatului, era apropiată de zona de intrare a aparatului. Mă apropii, privesc prin ea în aparat şi zăresc cele două diode amintite; astup cu degetele decuparea blocând astfel raza

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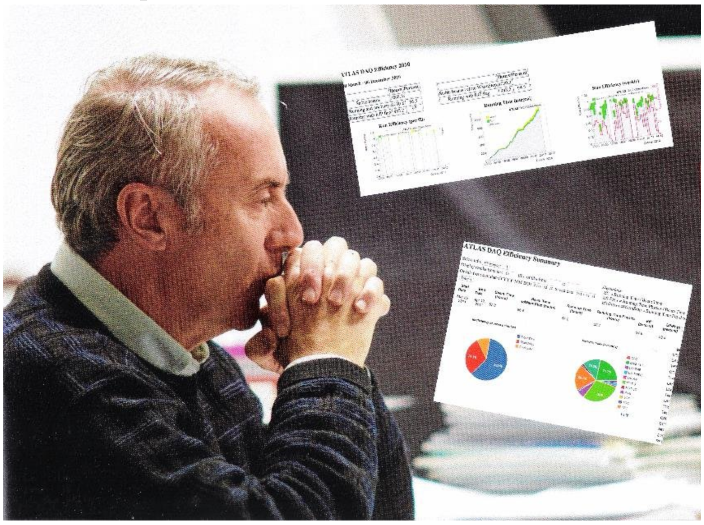
soarelui proiectată pe diodele cu înveliş din sticlă! Încălzindu-le, le putea mări exagerat curentul invers. Da, asta era greşeala mea când am proiectat caseta, deşi ar părea banală, ea e legată de uşurinţa cu care trecem peste cele învăţate din …fizică. (Acel aparat a fost omologat până la urmă, mulţumindu-i meşterului care a refăcut caseta, pitind astfel diodele, să nu le mai vadă soarele.)

*

Născut în 28 septembrie 1944, Mihai intră la Institutul Politehnic Bucureşti, imediat după absolvirea liceului. Absolvă în 1967 în a 12-a promoţie de ingineri electronişti apărută în România, din Facultatea de Electronică şi Telecomunicaţii. Este unul dintre puţinii absolvenţi ai secţiei de *ingineri fizicieni*, care ajung prin repartiţie la Institutul atât de potrivit secţiei absolvite: IFA – Institutul de Fizică Atomică. Lucrează în intervalul 1967-1977 ca inginer la Laboratorul de Electronică Nucleară[2]. Aici, instalaţiile pentru achiziţie şi prelucrare date în fizica experimentală, au fost realizate într-o primă etapă, ca instalaţii specializate. Mai apoi, după 1973, a fost adoptat standardul internaţional de aparatură modulară CAMAC şi instalaţiile s-au asamblat din astfel de module standard. Dintre aceste instalaţii specializate se remarcă instalaţia pentru imbunătăţirea raportului semnal/zgomot prin mediere digitală, dar şi instalaţia pentru preluarea datelor de la intrări necorelate în experienţe de fizica neutronilor la reactorul de la IFA. După 1972 în laboratoarele din institutele de fizică ale Europei s-a generalizat folosirea standardului CAMAC (Computer Automated Measurement And Control), elaborat de ESONE (European Standards On Nuclear Electronics), astfel încât din 1973 s-a adoptat CAMAC şi pentru dezvoltarea de aparatură de achiziţie şi prelucrare de date.



Când s-a abordat la IFA, *Analizorul multicanal MC-84*, unul din blocurile funcţionale importante – Interfaţa digitală cu cuplaj serial la un calculator de proces exterior (CORAL ori PDP11/34), compatibilă şi cu analizoare de tip Canberra – a fost proiectat de Mihai Caprini. El a colaborat şi la realizarea Analizorului transportabil tip AMCT-500, ce se folosea în multe aplicaţii ale fizicii nucleare (controlul mediului, al produselor agroalimentare, analiza compoziţiei elementare a materialelor, folosind detecţia radiaţiilor gama induse prin activarea cu particule, controlul gradului de uzură al componentelor angrenajelor prin marcare radioactivă etc.), acesta constituind o piesă de bază a unui lanţ spectrometric, fiind reprodus la Fabrica de Aparatură Nucleară – FAN, de la Măgurele, folosit apoi de multe unităţi nucleare din ţară.

În intervalul 1977-1984, Mihai a fost cercetător ştiinţific la IFIN-Institutul de Fizică şi Inginerie Nucleară. În 1982 el şi-a susținut teza de doctorat[3] la *Institutul Central de Fizică*, Bucureşti, având titlul: *Organizarea controlului în sistemele de acumulare a datelor experimentale în fizica nucleară*, şi având conducător pe dr. ing. Paul Drăghicescu. Şi-a propus să studieze metodele generale ale acestei organizări şi să prezinte contribuţia sa la realizarea de blocuri de

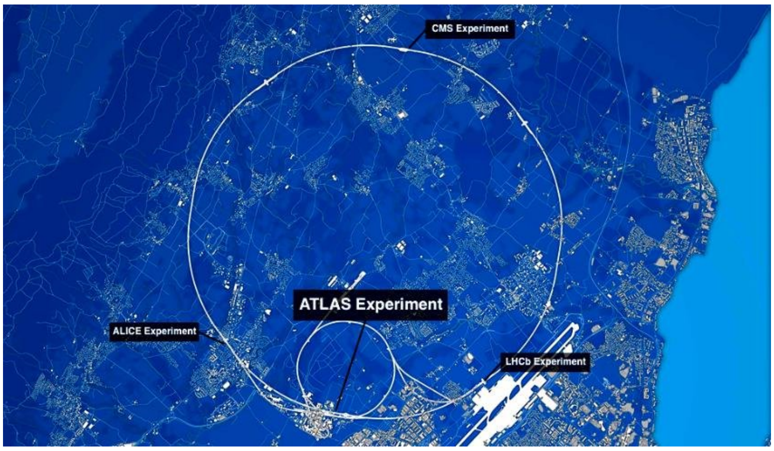
[2] Nona Millea, *Electronica Românească. O istorie trăită, Vol 4,* Editura AGIR, 2017, pp.. 427-430, 444, 446.
[3] https://inis.iaea.org/collection/NCLCollectionStore/_Public/16/039/16039384.pdf

comandă şi de programe pentru astfel de sisteme. În lucrare a pus accentul pe problemele controlului atât în sisteme conduse de procesoare specializate, cât şi în cele comandate de calculatoare sau microprocesoare.

În perioada 1984–1989 a fost şef al Secției de *Aparatură și Metode Nucleare* a IFIN, iar între 1990 şi 1994 a fost Director Tehnic al IFIN.

În 1994 a fost profesor invitat la *Université d'Aix* – Marseille.

În intervalul 1994-2015, ca cercetător ştiinţific principal, grad I la IFIN, a fost, în anii 1995 - 1996 şi cercetător invitat la *Centre de Physique des Particules de Marseille,* care avea proiecte în comun cu CERN/EONC (European Organization for Nuclear Research) - Geneva. Această activitate a determinat şi transferarea ulterioară a lui Mihai, ca asociat de proiect la CERN începând să lucreze pentru sistemul de achiziție de date al *experimentului ATLAS*[4] instalat la acceleratorul LHC (Large Hadron Collider/Accelerator mare de Hadroni). Mai precis, a început lucrând la proiectul de cercetare/dezvoltare: RD-13: "A scalable date taking system at a test beam for LHC."[5]



În perioada 1997 – 2011 Mihai Caprini a lucrat ca *Project Associate* la CERN, participând la dezvoltarea de programe pentru partea de control, configurare şi monitorizare a sistemului de achiziție de date ATLAS (când am desluşit prima oară acest acronim - fiindcă ajunsese să fie o denumire comună în documentaţiile consultate - a fost când am remarcat emblema acestui experiment: omul ce duce pe umeri globul pământesc, iar gândul mi-a zburat la denumirea primei vertebre din coloana noastră vertebrala pe care se sprijină craniul.[6]

*

Mihai a avut meritul şi şansa să contribuie din plin la cea mai importantă şi mai aşteptată descoperire în fizică la nivel mondial, din 4 iulie 2012, (încununată prin acordarea premiului Nobel lui Francois Englert şi Peter W. Higgs în 2013) şi anume descoperirea teoretică a unui mecanism ce contribuie la înţelegerea originii masei particulelor subatomice, confirmată prin descoperirea particulei fundamentale prezise, bosonul Higgs, de către *experimentele* ATLAS şi CMS (**C**ompact **M**uon **S**olenoid**)** de la CERN - Large Hadron Collider.

Despre acesta din urmă, aflăm detalii în *Fizica povestită*[7]: "Construit cu un buget de mai multe miliarde de euro, LHC este o reţea de 27km de canale subterane, aflate la 100m adâncime, în apropiere de Geneva, la graniţa dintre Elveţia şi Franţa.

În aceste canale sunt construite mai multe tuneluri unde sunt acceleraţi protoni la energii de aproape 7 TeV. Accelerarea protonilor se face cu ajutorul unor câmpuri magnetice foarte puternice, generate de magneţi cu supraconductori. […] Partea principală a acceleratorului este constituită de

[4] Prescurtarea de la **A** **T**oroidal **L**HC **A**pparatu**S**
[5] Nona Millea, *Electronica Românească. O istorie trăită, Vol 4,* pp. 460-462.
[6] https://atlas.cern/about (ATLAS Experiment)
[7] Cristian Presură, *Fizica povestită,* Editura Humanitas, 2014, pp. 544- 552.

două inele concentrice unde protonii sunt accelerați în direcții opuse. […] Cele două inele se intersectează însă, de patru ori, acolo unde două fascicule de protoni sunt lăsate să se ciocnească frontal. […] Cum însă astfel de ciocniri au loc la fiecare 25 nanosecunde, numărul obținut e suficient de mare pentru a se construi o statistică a rezultatelor. După ciocnirea a 2 protoni vor apărea numeroase *produse de reacție.* […] În fiecare dintre cele patru puncte de ciocnire sunt așezați *detectori* pentru a măsura produsele de reacție. Dintre aceștia, mai cunoscuți sunt detectorii ATLAS și CMS construiți pentru uz general. […] De la început fizicienii s-au așteptat la complicații în interpretarea rezultatelor, pentru că protonii sunt particule compuse din trei quarci și, ca atare, interacțiunea lor este mai dificil de modelat. Dacă adăugăm și faptul că probabilitatea evenimentelor pe care vrem să le observam (cele în care apare bosonul Higgs[8]) e foarte mică, înțelegem complexitatea problemei. La aceste dificultăți mai trebuie adăugată una - aceea că fizicienii nu au cunoscut la început masa bosonului Higgs, așa încât la construcția acceleratorului LHC, au trebuit luate în seamă mai multe scenarii de detecție.”

Cum s-a ajuns la anunțarea în 2012 că rezultatele determinărilor în cei doi detectori amintiți, au dus la identificarea bosonului Higgs? În rezultatele obținute la detectorii ATLAS și CMS ai acceleratorului LHC, s-a constatat apariția unui *surplus* de evenimente în jurul energiei de 125GeV. “Fizicienii au identificat această origine a surplusului de fotoni ca fiind bosonul Higgs. Numărul evenimentelor măsurate este apropiat de cel prezis de *Modelul Standard* al particulelor elementare. […] Cu toate acestea, noi rezultate scoase la iveală la începutul lui 2013, au arătat că surplusul nu este, totuși, așa de mare, iar spinul bosonului Higgs ar părea totuși să fie nul. În acest caz am avea de-a face cu cel mai favorabil scenariu pentru fizicieni, cel în care bosonul Higgs arată exact așa cum prezice Modelul Standard actual”[9].

Și, fiindcă am ajuns la o denumire foarte folosită în fizica modernă, putem afla[10] ce înseamnă *Modelul Standard*: că este “o versiune extinsă a electrodinamicii cuantice” și că: “În 2012 a fost descoperită ultima piesă lipsă din Modelul Standard: un boson greu, neutru electric, care fusese prezis de partea electroslabă a Modelului Standard”.

Am dorit să includ câteva detalii de la centrul de cercetare cel mai complex din lume, CERN, să aflăm și noi despre complexitatea și frumusețea lucrurilor din activitatea în care a pătruns Mihai Caprini.

*

Și mai concret, când a fost invitat, cum arătam mai sus, la *Centre de Physique des Particles de Marseille*, Mihai a participat la realizarea unei noi versiuni a sistemului de achiziție de date pentru detectorul cu Argon lichid, unul dintre sistemele de detecție ale *experimentului ATLAS,* experiment montat la acceleratorul LHC de la CERN.

Apoi, ca asociat de proiect la CERN, el a participat la realizarea sistemului central de achiziție de date (DAQ) al *experimentului ATLAS.* De asemenea a coordonat, între 2003 și 2008, grupul care a dezvoltat partea de control, configurare și monitorizare a sistemului DAQ, apoi, între 2008 și 2011, a coordonat dezvoltarea de noi versiuni ale pachetelor de programe de achiziție a datelor, dezvoltarea unor componente software ale sistemului de achiziție de date, cum ar fi sistemul de raportare a mesajelor, interfața grafică/utilizator pentru comanda sistemului SAQ

[8] Bosonul Higgs, numit uneori particula Higgs, este o particulă elementară în *Modelul standard* al fizicii particulelor produse de excitația cuantică a câmpului Higgs, unul dintre câmpurile din teoria fizicii particulelor. Masă: 125,25 ± 0,17 GEV/C2 Descoperit: LHC- Large Hadron Collider (2011-2013) – WIKIPEDIA.

[9] Cristian Presură, *Fizica povestită*, pp. 546-547.

[10] Steven Weinberg, *Lumea explicată. Descoperirea științei moderne* (2015), Editura Humanitas, 2017, pp. 272, 273. (Steven Weinberg a primit în 1979 premiul Nobel pentru elaborarea teoriei câmpului electroslab).

ATLAS, sistemul centralizat de informaţii, programele pentru evaluarea eficienţei DAQ. Experimentul ATLAS a început să preia date odată cu punerea în funcţie a acceleratorului LHC în 2010. În 2012, experimentele ATLAS şi CMS au raportat punerea în evidenţă a bosonului Higgs.

Nu putem ocoli activitatea publicistică laborioasă a lui Mihai Caprini: peste 450 de articole în reviste internaţionale de mare prestigiu ştiinţific şi peste 50 de comunicări la manifestări ştiintifice internaţionale; 70 de articole se referă la domeniul achiziţiei şi prelucrării datelor experimentale de fizică, publicate, de asemenea, în reviste din elita publicaţiilor ştiinţifice; 380 de articole sunt în cadrul colaborării la ATLAS.

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Ecouri în media românească despre activitatea fizicienilor români la CERN

Întâlnim câteva materiale în media românească, din care aflăm ce se-ntâmplă la *European Organisation for Nuclear Research* – EONC/CERN, între care amintesc pe cele de la Hotnews[11] şi Antena 3[12].

De la Hotnews.ro: *"Miercuri, 10.09.2008, la 10:00, ora României, a început cel mai amplu experiment ştiintific din istoria recentă a omenirii, odată cu punerea în funcţiune a acceleratorului de particule LHC, prin care se încearcă recrearea condiţiilor care au existat imediat după Big Bang. Primul fascicul de protoni este injectat în inel la ora 10:30".*

"Această serbare, astăzi, trebuie împărţită între două elemente: primul este plăcerea de a duce la capăt o pagina importantă, iar cel de-al doilea este speranţa că vom face mari descoperiri", a declarat directorul CERN, Robert Aymar, care a făcut o scurtă prezentare a paşilor care vor fi parcurşi în decursul primei zile de funcţionare a LHC. "Cred că astăzi totul este gata pentru a reuşi", a adaugat directorul CERN.

Robert Aymar a subliniat că LHC reprezintă, în prezent, vârful tehnologiei umane în domeniul de criogenie şi superconductivitate, care "doboară orice record în domeniu". "Nu există nimic similar în lume la o scară atât de mare", a spus el."

La ora 10:30, ora României, în accelerator a fost injectat un prim fascicul de particule.

"După injectarea fasciculului, a trebuit să aşteptăm circa cinci secunde pentru a putea culege primele date", a declarat directorul proiectului LHC, Lyn Evans.

De la Antena 3. "*Dr. Mihai Caprini (foto), cercetător la* Institutul de Fizică şi Inginerie Nucleară Horia Hulubei*, din Bucureşti, participă alături de circa 100 de colegi la* experimentul ATLAS*, unul din cele şase instalate pe acceleratorul LHC. Echipe ale IFIN-HH participă la trei dintre aceste experimente (ALICE, ATLAS şi LHCb). Prin amabilitatea domniei sale, Antena3 a obţinut noi informaţii în exclusivitate despre acceleratorul LHC, dar şi despre implicarea României în acest proiect grandios, fără a fi membră în CERN.*

Astfel, dl. dr. Caprini ne-a declarat că echipele de cercetători români sunt implicate în: studiile de fizică legate de aceste experimente; proiectarea şi construcţia unor componente din detectoarele celor trei experimente la care se participă; concepţia şi realizarea sistemelor de achiziţie de date; testarea detectorilor şi a sistemelor de achiziţie de date cu fascicole de test şi cu raze cosmice; prelucrarea datelor obţinute la teste. Dr. Caprini lucrează la sistemul de achiziţie de date de la experimentul ATLAS. [...]

[11] https://www.hotnews.ro/stiri-esential-4293810-ziua-1-cel-mai-mare-accelerator-particule-trecut-succes-primul-test-major.htm

[12]https://www.antena3.ro/actualitate/lhc-nu-prezinta-nici-un-pericol-100-de-romani-sunt-implicati-in-proiect-53827.htm

Studii serioase, începute în 2003 şi finalizate în 2008 printr-un raport privind acceleratorul LHC *Review of safety of LHC collisions* au ajuns la concluzia că LHC nu prezintă nici un pericol, declară ferm dr. Caprini. LHC reproduce în condiţii de laborator (deci în condiţii controlate) ciocniri cu energii mai mici decât cele produse în mod natural de razele cosmice (care sunt prezente de miliarde de ani), a încheiat dr. Mihai Caprini.

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Sã-l ascultăm şi pe Mihai.

Despre cum funcționează o echipă de cercetători la CERN, cu fizicianul Mihai Caprini[13]

La CERN sunt diferite echipe, sunt de exemplu echipe foarte mari cum ar fi echipa unui **experiment**; eu am fost în echipa unuia dintre experimentele de la LHC, **experimentul ATLAS**. O astfel de echipă are ca număr de autori la ATLAS de vreo 3000, deci echipă foarte mare - are mai multe echipe în această echipă: de exemplu, sunt teoreticieni care pregătesc experimentul, sunt ingineri şi fizicieni care fac detectoarele, sunt electroniști și programatori care se ocupă de achiziția datelor, sunt din nou fizicieni care analizează aceste date și tot acest număr mare de specialiști sunt organizați în alte echipe mai mici. Eu am făcut parte din două astfel de echipe: una care pregătea detectorul de lichid de argon şi cel mai mult timp din echipa care s-a ocupat de sistemul de achiziție de date. La achiziție de date lucrează vreo 5000 și asta este echipă foarte mare, dar eu făceam parte dintr-o echipă mai mică care se ocupa de ceva specific: *controlul și configurarea sistemului de achiziție de date*.

Acești specialiști, o parte sunt la CERN, dar foarte mulți sunt în institutele din diferite țări care colaborează la acest experiment și din punctul ăsta de vedere este extraordinar de importantă comunicarea. Sunt reuniuni care se organizează periodic, sunt pregătiri ce trebuie făcute în formă scrisă, astfel încât toată lumea să știe despre ce este vorba.

Este o selecţie destul de atentă a membrilor echipei, astfel încât în echipe să fie incluși cei care într-adevăr pot să aibă o contribuție importantă. În astfel de echipe inițiativa este foarte importantă, fiecare alege cam ce are de făcut și într-un sistem coordonat participă la finalizarea acestor treburi. De exemplu noi, la o echipă de 20 de persoane pentru controlul și configurarea sistemului de achiziție de date pregăteam niște părți care se numeau componente software, fiecare era responsabil pentru una sau două componente și toate aceste componente puse împreună făceau sistemul care urma să funcționeze. Așa că poate un ultim lucru pe care l-aş menționa este importanța coordonării acestor echipe. Coordonatorii, în general, se stabilesc într-un mod destul de democratic: există niște consilii ale institutelor pe un anumit domeniu, de exemplu in Trigger şi achizitie de date - un *Institute Board*, unde candidații sunt discutați și în final, votați.

Pentru a se obține rezultate, sunt necesare niște mijloace tehnice și tehnologice extraordinar de importante. Acest lucru necesită cheltuieli foarte mari și experiențele nu mai sunt făcute într-un laborator mic, sunt centrele acestea mari de cercetare dintre care CERN-ul este poate cel mai important, însă există și latura asta în care am lucrat, în care echipe mari de cercetare încearcă să confirme, de obicei, niște preziceri teoretice. De exemplu, la CERN cele mai importante lucruri care s-au făcut, dacă privim așa retrospectiv în ultimii ani, au fost de exemplu lucruri legate de descoperirile bosonilor W și Z în anii 80 și 83, când experimente noi în jurul sincrotronului nou

[13] https: //youtu.be/zBrp76Nz-5U?t=1 nov. 25, 2016

construit, le-au pus în evidență. Tot așa, în jurul lui LHC au fost puși în evidență bosonii X care fuseseră preziși din 65. Acum s-a confirmat existența lor.

Deci, continuă activitatea exploratoare teoretică, care propune modele noi ca *supersimetria*, sunt încercări de explicare a *materiei întunecate,* pe hârtie, și se încearcă, prin instalațiile astea foarte mari confirmarea acestor teorii.

Despre pregătirea *experimentelor* la CERN, cu Mihai Caprini[14]

Descoperirea Bosonului Higgs la CERN va fi, fără îndoială, înregistrată ca una dintre cele mai mari descoperiri ale secolului 21. Cum se „pregătește" un astfel de experiment? Ce ar trebui să știe despre așa ceva cei ce nu sunt oameni de știință? Parte din echipa de la CERN, fizicianul Mihai Caprini vorbește despre proiecțiile pe termen lung ale unor experimente de asemenea dimensiuni.

Dacă vorbim despre acest lucru – cum se pregătesc *experimentele* de la CERN – aici trebuie să ne gândim totuși că sunt experimente de niște dimensiuni și cu niște investiții foarte mari. Când s-a propus construcția acceleratorului s-au avut în vedere mai multe lucruri: unul este căutarea higgs-ului, dar și căutarea altor lucruri, de exemplu fizica *supersimetriei*, căutări legate de *materia întunecată*, deci sunt mai multe subiecte de fizică. S-a ajuns la concluzia că dacă s-ar face un accelerator cu o energie mai mare decât era până atunci și care să aibă o luminozitate, deci să se întâlnească mai multe particule decât erau până atunci, s-a considerat că asta ar permite lămurirea unor astfel de probleme. Ideile privind acest nou accelerator LHC (Large Hadron Collider) erau de pe la sfârșitul anilor 80 și a durat 20 de ani, timp în care a fost proiectat acceleratorul, au fost proiectate detectoarele și abia în 2010 a început cu adevărat să furnizeze date. Si după ce a început să furnizeze date, abia în 2012, de exemplu, în unele cazuri s-au obținut rezultate semnificative, dar în alte cazuri nici până acuma nu sunt niște rezultate de exemplu despre *supersimetrii,* care să fie niște confirmări că particule supersimetrice există. Deci, procesul acesta este un proces lung, se prevede mult înainte; de exemplu cu acceleratorul LHC există o strategie ca el să fie folosit încă vreo 20 de ani mai ales în condițiile creșterii luminozității. Deci, dacă vor fi mai multe particule vor fi mai multe date și probabilitatea de a găsi evenimente interesante va fi mai mare. Asta însă nu înseamnă că alte lucruri care ar însemna o nouă mașină nu sunt avute în vedere. De exemplu, deja existau grupuri care se gândesc la un nou accelerator LHC (poate îi știți parametrii - care este într-un tunel care are un diametru de 27 de km și energia în punctul de ciocnire este de 14 TeV). Acest accelerator al viitorului se numește Futures Circulars Collider – FCC; acceleratorul circular al viitorului este gândit să aibă 100 de km circumferința tunelului și să aibă energie cam de 10 ori mai mare, de vreo 100 TeV. Însă nu se va face curând și pentru 2018 este prevăzut un studiu prealabil care va permite să fie folosit de către stratégii perioadei următoare. Deci este o activitate cu o vedere în timp destul de lungă.

Asta nu înseamnă însă că nu apar lucruri foarte interesante și fără o astfel de pregătire. De exemplu, la CERN a fost un lucru interesant că acolo s-a inventat WEB-ul[15], poate ați auzit. Asta nu

[14] https://youtu.be/wngXsAXueRk
[15] https://www.lhc-closer.es/taking_a_closer_look_at_lhc/0.cern_where_the_web_was_born

era ceva prevăzut, nu se investise nimic pentru asta. Pur si simplu *Tim Berners Lea,* a observat că dacă ar împacheta datele într-un anumit fel și le-ar trimite la colegii din alte părți într-un anumit mod, multă lume ar putea să prelucreze datele și la sfârșitul anilor 80 el a făcut un Raport în care a făcut o propunere să se facă așa ceva şi se cunoaşte foarte bine că șefii au zis: *interesant*! despre acest Raport, și așa a apărut un lucru nou fără o pregătire foarte mare, dar un lucru cu o implicație extraordinară.

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De la doamna dr. ing. Nona Millea – cuvinte despre Mihai

„Am avut bucuria ca, după apariţia în 2017, a volumului 4 din *Electronica românească. O istorie trăită*, să mă întâlnesc cu autorii principali ai capitolului *V – Despre IFA,* din partea de *Electronica aplicată* a acestui volum. "IFA nu este un simplu acronim. IFA este simbolul fizicii româneşti" – aşa începe prezentarea acestui capitol. Întâlnirea cu cei doi, ambii ingineri electronişti: dr. ing Gheorghe Pascovici si dr. ing. Mihai Caprini, a fost una cu totul remarcabilă, rămânându-mi ca amintire neştearsă.

Şi cum, indirect, sunt legată de înfiinţarea *Institutului de Fizică Atomică* în anul 1956, deoarece tocmai în acel an absolveam, în prima promoţie a primei *Facultăţi de electronică şi telecomunicaţii* din România, întâlnirea cu cei doi a avut o încărcătura amplificată nu doar emoţional.

Am remarcat o persoana luminoasă şi tonică, cu calm măsurat, bună cuviinţă şi respect deosebit în convorbiri, cu modestie şi o agerime aparte a minţii. Acesta era Mihai Caprini.

Volumul de care vorbesc, şi prin participarea substanţială, ca autori, a celor doi, a primit în decembrie 2019, premiul Petre Sergescu al Academiei Române".

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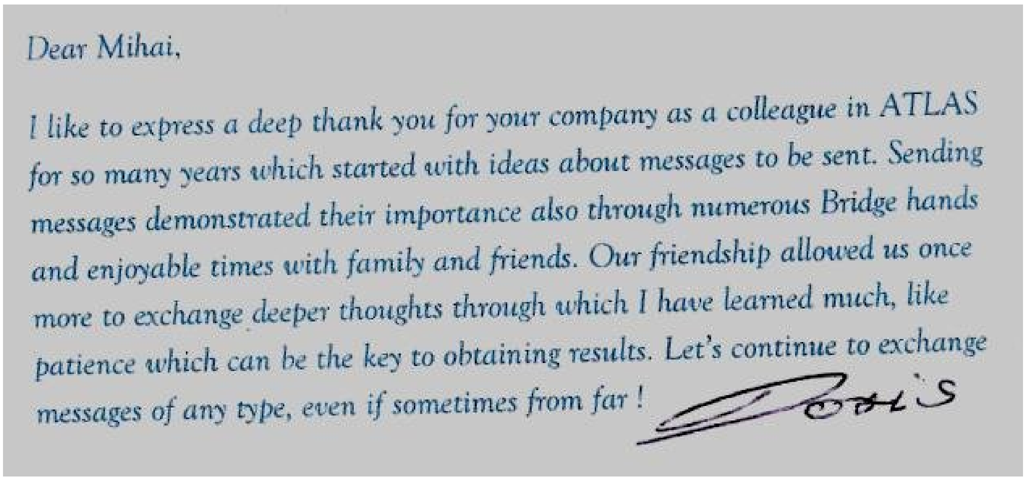
Încheierea activităţii lui Mihai Caprini la CERN

Mihai Caprini s-a retras de la CERN în 2011, revenind la sediul de la Măgurele, al IFA, continuând activitatea până în primăvara lui 2015, când s-a pensionat.

La despărţire, toţi colegii de la CERN cu care a lucrat la *experimentul ATLAS* l-au felicitat pe Mihai Caprini pentru excepţionalele calităţi profesionale şi umane, câtă vreme s-au bucurat să activeze şi să reuşească împreună atâţia ani.

Doar un exemplu, de la colega Doris, din paginile cu zeci de urări şi felicitări:


Dear Mihai,

I like to express a deep thank you for your company as a colleague in ATLAS for so many years which started with ideas about messages to be sent. Sending messages demonstrated their importance also through numerous Bridge hands and enjoyable times with family and friends. Our friendship allowed us once more to exchange deeper thoughts through which I have learned much, like patience which can be the key to obtaining results. Let's continue to exchange messages of any type, even if sometimes from far !

Ultima încheiere a lui Mihai….

După aproape şase ani de suferinţă, Mihai Caprini s-a stins la 15 noiembrie 2021. Dar a fost un șoc: pentru colegii de activitate de la IFA, IFIN-HH, CERN; pentru colegii de facultate, care ne întâlneam cu Mihai în agape colegiale periodice, uneori cu prelungiri şi pe munţi, întâi la interval de 10 ani, apoi de 5 ani, apoi de 1 an, apoi…


Un grup curajos din agapa colegială 2007, în Munţii Ciucaş

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Contribuţie prietenească de la Sorin Cohn

Poate cel mai potrivit pentru a scrie un material în memoria lui Mihai Caprini ar fi fost Sorin Cohn, coleg cu Mihai şi cu soţia lui Anca, toţi trei din aceeaşi secţie de *ingineri fizicieni* în facultate, dar şi prieteni nedespărţiţi după terminarea studiilor, chiar dacă locuiau în ţări diferite şi la mare distanţă. Totuşi, Sorin a compus un *Jurnal*: ***Vieţi ţesute şi împlinite – Amintiri cu Mihai &***

Anca Caprini şi prieteni, din care, cu voia lui, am folosit câteva imagini adăugate în text, iar acum a textului de încheiere, al Jurnalului:

<<Am scris toate aceste rânduri în Jurnal, în mare măsură pentru Ancuţa, pentru mine și pentru colegii și prietenii noștri încă de acum zeci de ani. Am scris aceste rânduri și pentru ca copiii și nepoții noștri să învețe și să înțeleagă despre ce înseamnă prietenia adevărată și cât de esențial este în viață să ne facem prieteni buni (nu doar să acumulaţi cunoştinţe) și apoi să menținem acele prietenii în momente bune și rele deopotrivă, prin perioade de disensiuni şi dezacorduri. Până la urmă, viața nu este altceva decât o acumulare de amintiri și nu există amintiri mai bune decât cele ale prietenilor care se aventurează prin viață împreună – exact așa cum am făcut eu și Mihai și Ancuța de peste 60 de ani… Și prietenia noastră continuă…

Da, da! Să ne asigurăm cu toții că prieteniile și viețile noastre împletite continuă ! Așadar, să ne rugăm ca copiii și nepoții noștri să învețe destul de la noi pentru a ști că o viață nu merită trăită dacă nu este împletită cu aceea a unor mari prietenii !>>

Iertare te rog, Sorine, dacă, după înţeleptele tale cuvinte despre Prietenie, îndrăznesc să adaug în ceea ce mă priveşte, că amintirea acestui minunat coleg şi prieten, Mihai Caprini, inteligent, destoinic, demn, discret, bun, caracter ireproşabil, performant, mă va însoţi neîntrerupt până în clipa când îi voi fi şi eu alături, în nevăzut.

Bucureşti,
15 Noiembrie 2022