The Unification of Sciences in Scientia Generalis of Leibniz
Where a Science is the Metascience of its Immediate Successor in an Arborescent Structure Ascending - Converging, Respectively Descending - Diverging

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Abstract

The scientific concepts, notions and assertions are presented nowadays in an entropic and redundant manner which makes it difficult both their learning and their comprehension for the human brain, as well as impossible to be implemented in the Intelligent Systems, respectively in Artificial Intelligence.

In the dialectic logic this theory is completed, extending the axiom system by raising the true non-demonstrable proposition to the rank of an axiom and adding it to the other axioms. The change of axioms in an axiom system alters the meaning of predicates and the relations on the theory, the new theory becoming a metatheory in which a new true non-demonstrable proposition can be formulated.

Thus, it is possible to develop a sequence of methateories each representing a relative truth possible to replace by a larger relative truth situated on a higher step.

The analysis of the dynamics of this type of propositions facilitates the elaboration of the basis of universal knowledge similar to human brain and creates the possibility of developing the general science, meant to comprise the principles of scientific thinking of all sciences, named by Leibniz "Scientia generalis".

In the paper, the knowledge basis is considered n-dimensional topological space, on which geometry can be defined and within it the concepts of open set and contact neighbourhood, frontier, continuity and topological transformation are operand. The metric space of the knowledge basis should not be limited only to the level of forms detected in the real space but to that of notions.

The information stored in the knowledge basis must by organised in sets or classes; the totality of classes forms the knowledge basis or the reference structure of intelligent systems.

The paper establishes the relational – propertational – objectual trimatricial generalised model of the knowledge domain organised in bodies of concepts and sets of assertions.

Being integrated into the methodological strategy structuralism, the paper introduces the concepts of synchronic and diachronic relations underlying inferences and syllogisms in order too explicit the definibility and deductibility connections between the concepts and assertions of theories.

Keywords: scientia generalis, hypergraph syllogistic, metascience.

1 General Considerations

1.1 On Formalisation

Generating systems, formalization fulfils the function of a through analysis of knowledge fields. Concept formalization implies their analysis, contributing to their clarifying and explanation. Formalization facilitates the understanding of a demonstration or theory clarifying and consolidating demonstrations and reasoning.
Concepts can be considered results of formalization or abstraction, serving as instruments of thinking and research, which enable us to save brain resources. Scientific theories consist of bodies of concepts and sets of assertions. The problem of understanding a concept or that of verifying the truth of an assertion implies a start from a small number of concepts and primitive propositions named axioms or postulates. A concept can be explained or defined by means of other concepts. The truth of an assertion is to be inferred from other accepted assertions. Starting from a small number of ideas and primitive propositions, the lineal approach gives the possibility of concentrating matter of significance and truth in the initial primitive elements; it also involves typical modalities of definition and inference. If the propositions and concepts of a theory are disposed according to definibility and inferability links, an axiomatic system of the theory can be obtained.

1.2 Definition, Structure and Dichotomic Division

Aristotle turns definition into the motor of syllogistic inference, the medial term being a definition.
According to Leibniz, definition is the beginning and the end of any demonstration, the later being nothing but a chain of definitions.
B. Russel states that "definition is undefinable and it is not even a definite notion".
In traditional logic treatises it is shown that a definition is asserted "genus proximum et differentia specifica".
As a restriction, it is pointed out that a definition shouldn't be constructed "idem per idem"; it shouldn't be tautologic as it is impossible to define the definite by means of the definite "definiendum per definiendum" or by means of a more developed form of the false definition "circulus in definiendo" or "dialela" each thing should be defined by means of another, either of them being defined by the other's elements.
The concept of structure designates the "constellation" of necessary relationships, invariable and independent from the elements, therefore formalizable which offer the explanation of the "code" of all the possible transformations within the given system.
A system becomes completely unintelligible if its parts are studied separately, as it has new properties, distinct from those of its components and not derivable from their sum.
By constructing abstract models, it is possible to observe invariable relations who can explain the structure and dynamics of systems.
J.Paget defines the structure of a system a coherent assembly of transformations, which ensures the self-regulation of a totality.

By the concept of structure as an abstract model, the rules that govern transformations and ensure the functionality of a system become rationally intelligible.
In the methodological strategy of structuralism, the rule of diachronic variation enables the explanation of system variations by structural variants. There is a distinction between "synchronic" which designates the relationship between coexistent terms and "diachronic" which refers to the relationship between successive terms. Therefore, structural analysis consists of a topological and relational approach.
Applying structural analysis rules, especially the immanence rule, analysis is exclusively focussed on the interior of the investigated field, operating temporarily, from methodological reasons, a closing of the respective field.
The interval structure of a knowledge field is established not on grounds of resembling, but of differences, by grouping and ordering differences, more exactly binary oppositions, where there are complementary relations between the elements.
The activity of ordering differences or binary oppositions will be named dichotomic division.
Dichotomic division consists of dividing a field associated to an object O_{00} into a species-object and its complementary, so as the following relations should be observed:

$$O_{00} = O_{ik} \vee O_{ik+1} \text{ and } O_{ik} \wedge O_{ik+1} = \emptyset \quad (1)$$

Where: O_{00} – origin object; O_{ik} – species object; O_{ik+1} – complementary object; i, k – level and order indices of the objects; Ø – void set.
Subdivision can be continued, by dividing again the complementary object O_{ik+1} into a new species-object and complementary object, observing the relations:

$$O_{ik+1} = O_{i+1k+1} \vee O_{i+1k+2} \text{ and } O_{i+1k+1} \wedge O_{i+1k+2} = \emptyset \quad (2)$$

These subdivisions go on until the whole field is exhausted for objects $O_{i+k,k}$; no other undetermined complementary objects appear.
The finite number of dichotomy divisions which lead to the exhaustion of the field justify the principle of sufficient reason initially formulated by Leibniz.

1.3 The Principle of Sufficient Reason, the Theorem of Sampling, Scientia Generalis

Leibniz elaborates the principle of sufficient reason and formulates it as it follows: "The meaning of sufficient reason (Raison suffisante) is that no fact can be considered true or sufficient and no proposition can be considered true without the existence of a sufficient motivation for why it is like this and not otherwise Schopenhauer consecrated to this principle the paper entitled "The quadruple Root of Sufficient Raison", in which he distinguishes the following forms of this principle: the principle of sufficient reason of existence, becoming, knowledge and action, involving the following aspects: existence, cause, knowledge and motive.

A proposition is true if is correctly inferred from a logical point of view from other propositions as it follows: if it is known that a proposition $p \rightarrow q$ is true and if p is true then it can be inferred from the truth matrix of the implication that q is true.
The principle of "sufficient reason" can be considered the sum of all the rules of logical inferences, but from the point of view of formal logic it can't be formally represented.
There is a similitude between "the principle of sufficient reason and the theorem of sampling, which can be stated as it follows : "for transmitting a continuous signal with a frequency spectrum f it is sufficient to transmit the function values at time intervals equal to $\Delta t = \frac{1}{2f_{max}}$ these values are named samples" as there is a class of continuous functions which can be determined by a limited number of values; this class is called the class of limited spectrum functions.
Leibniz, by elaborating "characteristica universalis", i.e. a general system of signs and formulae" so that in a certain scientific system to each object or object relationship corresponds a sing", believed in the possibility of constructing a general science.
Within the frame of this science, named "scientia generalis", the principles of the "general methodology" of sciences can be elaborated.

1.4 Semantic Steps, Intension and Extension of Notion

The theory of semantic steps in Semiotics starts from the fact that there are objects, properties and relations, which belong to objective reality, approached to as a knowledge field. The objects of the first step, which have a corresponding formalisation in an object language, constitute the so-called zero steps. The languages from the second step on will be called metalanguages and they serve to the formalisation of objects on superior steps. The objects, properties and relations of the zero steps form the basis of the whole sequence of steps of human knowledge. However from the theory of types, it follows that any property belongs to a higher step than the objects having that property.
Any notion has two fundamental determinations, which are connected, namely the extension and the intension of the notion. Notions are obtained by abstraction from concrete objects and phenomena and they reflect classes of things. The reflection of a class of objects in a notion is called notion extension. The extension of a notion is not sufficient for notion determination; therefore, another fundamental determination is necessary namely intension. Notion intension is the abstract reflection of invariable properties and relations belonging to a class of objects. Therefore, extension reflects a certain class of objects where as intension reflects certain characteristics, i.e. properties or relations. Noting E_i the extension and by I_i – the intension of a notion which designates an object, according to the law in the Port Royal Logic, the following relations are considered valid.

$$E_i < E_{i-1} \quad \text{and} \quad I_i > I_{i-1} \qquad (3)$$

I.e. any intension increase diminishes extension and vice versa.

For rendering the relationship between objects, the notion of "inclusion" is introduced. A class of objects $O_{i+h,k}$ will be included in the class of objects $O_{i+h-1,k}$ when each element of the former is also an element of the latter, but the reciprocal is not true.

1.5 Immediate Inferences, Syllogisms, Syllogistic Figure and Modes

Immediate inferences or the inferences, in which from a single proposition another proposition can be obtained, result from the so-called logical square (quadrilateral); there are four groups of immediate inferences: by subordination, by opposition, by conversion and counterposition.
Aristotle, in a systematic study of inferences, considers proposition from the point of view of "quality" and "quantity": "I name it universal when something belongs to everybody or to nobody, particular when it belongs or does not belong to some..."
In traditional logic S and the predicate note subject by P.
The propositions will be: All S are P; all S are not P;
Some S is P; some S are not P.
The general presentation of a proposition (prepositional functions) without taking into account quality and quantity has the form: S is P or S – P.
Starting from the Latin words for the affirmative and the negative assertion, "afirmo" and "nego" respectively, general affirmative propositions are noted by SaP using the first vowel of the word "afirmo" and particular affirmative propositions by SiP using the second vowel of the same word; correspondingly, the other two propositions will be SeP and SoP.
According to Aristotle, a syllogism consists on the inference of a sentence from other two sentences.
The propositions from which we start are called premises; the deduced proposition is the inferred proposition, the conclusion respectively. The relationship between premises is established by a common notion (the medial term M). Noting the subject notion of the conclusion by S, the predicate notion by P and the common notion of the premises by M, according to Aristotle, four possible syllogistic figures result.
Aristotle did not recognize the fourth syllogistic figure as an independent one, although he explicitly formulated it.
The formulations of Aristotelian syllogistic figures are the following:

	I)	II)	III)	IV)
P_1 – premise 1:	M-P	P-M	M-P	P-M
P_2 – premise 2:	S-M	S-M	M-S	M-S
C – conclusion:	S-P	S-P	S-P	S-P

By replacing the symbol "-" with the letters "a", "i", "e", "o" the following syllogistic modes are obtained for each syllogistic figure :

-Syllogistic figure 1: modes : Barbara, Barbari, Celarent, Celaront, Darii, Ferio;
-Syllogistic figure 2: modes : Baroco, Camestre, Camestro, Cesare, Cesaro, Festino;
-Syllogistic figure 3: modes : Bocardo, Darapti, Datisi, Disamis, Felapton, Ferison;

-Syllogistic figure 4: modes: Bamalip,Camanes,Camenop, Dimaris, Fesapo, Fresison

1.6 Relations of Equivalence, Relations of Order

If X and Y are two sets, then
$X \times Y = \{(x, y) : x \in X, y \in Y\}$ is named their Cartesian product.
A *binary relation is an ordered triplet* $\rho = (X, Y, G)$, where X and Y are basic sets of ρ and $G \subset X \times Y$.
If the two basic sets coincide, the binary relations are called homogeneous.
For the binary relation $\rho = (X, Y, G)$, $G \subset X^2$ takes place: therefore, it is a homogeneous binary relation on set X.
Among the homogeneous binary relations, the equivalence and order relations are to be remarked.
The binary relation $\rho = (X, Y, G)$, is equivalence on set X if it satisfies the following *conditions:*
- It is reflexive, i.e. $x \in X \Rightarrow x\rho x$;
- It is symmetrical, i.e. $x\rho y \Rightarrow y\rho x$;
- It is transitive, i.e. $x\rho y$ and $x\rho z \Rightarrow x\rho z$.

For such a binary relation, to an arbitrary element $x \in X$ its class of equivalence will be associated as it follows:

$$\rho_x = \{y : y\rho x\}$$

For distinct elements x, y, classes of equivalence ρ_x, ρ_y are disjunctive or they coincide.
Due to the reflexivity property, any element x from X belongs at least to be class of equivalence $(x \in \rho_x)$, so:

$$\bigcup_{x \in X} \rho_x = X$$

Set $X/\rho = \{\rho_x : x \in X\}$ constitutes the factor set or the quotient set of X by the relation ρ ; its elements are equivalence classes and they form a partition of set X.
Partition X/ρ uniquely determines the equivalence ρ.
Application $\pi : x \to X/\rho$ defined by $\pi(x) = \rho_x$ is named the canonical projection of equivalence ρ.
The binary relation $\rho = (X, Y, G)$ is a homogeneous binary relation of order for set X, if it is reflexive, transitive and "anti-symmetrical", i.e.:

$$x \lhd y \quad \text{and} \quad y \lhd x \Rightarrow x = y$$

Considering a fixed set U, a "universe" and any sets X, who can be then, considered elements in U, equivalence on universe U can be defined.
A class of equivalence is named cardinal number in universe U; the equivalence class of a set X will be named the cardinal of X in U.

1.7 Arborescent Graphs. Taxonomy

A graph is a set of peaks or nodes and of arcs which connect these peaks and nodes.
As arborescent graph is a particular graph in which there is a peak S called root, so that any peak of the graph is linked with S by a unique route.
The arborescent graph is also known as tree.
Taxonomy or taxonomic arborescent graph is a graph in which there are inherited properties.
The construction of taxonomy enables the system to know that an element has, besides its own properties, the properties of all its precursors in the graph.
Taxonomy is used for hierarchic graphs.

2 The Elaboration of the Generalized Three-Matrix Object-Property Model and the Modeling of Aristotelian Syllogistic-Inferential Processes

For the elaboration of the generalized model, the paper considers knowledge fields (the ontos) to be ensembles or systems, which have corresponding specific structures.
Applying the methods of structural analysis, dichotomic division, the theory of semantic steps, the theory of types and taking into account the inclusion property which will be considered of a " diachronic type", it follows that a given property P_{00} more exactly the "existence" property in a Hegelian sense, belongs to an origin object O_{00} which is nothing but the field of universal knowledge initially approached (ontos).
We consider "genus proximus" the object corresponding to the superior step (O_{i-1k}), and "differentia specifica" – corresponding to a property (P_{ik}) in relation with which this object is devided into two successors O_{ik} and O_{ik+1}.
Accepting Leibniz's concept of "definition chain" and repeatedly applying the mechanism of "dichotomic division, it follows that the newely obtained objects can be considered new "genus proximus" which, in relation with new "differentia specifica" are divided into other new objects.
Consequently, a knowledge field (ontos) can by modeled by three matrices, namely: object matrix (1); property matrix (2), and, as the relations between objects can be of synchronic end diachronic type, relation matrix (3).

a) - diachronic (3.1)
b) - synchronic (3.2)

$$\begin{bmatrix} O_{00}(\text{axiomatic}) \\ O_{11} \quad O_{12} \\ O_{21} \quad O_{22} \quad O_{23} \quad O_{24} \\ \cdots\cdots\cdots\cdots\cdots\cdots \\ O_{i-11} \quad O_{i-12} \cdots O_{i-1k} \quad O_{i-1k+1} \cdots \\ O_{i1} \quad O_{i2} \cdots O_{ik} \quad O_{ik+1} \cdots \\ O_{i+11} \quad O_{i+12} \cdots O_{i+1k} \quad O_{i+1k+1} \cdots \\ \cdots\cdots\cdots\cdots\cdots\cdots \end{bmatrix} \quad (1)$$

Object matrix

$$\begin{bmatrix} P_{00}(\text{axiomatic}) \\ P_{11} \\ P_{21} \quad P_{22} \\ P_{31} \quad P_{32} \quad P_{33} \quad P_{34} \\ \cdots\cdots\cdots\cdots\cdots\cdots \\ P_{i-11} \quad P_{i-12} \cdots P_{i-1k} \quad P_{i-1k+1} \cdots \\ P_{i1} \quad P_{i2} \cdots P_{ik} \quad P_{ik+1} \cdots \\ P_{i+11} \quad P_{i+12} \cdots P_{i+1k} \quad P_{i+1k+1} \cdots \\ \cdots\cdots\cdots\cdots\cdots\cdots \end{bmatrix} \quad (2)$$

Property matrix

Relation matrix

a) Diachronic

$$\begin{bmatrix} \Re_{0011} \quad \Re_{0012} \\ \Re_{1121} \quad \Re_{1122} \quad \Re_{1223} \quad \Re_{1224} \\ \Re_{2131} \quad \Re_{2132} \quad \Re_{2233} \quad \Re_{2335} \quad \Re_{2336} \quad \Re_{2437} \quad \Re_{2438} \\ \cdots\cdots\cdots\cdots\cdots\cdots \end{bmatrix} \quad (3.1)$$

b) Synchronic

$$\begin{bmatrix} R_{1112} \\ R_{2122} \quad R_{2324} \\ R_{3132} \quad R_{3334} \quad R_{3538} \quad R_{3738} \\ \cdots\cdots\cdots\cdots\cdots\cdots \end{bmatrix} \quad (3.2)$$

By assimilating notions with classes of objects, it is possible to achieve mathematics modeling of Aristotelian syllogistic figure using the theory of graphs, as well as the theory of sets. Each syllogistic mode has a corresponding mathematics model represented by an oriented graph with an arborescent structure of a binary tree – type and a model given by sets and subsets consisting of object classes.

3 The Elaboration of the Generalized Syllogistic Hypergraph

3.1 Characteristica Universalis

Defined by Leibniz as a system of signs and formulae, so that in a scientific system each object and relation should have a corresponding sign, characteristica universalis is associated with the generalised syllogistic hypergraph (fig.1) which will enable the founding of the science named "scientia generalis", within which the principles of the "general methodology" of sciences can be elaborated.

3.2 The Thing in Itself. The Aristotelian Concept of Matter

In his "Criticism of Pure Reason". Im. Kant turned the problem of existence into the "thing in itself".

The thing in itself is the support of a mental edifice, the seal of knowledge instructions.

The a priori pure reason, the theoretical reason (before the experiment) plays the part of a framework in knowledge.

According to Kant, reason should determine the object: "reason notices only what it can produce itself according to its own plan, that it should go forward led by the principles of its judgements according to inflexible laws and force nature to answer its questions... "

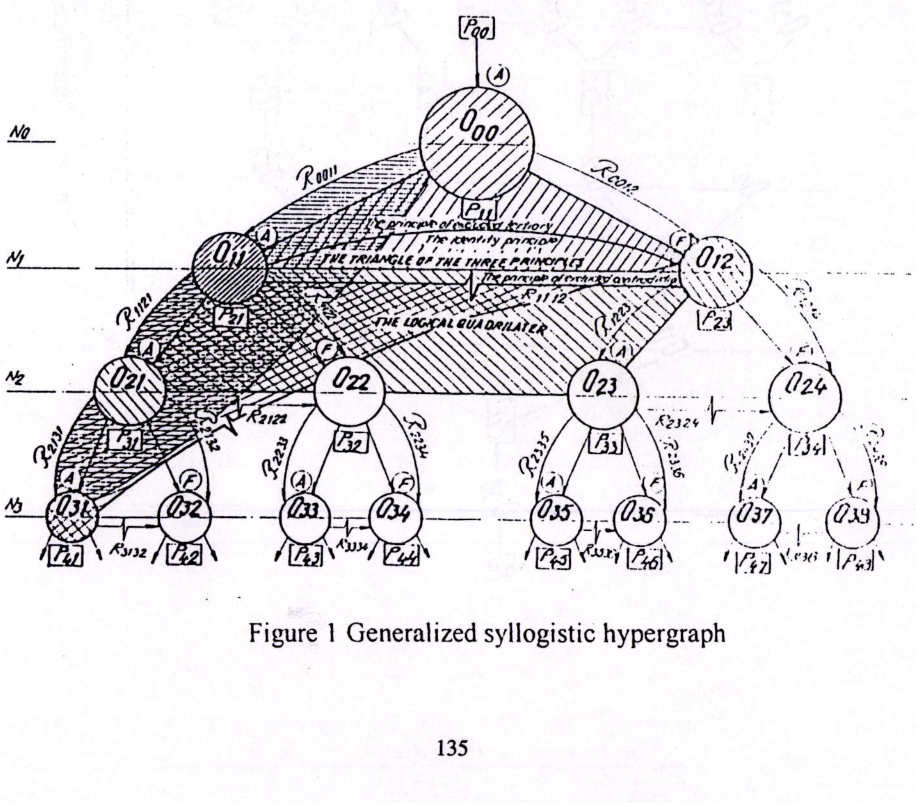

Figure 1 Generalized syllogistic hypergraph

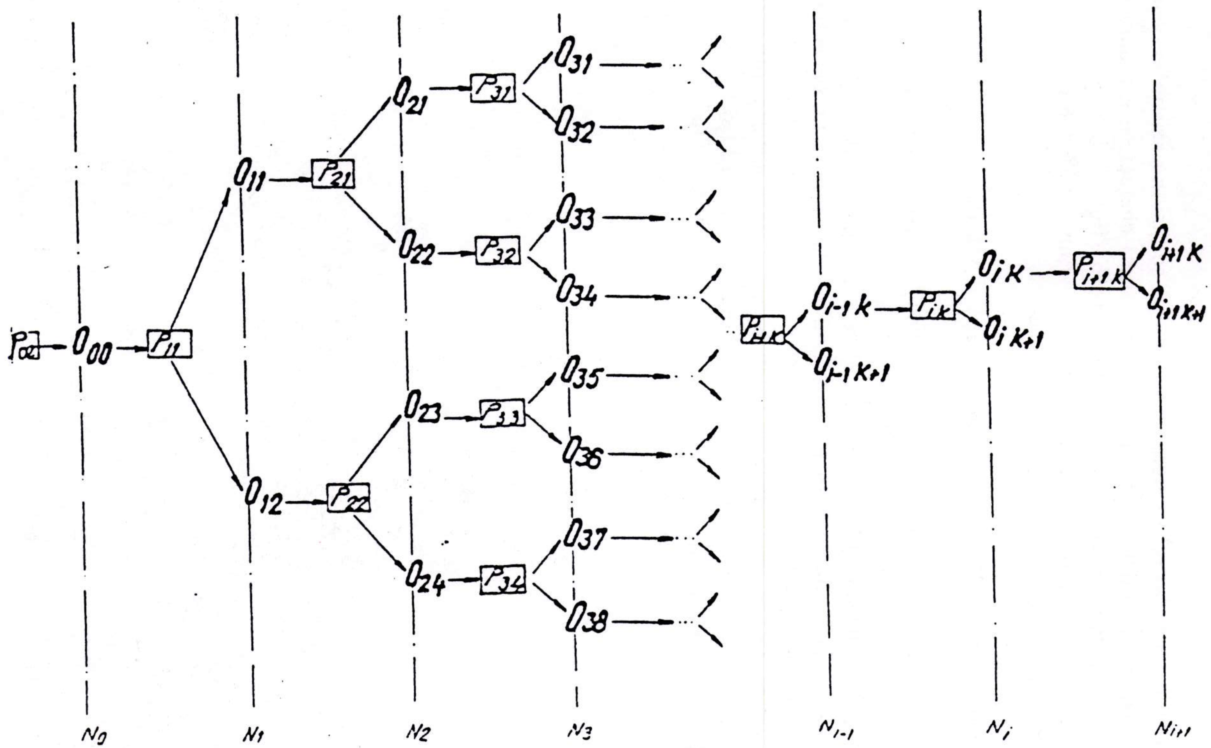

Figure 2: Generalized arborescent hypergraph (taxonomy)

The Aristotelian theory accepts matter as pure potentially. Matter is a principle (Physics, I, 7,191 c) and it represents the substratum of simple elements; by matter we understand "not that which can be determined in the act, but only in potency"; "matter exists potentially, because it is under its own shape only when it is in the act";"neither matter non form are subject to birth, only substances and things are, as they are made of substances and forms" (Metaphysics).

Matter is the substratum of changes, it is potential and it lacks attributes and it is shown in forms, as it is very difficult to define.

In Aristotle's view, the world cannot be reduced to a single principle, be it form or matter.

Neither can too many primordial principles be admitted "the infinite is not possible in the act and neither is it possible as a number of principles, but only one or two because principles are in a finite number; to consider only two principles has a certain reason...".

Aristotle considers that it is impossible to exist only one because the contrary is not one; neither is it possible to be endless, as existence wouldn't be intelligible.

He initially intended to keep only two principles, from and privation (lack of form) to be contrary to each other and solve the problem of existence and non-existence but then, the two principles wouldn't have had any substratum which is to be added ("that is why it can be said that there are two principles but, in a way, they are three").

3.3 The Generalized Syllogistic "Hypergraph"

Formalizing "the thing in itself" or the concept of matter in an Aristotelian sense by object O_{00} which has most general "existence" property P_{00} we shall introduce two methodological principles.

1. The principle of convergence to "AXIOMATIC ONE": any structure tends and converges ascendently to "AXIOMATIC ONE" which is associated to object O_{00};
2. The principle of "SUFFICIENT DIVERGENCE": any structure is descendently divergent on an unlimited number of levels; for it to be intelligible, however, a finite number of descendence levels are sufficient".
3. According to Kant, reason as an instrument of knowledge is applied to existence and pure, theoretical reason is a priori (a framework which is to be correctly filled with the results of experiences).

The Kantian apriorism of the framework-reason can be justified by the biarborescent structure of human brain, whose functioning can be formally explained by using the generalized syllogistic "hypergraph" (fig.1).

The generalised syllogistic hypergraph represents the model of the most general diachronic structures, constituted of structural-diachronic cells; it is elaborated by superposing three arborescent structures:

- Property arborescent graph (fig.4);
- Object arborescent graph (fig.5);

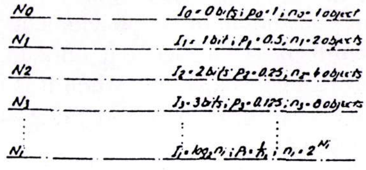

Figure 3: Diachronic space
(Diachronic levels)

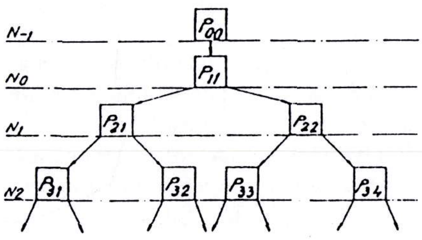

Figure 4: Property arborescent graph

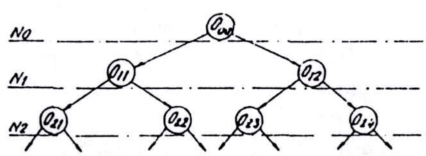

Figure 5: Object arborescent graph

The arborescent graph of :

- diachronic relations (fig.6);
- shyncronic relations (fig.7).

The generalised syllogistic hypergraph is asserted with the truth tree (fig.8), mathematically represented by the truth matrix (4).
The arborescent structures are mathematically represented by matrices (1), (2), (3.1) and (3.2).

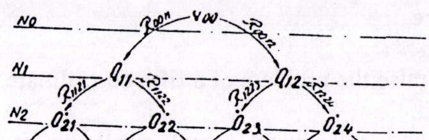

Figure 6: Arborescent graph of diachronic relations

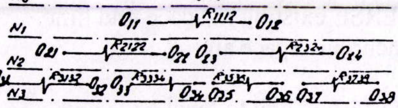

Figure 7: Arborescent graph of synchronic relations

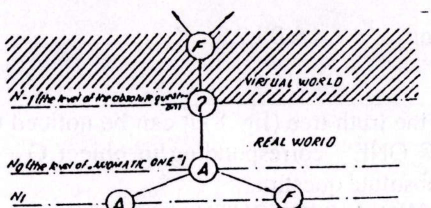

Figure 8: Truth tree

$$\begin{bmatrix} A_{(\text{axiomatic})} & & & & & \\ A & F & & & & \\ A & F & A & F & & \\ A & F & A & F & A & F \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \end{bmatrix}$$

Truth matrix

3.4 The Diachronic Space

Descartes was the first to raise the problem of a fifth co-ordinate, besides space and time but he rejected it as absurd.
This paper introduces an extra co-ordinate, namely depth, or diachrony.
We shall name diachronic or hypercartesian space the limitless ensemble of diachronic levels, consisting of a sequence of levels $N_0, N_1, \ldots, N_i, \ldots$ (fig.3); each diachronic level a corresponding "step" in the becoming of a UNIVERSE.

3.4.1 The Universal Parameters of Diachronic Space

The reference system of diachronic space contains the axes of diachrony and synchrony. The axis of diachrony represents the history of the becoming UNIVERSE, and the axis of synchrony represents UNIVERSE existing in space and time.
The universal parameters of diachronic space are:

- Diachronic levels N_i, $i=1,2,\ldots$;
- The quantity of information corresponding to level I_i;
- Level probability p_i;
- The number of objects corresponding to level n_i.

The relations between the universal parameters are :

$$n_i = 2^{N_i} \quad P_i = \frac{1}{2^{N_i}} \quad I_i = \log_2 2^{N_i}, \quad i = 0,1,2,3,\ldots K,\ldots \tag{4}$$

From the representation of the truth tree (fig. 8) it can be noticed that, besides level N_0, the level of "AXIOMATIC ONE", corresponding to object O_{00} (fig. 1), there is also level N_{-1}, the level of the "absolute question".
Level N_0 corresponds to "AXIOMATIC TRUTH".
Level N_{-1} is the level of symmetry between the "REAL WORLD" and the "VIRTUAL WORLD".
According to the principle of "SUFFICIENT DIVERGENCE" the last level in the "SUFFICIENT" number of levels will be associated to the zero step from the theory of semantic steps (N_i).
The objects of this step which belong to objective reality approached to as knowledge field, form a universe (U) or a set of sets.
Considering the objects on the diachronic levels to be sets applications $\pi_i : U \rightarrow U/\rho_i$ defined by $\pi_i(x) = \rho_i$, where ρ_i are unique equivalencies specific to diachronic levels and determining partitions are named canonical projections of equivalencies ρ_i.
Each diachronic level has a corresponding class of equivalence, therefore a cardinal number (n_i).
According to the cardinal of each level, it is possible to calculate the level probability (p_i) and the quantity of information I_i corresponding to the level.

According to the principle of convergence to "AXIOMATIC ONE" the limit of the cardinal numbers row tends to "ONE".

As cardinal numbers are classes of equivalence, which, imply binary equivalence relations defined in Cartesian spaces, the diachronic space constitutes a hypercartesian space.

3.5 The Universal Knowledge Base

The achievement of a "scientia generalis" requires the construction of a universal knowledge base.

For this construction, it is necessary to associate notions concepts to the objects (O_{ik}) in the generalized syllogistic hypergraph (fig.1).

Mathematically, the objects in the "graph's ways (sequences of arcs)" will be considered as well ordered sets (which imply the existence of a first element O_{00}).

For example, the following set:

$$\{O_{00}, O_{11}, O_{22}, \ldots, O_{i-1k}, O_{ik}, O_{i+1k}, \ldots\} \tag{5}$$

The objects on the diachronic levels have the following corresponding properties: actual (P_{ik}), a priori (P_{i-1k}) and a posteriori (P_{i+1k}); consequently, in the construction of the "knowledge base", properties should be approached to as well-ordered sets whose first element is P_{00} (the property of maximal generality).

A way from the generalized syllogistic hypergraph has the following corresponding well-ordered set of properties:

$$\{P_{00}, P_{11}, P_{21}, P_{32}, \ldots, P_{i-1k}, P_{ik}, P_{i+1k}, \ldots\} \tag{6}$$

Between objects and properties there are well-ordered sequences and well-ordered sets of diachronic and synchronic relations are established, which determines each object to have a chain of well-ordered inherited properties.

The structure of the generalized semantic network of objects requires a hierarchic organization of objects (concepts, notions) by a generalized taxonomic arborescent graph (fig.2) which enables each object to possess, besides its own properties, the properties of all its predecessors in the graph.

3.6 The Structural-Diachronic Cell

Let be an elementary structure (fig.1.1) from the generalized syllogistic hypergraph (fig.1), where :

- i – the index of diachronic levels;
- k – the index of synchronic objects;
- N_i – diachronic levels;
- P_{ik} – properties;

O_{ik} – objects;
$\mathfrak{R}_{ik}$ – diachronic relations;
R_{ik} – synchronic relations;
n_i- the cardinal of the synchronic objects on a diachronic level;
p_i – level probability;
I_i – the quality of information associated to a diachronic level.

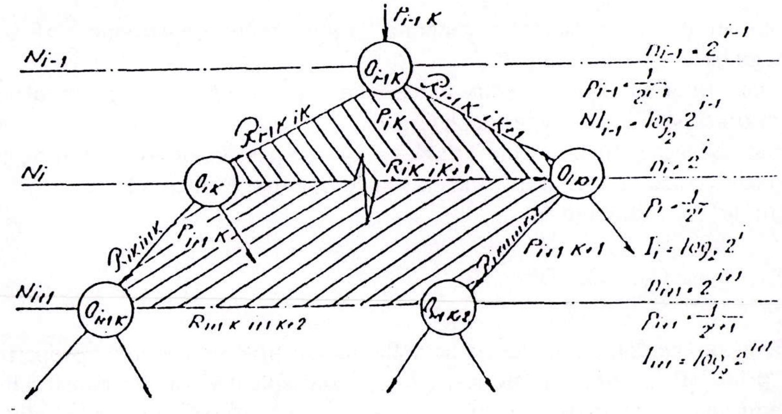

Figure 1.1: Structural – diachronic cell

The structural-diachronic cell will be defined as the minimal quatro-property, three-object, three-relation ensemble.
Mathematically, this cell is defined as the set of the three minimal property-object-relation sets, as follow:

$$\{\{P_{i-1l}, P_{ik}, P_{i+1k}, P_{i+1k+1}\}, \{O_{i-1k}, O_{ik}, O_{ik+1}\}, \{\mathfrak{R}_{i-1kik}, \mathfrak{R}_{i-1ki+1}, \mathfrak{R}_{ikik+1}\}\} \quad (7)$$

Where:

P_{i-1k} – the a priori property;
P_{ik} – the actual property (in act);
P_{i+1k} – P_{i+1k+1} – aposteriori (potential) properties;
O_{i-1k} – diachronic precursor (proceeding) object;
O_{ik}, O_{ik+1} – synchronic successor (descendent) objects;
$\mathfrak{R}_{i-kik}$, $\mathfrak{R}_{i-kkik+1}$ – diachronic relations;
R_{ikik+1} – synchronic relation.

The structural-diachronic cell can be mathematically modeled by three elementary matrices:

$$1 - \text{the property} - \text{elemntary matrix} \begin{bmatrix} P_{i-k} & \\ P_{ik} & \\ P_{i+1k} & P_{i+1k+1} \end{bmatrix} \tag{8}$$

$$2 - \text{the object} - \text{elemntary matrix} \begin{bmatrix} O_{i-1k} & \\ O_{ik} & O_{ik+1} \end{bmatrix} \tag{9}$$

$$3 - \text{the relation} - \text{elemntary matrix} \begin{bmatrix} \mathfrak{R}_{i-1kkik} & \mathfrak{R}_{i-kki+1} \\ R_{ikik+1} & \end{bmatrix} \tag{10}$$

The bit as an elementary unit for measuring information, can be associated as a measure of the structural-diachronic cell.
The diachronic structure is the ordered ensemble of structural diachronic cells, which can be represented by a graph.
Information represents the measure of the diachronic structure.

3.7 The Triangle of the Three Logic Principles

Considering an object O_{00} (a UNIVERSE), this can be divided only into two objects O_{11} and O_{12} according to the principle of the "EXCLUDED TERTIARY", so that the two objects (descendants, successors) should necessarily be in a relation of contradiction according to the principle of the "EXCLUDED CONTRADICTION'; overlooking property P_{11} between the two resulting objects (sets classes) there is a relation of equivalence according to the "IDENTITY" principle (fig.1).
Generally, considering a precursor object O_{i-1k} (a UNIVERSE or set of sets) this can be divided only into two successor objects O_{ik} and O_{ik+1} (two sets of sets) according to the principle of the "EXCLUDED TERTIARY), so that the two descendent objects should necessarily be in a relation of contraindication according to the principle of the "EXCLUDED CONTRADICTION"; overlooking property P_{ik} between the two objects there is a relation of equivalence according to the "IDENTITY" principle (fig.1.1).

3.8 The Logical Quadrilateral (Square). Immediate Inferences.

From the generalized syllogistic hypergraph (fig.1) it follow that among four objects on two successive diachronic levels (N_i, N_{i+1}) there can be considered a logical quadrilateral (square) from which immediate inferences result and the following relations can be established.

1.- $\mathfrak{R}_{i-1kik}$ – all the elements of object (set) O_{ik} have the property P_{ik};
2.- $\mathfrak{R}_{i-1kik+1}$ – no element of object (set) O_{ik+1} has the property P_{ik};
3.- $\mathfrak{R}_{iki-1k}$ – some elements of object O_{ik} have the property P_{i+1k} ;
(the elements of object O_{i+1k});
4.- $\mathfrak{R}_{ik+1i+1k+2}$ – some elements of object O_{i+1k} (the elements of object O_{i+1k+2}) do not have the property P_{ik} (fig.1.1).

3.9 Inferences

The following general inference is considered:

If all S are M
And if all M are P
Then all S are P.

The from syllogistic hypergraph (fig.1) and from the representation of the structural-diachronic cell (fig.1.1) it follows that:

- if all the elements of object (set) O_{i+1k} on the diachronic level N_{i+1} have property P_{i+1k} and if all the elements of object (set) O_{ik} on level N_i have the property P_{ik}, then all the elements of object O_{i+1k} have the property P_{ik}.

From the analysis of the representation by graph of the syllogistic modes corresponding to Aristotelian syllogistic figures, it follows that the following relations established between object.

1.- direct diachronic relation-binary relations between two objects on two successive diachronic levels ($\mathfrak{R}_{i-1kik}$);
2.- transcendental diachronic relations binary relations between two objects which are not on two successive diachronic levels (eg: $\mathfrak{R}_{i-1ki+1k}$);
3.- synchronic relations of contradiction-binary relations between two successive synchronic objects on the same diachronic level (R_{ikik+1});
4.- transcendental synchronic relations-binary relations between two synchronic objects which are not successive (e.g.: R_{ikik+2}).

3.10 The Definition

The definition is a diachronic homogeneous binary relation or order given by triplet (O_{ik},O_{i-1k},P_{1k}) and formally written:

$O_{ik} =_{Df} O_{i-1k}$, in accordance with property P_{ik},

Where : O_{ik} – definiendum; O_{i-1k} – definiens (genus proximus in traditional Logic);

P_{ik} –defferentia specifica.

Definition implies two successive diachronic levels corresponding to objects (O_{i-1k} ,O_{ik}) which are in a diachronic relation $\mathfrak{R}_{i-1kik}$. In a chain of definitions of a "Leibnizian" type, the sense is ascending. According to the principle of the convergence to "AXIOMATIC ONE" object O_{00}.

4 Conclusion

1.The elaboration of the generalised syllogistic hypergraph gives the theoretical possibility of unifying sciences in a "scientia generalis".

2. The rigorous formalisation of inferences and syllogisms by the theory of graphs the theory of sets, unified in the generalized syllogistic hypergraph, will enable the achievement of artificial intelligence with functions similar to human brain and having a universal knowledge base;

3. The scientific concepts, notions and assertions are presented nowadays in an entropic and redundant manner which makes it difficult both their learning and their comprehension for the human brain, as well as impossible to be implemented in the Intelligent Systems, respectively in Artificial Intelligence.
4. The application of the studies will be "The Unification of Sciences" in "Sciencia Generalis" of Leibniz, where a science is metascience of its immediate successor in arborescent structure ascending-converging, respectively descending-diverging, requiring the collaboration of the scientists of the World Science Academies.

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