Language and Geometry

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Abstract
This study compares language and geometry which are both communication tools with their own specificities and performances. It follows a briefly presentation of the essential characteristics of languages and geometry to discover their main similarities in the domain of knowledge transfer. The waves are the essential language vehicles: sounds or vocal waves for conversations and lectures; electromagnetic waves for reading the scriptures. Consequently waves need a space for their propagation. On the other side, any language needs a diffusion space between the interlocutors. The three-phase structures in the fragmentation of our social proximity is indicated by the personal pronouns which structure our conjugations.
Verbs are the kinematic components of any sentence, they bring movements, modifications as well as descriptions of states and situations. Therefore we draw a functional analogy between verbs and waves. It is the crucial point of this report.
In relation to their significations, a verb partition is performed in a hexagonal configuration which supports on the first side 3 active verbs: motor, social, anticipative verbs and on the second side 3 statics: state, reactive, metrological verbs.
The tense range locates any sentence along the time axis. Consequently these ones can follow variation sequences and introduce the kinematic behaviour. For their representing topology it is requested to use a multidimensional complex space whose real axes support the objective tenses of simple description and whose imaginary axes support the tenses loaded with subject intentions.
The future tenses necessary bring anticipative views.

Keywords : Communication processes, Verb classification, Waves,
Geometrical configuration

1. Introduction

For a long time, I am thinking that geometry contains a few possibilities to help the information retrieval from many various domains.
Consequently we let remind that the first communication middles were constituted by caricatures or schemes of animals, objects and persons engraved on the rock of inhabited caverns. At this first stage of the manhood evolution, these picture languages were sufficient for expressing the basic needs of our very far ancestors. At present our Indo European and Semitic languages are word assemblies. Consequently their structures are

completely abstract without any apparent geometric influence. To be able to understand and use these languages we have to learn their specific vocabularies and grammars. On the other side they gain a powerful efficiency to translate the abstract topics such as feelings, thoughts, idea concatenations, reasoning, logic proposals, forecasting. This is the proof that the words bring high potentiality to express large series of accurate concepts.

Here the geometric behaviour of verbs is deduced and related to waves. Any communication way needs propagating wave through a carrier space, what expresses its geometric insertion.

The geometric sentence configuration will be treated in a second report

2. Properties of Language

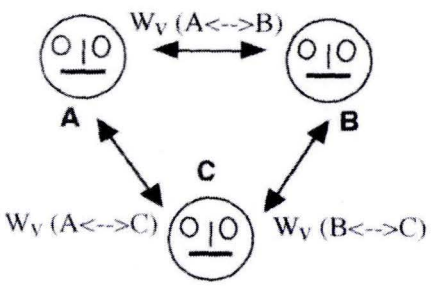

Fig.1: Conversation

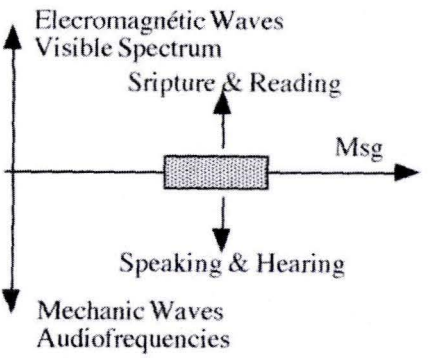

Fig.2: Message Conversion in oral and scripted Forms

Language is an essential diffusion agent of thoughts from our mind to other minds and it also gives the possibility of intercepting and interpreting the ideas from surrounding people. (Fig. 1)

Language appears in both forms: in oral form by means of speeches, lectures, conversations, phone connections; in script form by means of books, letters, newspapers, electronic mail. (Fig. 2)

Language is the essential key of the civilization progress. It is the stimulating fuel for our mind working. It plays as the cement of the social relations, of the teaching processes, of any commercial dealing. (Fig.3)

Because any language transmits knowledge flow between a few persons, it acts as a propagating flow which is similar to a propagating wave. Accordingly we consider that waves are vehicles of language and travelling waves need a space for accomplishing their runs. These waves give a geometric specificity to any language. Language subtends any group activity and coordinates every business and industry.

Wave types: when we are speaking and hearing we use phonetic waves which are mechanical waves of frequency distribution: [20 Hz.....2 10^4 Hz]

When we are writing and reading, we use visible waves which are electromagnetic waves of frequency distribution: [370 10^{12}Hz (red).....750 10^{12}Hz (violet)].

This last frequency window is the visible spectrum what is the detection area of our eyes.

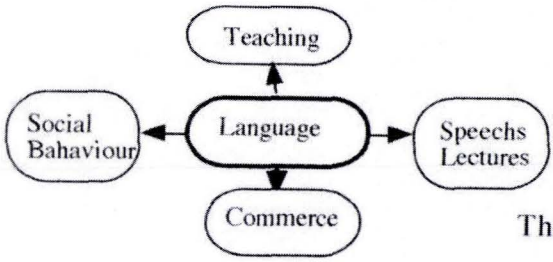

Fig.3: Language Applications

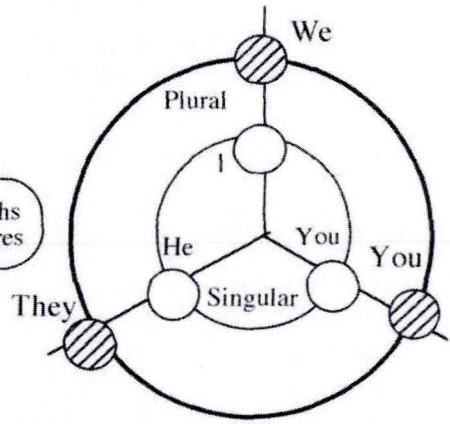

Fig.7: 3 phase Phasor of Pronouns

3. Essential Properties of Geometry

Geometry is the domain of spaces and figures. It studies the shapes and the locations. It values the distances, the areas, the volumes and the curvatures.(Fig.4) Geometry is very important in every technical domain and also for our behaviour. It subtends our observation field. Therefore it is the most useful mathematic matter which
records the characteristics of our neighbourhood. Indeed each object and its surrounding constitute a reduced landscape.
We underline that at each instant our mind implicitly uses geometric detections to deduce the best adapted behaviour under the surrounding circumstances. At each glance, we automatically deal a few geometric elements by comparing them with the next reference shapes of our mind data bank to identify these new records. Consequently our eyes are essential geometric sensors for the electromagnetic waves. Therefore they are the most efficacious estimators during the totality of our activities.
Geometry supplies huge multilevel storage spaces for various information, if they are transformed into picture forms. It plays as the long time memory of our mind.
This domain can be used as an observable communication language because each picture contents a set of information, detectable by anybody who carefully observes it.

4. Three Phase Structures in the Languages

The pronouns used in the verb conjugation divide our social vicinity in 3 parts.
This procedure translates the mind conception of our relations and may be interpreted as geometric action.
We use a right angle triangle for illustrating these action types (Fig.5)

Transformation of the singular forms to the plural forms keeps the triangular configuration. Instead of lone persons we consider groups what is indicated in table 2 and (Fig.6)

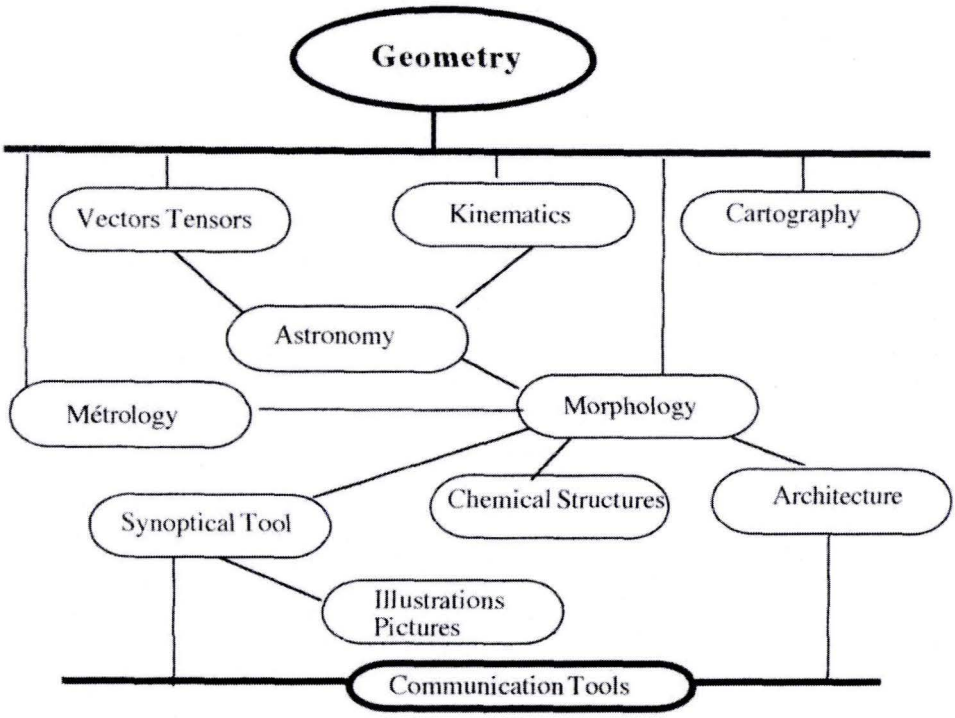

Fig.4: Essential Domains of Geome

Table1:Three Phase Structure of Conjugation (singular)

Pronoun	Verb	Explanation & Interpretation
I	work	Description of my own action
You	work	I speak to a selected person about his action
He (She)	works	Mention of the action of a third person with whom I don't have any particular relation

Table2: Three Phase Structure of Conjugation (plural)

Pronoun	Verb	Explanation & Interpretation
We	work	Description of our own action
You	work	We speak to selected group about their action
They	work	Mention of the action to a third group with whom we don't have any selected relation

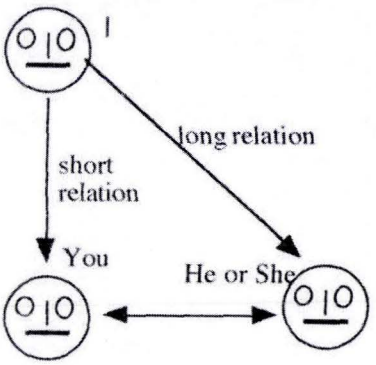

Fig.5: Triangular Distribution of singular Pronouns

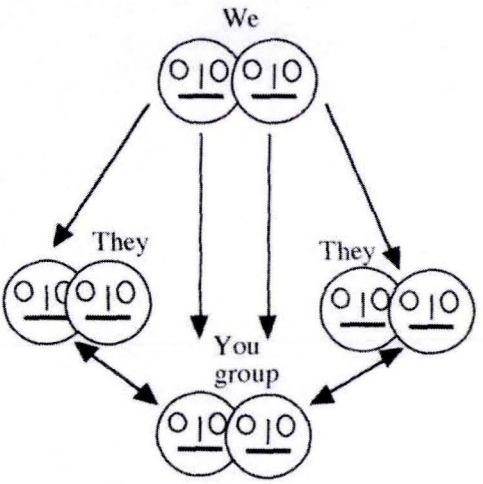

Fig. 6: Triangular Distribution of plural Pronouns

Adaptation of the singular right angle triangle to the plural cone
At first we give a rotation the (I - He) hypotenuse around the (I -You) axis what amplifies the (He) point in a circle, where the members of the (They) group may be distributed.
The following operations amplify the (I) and (singular You) points in the respective (We) and (plural You) circles. (Fig.6).
It is also possible to use a "star configuration" to represent the persons of the conjugation. (Fig.7)

5. Tenses of Verbs

These tenses divide the time in 3 main periods what gives Past, Present and Future. This has to indicate when the considered verb acts. This inserts another three phase partition along the time domain. (Figs. 8-9)
Properties of the time periods related to our behaviour.
Past is dead and consequently fossilized for us. It is impossible to modify any past event. It can influence our present by means of our memories and consequently transmits us a sum of information. It induces our present circumstances as an integral regulator.
Present is alive and may be constructed by our activities. It is the tense for starting any undertaking. By this way it influences our future. It appears as an intermediary gate between past and future. This two- headed limit layer is an infinite short duration which transforms every future instant into a past instant. This is the effect of time run away.
Future is not yet born but it is ready to spring up to us. It is the anticipatory period and oft carries our wishes and hopes. It performs and provides the results of our present tasks.

Sometimes it may occur a sublimation of future in past, what corresponds to a virtual shunt of the present when our mind is disconnected off the reality: during sleeping or dreaming.
The variety of the tenses is due to our mind ability of dividing the time domain in thin sub slices, what produces an accuracy increase for the location of the action sequences. With each time determination we may associate a specified time sub domain in which some variable pictures are located. In this way each tense introduces a new sub dimension in the monotone homogeneous time domain which is split into a real patchwork. Each tense projects the effects of a verb in a specific instant with some various durations to permit the verb accomplishment and consequently introduction of continuous tenses for long actions connected to simple ones for short actions or mini events.

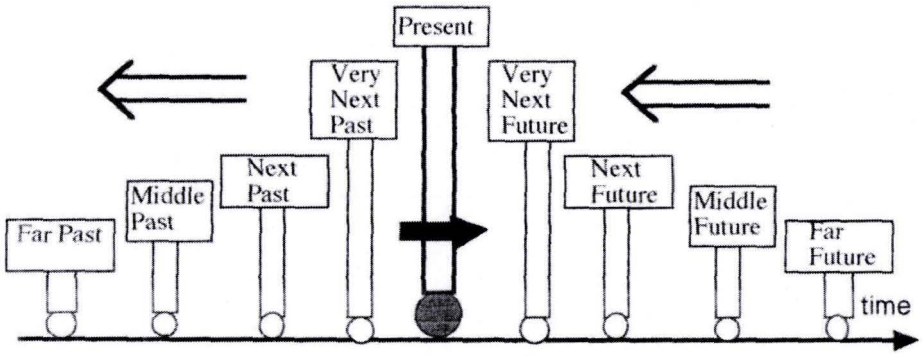

Fig.8: Mobility of Present from Past to Future

As a result from these previous deductions we systematically obtain the association of each tense with its specific dimension, what may give 9 time sub dimensions
(see Table 3)

Table 3: Simple Tenses and Time Subspaces

Tenses	Time Subspaces & geom. Addresses	Examples
Plus perfect	Far Past = T-4	I had worked
Preterit	Middle Past =T-3	I worked
Present Perfect	Near Past = T-2	I have worked
"To have just" form	Very Near Past = T-1	I have just begun to work
Present	Present = T_0	I work
"I am going to" form	Very Near Future = T1	I am going to work
Anterior Future	Near Future = T2	I shall have worked
Future	Middle Future = T3	I shall work
(Prospective Future)	Far Future = T4	(I will think to work later)

Table 3 indicates a minimum number of time subspaces. In some other languages such as Latin, Greek, it is possible to use other tenses what gives a different number of time

subspaces. The continuous tenses add prolongation to their associated simple ones and can perform time bridges between both successive simples ones.
It is also possible to differentiate these tenses by use of colours (see table 4)

Table 4: Correspondence between Tenses & Colours

Time Horizons	Colours	Visibility Grade
Far Past = T-4	Infra Red (I.R.)	Invisible
Middle Past =T-3	Red	Weak sensibility
Near Past = T-2	Orange	Weak Middle sensibility
Very Near Past = T-1	Light Orange	Middle sensibility
Present = T_0	Yellow	Most Visible (Max. Sensibility)
Very Near Future = T1	Light Green	Middle sensibility
Near Future = T2	Green	Weak Middle sensibility
Middle Future = T3	Violet	Weak sensibility
Far Future = T4	Ultra Violet (U.V.)	Invisible

Table 4 associates the Ultra Violet with the Far Future and the Infra Red with the Far Past. This colour distribution verifies the Doppler effect, because the future events are approaching us, with increasing frequencies, whereas the past events are flying away with decreasing frequencies.

6. The Moods of Conjugation

Action of loaded moods: they can impregnate any tense by subject feelings, appreciations or conditions. Therefore they are reactive ones. Consequently it is possible to classify the verb moods into two types.
Neutral or descriptive moods which are simply descriptive as photographic detectors without any appreciation. They put their tenses along active or real axes. They are: Indicative, Infinitive, Participle, Gerund. (Fig.9)
Reactive modes or loaded moods: they induce a subjective expression about the verb acting. They transfer the tenses to reactive or imaginary axes by analogy with the inductive or capacitive effects in electromagnetic domain. (table 5)

7. Word Kingdom and Lexicographic Space Curvature

The words constitute the wealth source of any language. Each word gives reference to a correspondent topic which may express: an action (verb), an object (name or pronoun), a property (adjective), a way of doing (adverb), a linkage (preposition or conjunction)
More words, more flexibility for expressing the ideas and projects and more power for mastering the thought variability. Indeed synonymy proliferation around each topic can increase language effectiveness as well as meaning density
These variations of meaning density are geometrically represented by local curvature variations in the projection space of the language.(Fig.10)

In recapitulation a flat space corresponds to an elementary language with a poor meaning flexibility. On the contrary, a deep hilly space can support a very developed language with high accuracy grade.

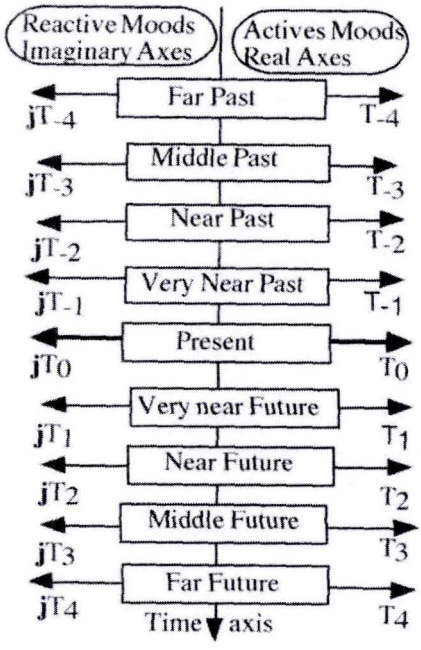

Fig.9: Tenses Topology

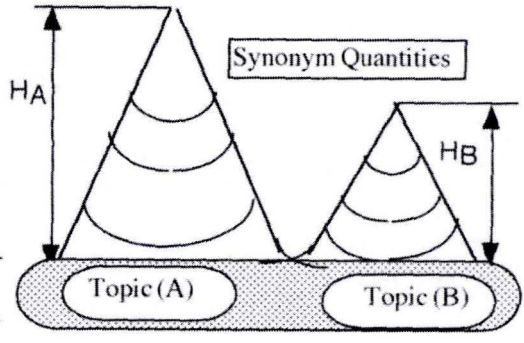

Fig.10: Curvature of lexicographic Space due to Synonym Density

Table 5: Meaning of Moods

Names of Modes	Reactivity Types	Kind of Axes
Indicative	Neutral	Real
Infinitive	Neutral	Real
English Gerund	Neutral	Real
Conditional	Hypothetical	Imaginary
Subjunctive	Obligation or Wish expression	Imaginary
Imperative	Command &	Imaginary
Latin Gerund	Obligation expression	Imaginary
Greek Optative	Wish Expression	Imaginary

8. Geometric Representation of Words

Words can express different kinds of topics: Some words translate material topics such as: objects, animals or persons, with well defined forms. They will be named mat words and will be immediately transposed keeping their associated profile in any circumstances.

They present the easiest configurations to transfer because our mind immediately records the pictures carried by these words. When we think "parrot", we say "parrot" and we see a parrot with its form and coloured feathers.

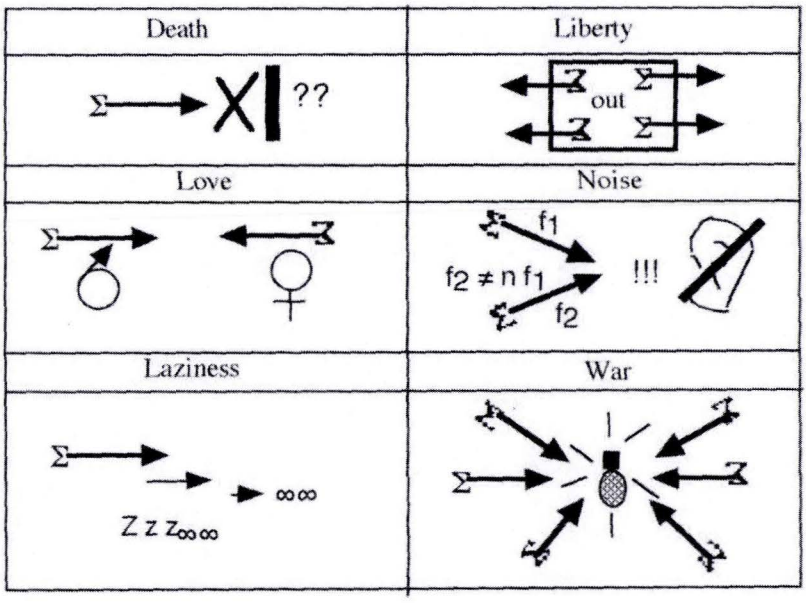

Fig. 11: Wave illustrating of the Abst Words of Table 6

Some other ones indicate abstract topics without any associated picture. They are metaphysical objects named abst words. To transfer these abst. words into geometric objects, it is necessary to search analogical ways. In these cases we link each of these with an allegoric figure.
It is possible to relate these abst. words to their visible effects by transition waves between the abstract source and its effects. It is a dynamic process travelling from causes to effect as waves. These waves of undefined frequency are recorded by their trajectories from the topic domain to the figurative one. The dynamic procedures are configured by short suggestive cartoons, moving stories supported by waves. (Fig. 11) and Table 6

9. Verb Classification

Each verb is the main element in its sentence. It gives the essential meaning of sentences. Therefore they structure the language and supply the dynamic of each idea development. The verbs may be considered as the locomotives of any information diffusion. They are the motors of our thoughts and the sculptors of the landscapes of our ideas.
There are different types of verbs for different tasks. This point of view induces the functional classification which is established in this study.

Table 6 Interpretations and dynamic Illustrations of a few abst. words.

Abst Words	Allegories	Dynamic Process	Transformation Waves
Death	A fleshless Being with a scythe	From evolution Sub Domain to petrified One	Disappearing Waves in a same sink
Liberty	Liberty Statue in New-York Harbour	Chain Breaking	Diverging waves from a closed cell
Love	Cupid with Arrows	Run of 2 persons into an embrace	Convergence of 2 Waves at equal frequencies
War	Canons, smoking Ruins	Soldiers in armed conflict	Explosion between Shock Waves
Laziness	Sleeping Worker on his Tool	Stopped Working	Braking wave with frequency decrease
Noise	Broken Ear	Disharmony between Drums	Stochastic wave Frequencies

There are two large verb divisions: the recording verbs for the estimations of the characteristics of their subjects and the action verbs for the transformations exerted by their subjects. In our hexagonal configuration, the recording verbs are located on the left side and the action verbs on the right. This selected procedure seems well adapted to classify the activities of our mind. When we develop any reasoning, it is logic to define the studied subjects and objects with care before their introductions into developments describing their influences on their surroundings. This logic process shows that it is necessary to detect a lot of information from the considered domain (= incident waves) before the planning of any project or undertaking (emitted waves). This is another proof that the languages play as bridges between minds and knowledge.

The table (7) gives a few verbs for the 6 predefined categories. This shows and explains the used ideas to obtain this partition.

10. Virtual Mobility of the Verb Classes

The reactive, state, metrological verbs indicate the potentialities of a subject or an object. Therefore these seem to slide along peripheral trajectories around the described entities for recording their characteristics. Consequently these will be considered as "around verbs or rotation verbs". (Fig.13)

The anticipative, social and trans verbs act along axial trajectories across the external surroundings. They produce effects in the space and consequently modify the structure and composition of the extended ecologic sphere. (Fig.13) The anticipative verbs act along the time axis because they bridge present with future and explore the time axis. The social verbs establish flows between us and other people; they organize our influence

zone. They develop bonds along the space axis. The trans. verbs express the mutual actions between us and our vicinity

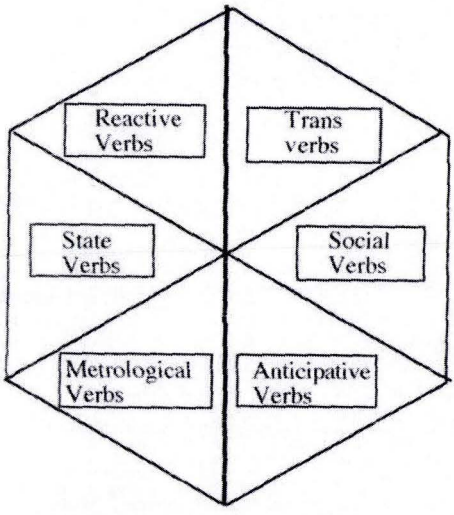

Fig.12: Hexagonale Verb Partition

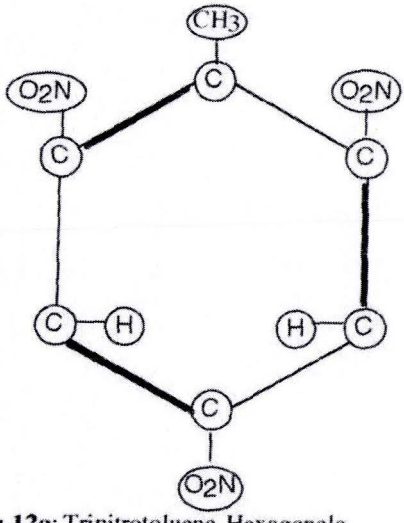

Fig.12a: Trinitrotoluene Hexagonale Molecule

These trans.verbs. play as idea motors for diffusing their performances and they also illustrate the technologic operations. The trans. verbs introduce the space anisotropy caused by their particular effects which induce specific curvatures. This last class triplet will be denominated "across verbs" to underline their space propagation. They slide along time axial or geometric radial trajectories and radiate across the whole external universe.

Table 7: Verb Classification

a)Verb Classes	Functions	Behaviours
State Verbs	Description of realities	Static: photographic Recorder
Metrological Verbs	Evaluation , Measure Comparison	Quantifiers Scale Developers
Reactive Verbs	Modify the abilities and levels of our mind & body	Potential Developer Actor is his own Objective
Anticipative Verbs	Express hope, supposition , or waiting	Future Inductors Forecasters
Social Verbs	Link persons each other	Organize the Society
Action Verbs Or Trans Verbs	Transform & Transport states or Idea along space and time axes	Operators acting in the surrounding

b) State Verbs	Meanings
to Be	Indication of a lot of qualities
to Seem	(idem with light uncertainty)
to Appear	Sudden state discovery
to Have	Mention of properties or acquisitions
to Posses	(idem)
to Display	Producing of information about an object
c)Reactive Verbs	**Meanings**
to Calculate	Algorithm development
to Learn	Knowledge storage
to Think	Mind activity
to Analyze	Knowledge decomposition
to Remember, to Remind	Reactivate old information
to Forget	Erase information Decrease the knowledge
d)Metrological Verbs	**Meanings**
to Measure	Quantitative determination of size
to Control	Data Verification
to Weight	Quantitative determination of mass
to Estimate	Qualitative determination
To Appreciate	Subjective qualitative determination
To Compare	Classification of elements
e)Anticipative Verbs	**Meanings**
to Hope	Thought projection from present to future
to Suppose	Extrapolation from present to future
to Wish	Feeling projection from present to future
to Prospect	Trial of future evaluation
to Search	performs result in a next future
f)Social Verbs	**Meanings**
to Link	Develops relations
to Invite	Contacts other persons
to Speak, to Write	Communicate information to auditors
to Gather , to Group	Social structures
to Sell , to Buy	Commercial acts
c) Trans Verbs	**Meanings**
to Construct	Action verb
to Transform	Modification verb
to Carry, to Send	Transport verb
to Move	Transport verb
to Work	Action verb

g)Overlapping Meaning	Class Denominations	Class Denominations
to Give	Social verb	Trans verb
to Prepare	Anticipative verb	Trans verb
to Diffuse	Trans verb	Social verb
to Appreciate	Metrological verb	Reactive verb
to Appear	State verb	Trans verb

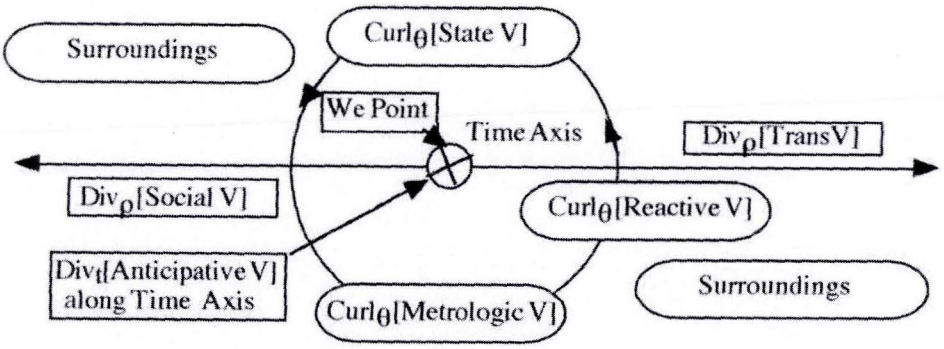

Fig.13: Functional Trajectories of the 6 Verb Types

At present we have obtained 2 important verb groups which follow both trajectories : "around group" or "circular group" and on the other side " across group" or "divergent group". These mobilities implie a cylindrical structure with time axis orthogonal to the geometric plans. The figure centre, at present time and location, corresponds to our effective position and defines the "We point". (Fig. 13) The concentric circle support the "around group", the time axis is for the anticipative verbs and the radial axes for social and trans verbs. When the verbs are working, there is introduction of a dynamic topology which causes whirls.

11. Advantages and Limits of our Verb Classification

Each classification always results from selected decisions. Here we have followed a useful logic, oft developed by electrical engineers. It is founded over the discrimination between storage caused by reactive power and the dissipation or conversion of active power. These dual behaviours oft structure the composition of our activities wherein reactive touch may impregnate active transforms. Here we divide the verb set into 6 categories whose the first triplet contains the "around verbs" or reactive verbs and the second one the "across verbs" or active verbs. This division introduces a fine functional symmetry.

Why only 6 classes and no more ones? Because a too important number of classes becomes rather cumbersome, it is necessary to limit the category number following the statistical procedures for grouping event series into a few classes. We underline that the hexagonal configuration is largely spread in a few sciences. It is the structure of the set of benzene molecules and their derivatives which are the main component parts of a lot of

explosives, aromas, colouring matters. (Fig.12a) presents as example, the hexagonal molecule of Trinitrotoluene, a powerful explosive

Besides some overlapping of verb classes is unavoidable because the flexibility and the extended meaning of a few verbs. (Fig. 14) The table (7g) indicates overlapping types.

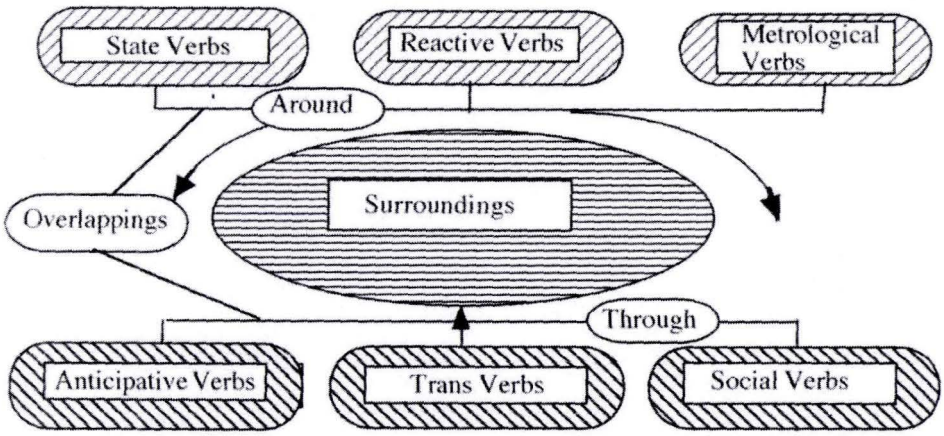

Fig. 14: Representation of Overlapping between the 6 Verb Kinds

12. Functional Similarities between Verbs and Waves

In chapter 9 we have associated with each verb group a specific movement. Consequently the verbs transport their actions through time and geometric space and they act as idea vehicles what have already been mentioned. Here, the main idea tries to highlight the essential dynamic effect carried by any verb because we have associated trajectories to each verb indicated in the mentions "across and around verbs". This induced mobility in the verb interpretation drives to the comparison with the waves.

Waves present a few kinematical similarities with verbs. (fig.15)

The travelling waves play as vehicles throughout their propagation space. They can carry power or information between different sub domains by following circular or linear trajectories. But the wave movements modify the space profiles because they develop action fields along the sliding trajectories. These fields introduce kinematical anisotropy. We are again plunged in the cylindrical topology, already presented for the "across and around verbs".

Divergent fields due to axial and radial waves are directed along the "across" trajectories; rotational fields due to circular waves are directed along the "around" trajectories. This similarity between verb and wave trajectories offers the possibility to define the following operators applied to information flows for translating verb actions in time and space:

$Div_\rho(\Phi)$ = Div_ρ(Trans V.) or Div_ρ(Social V.), where Φ is the transported radial flow

$Div_t(Ft)$ = Div_t(Anticipative V.), where Ft is the flow transported along time

$Curl_\theta(\Psi_\theta)$ = $Curl_\theta$(State V.) or $Curl_\theta$(Metrological V.) or $Curl_\theta$(Reactive V.)

where Ψ_θ is the transported circular flow.

This strong analogy between verbs and waves shows a supplementary way for asserting the kinematical behaviour of the language.

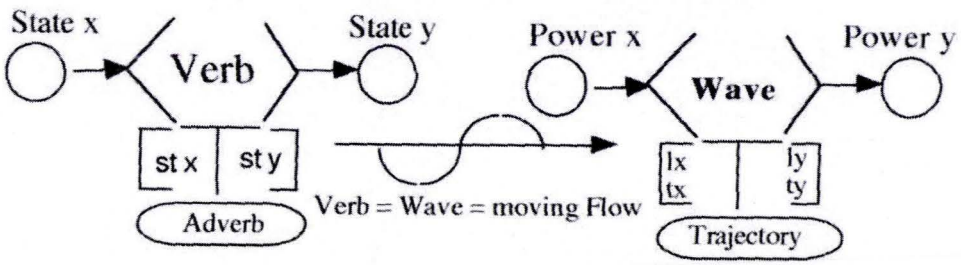

Fig. 15: Similarities between Verbs and Waves

13. Further Identification of Verb with Wave

This viewpoint has been written in the Gospel according St John:
Indeed this holy link becomes obvious when we successively consider in the chapter 1, the verses (1 & 4) Hereafter in table 8, are noticed both verses:

Table 8: Verses according St. John

Verse 1	In the beginning was the **Verb** and the Verb was with God, and the Verb was God
Verse 4	In Him was **Life**; and the Life was the **Light** of men

From table 8, it is possible to retrieve the following sequence:

God is Verb; and Verb is Life; and Life is Light.

It gives an identification of Verb with Light and Light is an electromagnetic Wave. Finally it is possible to obtain the following crucial relation: "Verb is Wave". This assertion is the shortage of an essential point of this communication.

14. Conclusion

After this study, the geometric integration of language has to appear as a very natural powerful procedure displaying useful illustrations for a better universal understanding of language. Here we have explored the ground three phase structures at the level of the thought and of the relations between topics. The functional verb analysis develops bridges between their meanings and kinematical evolutions. The operational coupling between verbs and waves links a very extraordinary pair of vehicles: verbs are the sentence locomotives for ideas and travelling waves are the power carriers through time and space, always essential for any technologic transformation. It is logic that our mind thinks by kinematical schemes, because we live and work in a time evolutional geometry. It is also possible to acquire a new mnemonic view of our knowledge. This may be condensed with the following quadruplet: "to think, to say, to draw and to do"

To construct a more complete geometric illustration of the thought it is necessary to explore and visualize the sentence structures. This will be the task of our second report : "Sentences with Associated Geometry"

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