ADRIAN GAGEA

IDEAS AND ESSAYS INTRUDED INTO SCIENCE

Essay on the "Homo Intellectus" knowledge pattern
Essay on the predictive patterns
Essay on the labeling of measurands
Essay on the paradigm of value
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Născut Liber
2017

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> ***"Those among us who are unwilling to expose their ideas to the hazard of refutation do not take part in the scientific game."***
> ***(Karl Popper, "Logik der Forschung")***

FOREWORD

I am addressing myself to the people who believe that science, beside its goals of livability and profit, has also a more elevated motivation, directed toward some of the essential characteristics of the human spirit. That is the scientific curiosity, the desire to understand, the joy of knowledge, that honorable "engine" of the human species that eased man's evolution from a primitive lifestyle to the modern life. From this point of view, we feel obliged to bring homage to empathy and its respectable owners.

Aiming for a concise and unequivocal communication, the following paragraphs will define or detail the meaning in which I have used the basic notions of scientific research. I admit that I wrote these paragraphs, which are apparently redundant and somewhat inadequately presented from a didactic viewpoint, mainly because of my dissatisfaction for the way in which these notions are used in the everyday language or in popular dictionaries. For example, the notion of "force" is defined precariously in the Romanian Language Dictionary, first as an "ability of living beings (my note - pleonasm) to make an effort, to perform physical actions through muscle contraction...", then tautologically, and, not in the least, using incorrect synonymies with power, energy, also using the oddest language, etc.

Not to mention most physics textbooks that confuse force and the measurement of force (F=m.a), confuse processes and effects (displacement/movement, deformation, balance), etc.

The readers with a scientific background are asked to skip the aforementioned paragraphs and to read directly the essays (which I would like to think are thought-provoking). Some of these essay have been published in other books of mine, but there, because of a misunderstood sense of modesty, I did not mention they are original. Thus, my thought is better to feel sorry for writing them, then for not publishing them.

ON THE INSTRUMENTS OF KNOWLEDGE

The System

The system is a theoretical concept, an instrument of knowledge that simplifies the reality, making it observable. The system can be even a philosophy of knowledge... It improves the Aristotelian thinking, interspersing the process between cause and effect, so that the effect can depend parametrically also on the implicit characteristics of the process. For example, the stress; obviously it cannot be mistaken with the stressful factors (such as noise, uncertainty, etc.), but it is neither the effect (such as discordant behavior, drastic drop of attention, etc.), as it is neither just the process nor mechanism (physiological or psychological) that intermediates it, but it is *their entirety,* it is *the system itself.*

The classical definition, invoking the *genus proximus* and the *diferentia speciae*, is not enough. That is why, I believe, supplementary regulations are needed:

The system is a theoretical concept (instrument) of simplification of reality, elaborated for the facilitation of knowledge (the rule of justification) and formed of at least two nontrivial (the rule of observability) entities (the rule of consistency) and one relation (the rule of consequence).

The large diversity of definitions of the system in the professional literature argues the fact that its theory is not yet complete, or that it is not yet possible an unification of the notions. For example, the expressions "system of systems" or "intelligent systems" (the equivalent of the set with intelligent elements) are, in my opinion, debatable. The species of systems evolve quickly (from *self-teaching, anticipatory cybernetic systems* to *bio-cybernetic, eutrophic systems*, etc.), but it seems that another, more advanced instrument (genus) of knowledge is needed... Could this be the virtual reality?

"What's the problem?"

The problem must not be mistaken for the question. Of course, each problem has an interrogative part, sometimes directly expressed as a question, sometimes masked by a simple puzzlement, doubt, uncertainty, etc.

Without *uncertainty*, the problem does not make any sense; but our uncertainty does not guarantees the existence of a "real problem." The fact that we can elaborate a question, that we have an uncertainty regarding a certain object of scientific research, does not put us always in front of a real problem; however, it can mean a lack of documentation, not knowing what other people did, and in general, the idea that the solution exists already, but it unknown to us. In other words, we can be tempted to try to unlock a door that is already opened, meaning that we have repeated uselessly the problem or that we have created a false one.

Excluding this last situation (only signaled), *outlining the problem* is the first step in any scientific research, which must be taken very carefully, because from this results the hypothesis and, finally, the thesis.

Thus, *a correct thesis comes from a correct hypothesis (through complicated metamorphoses), and a correct hypothesis comes from a correct problem, which also means a well-asked question.*

The problem, as seed of scientific research, is similar to a syllogism or a sorites. As in any syllogism (a deductive reasoning), in which we distinguish three judgments (a major premise, from which, through a minor premise, a conclusion is drawn), three parts can be identified in any problem: a permissive assertion, a restrictive assertion, and an interrogation.

The permissive assertion, sometimes improperly called the "problematic framework" refers to the general context, to the existential aspect, to the insertion place of the virtual interrogation.

In physics, the permissive assertion starts almost always with the expression "given a ... mobile, body, etc." that... "Does something." *The restrictive assertion outlines or highlights the interrogation's area of validity, reliability, verisimilitude.* In physics, the correspondent of restrictive assertion is information that outlines or limits some characteristics of the studied object. Usually, intensive documentation is the preferred solution to the verification of the fact that the problem does not yet have known solutions.

It must be said, however, that some problems cannot have (practical) solutions, and what is more important, that sometimes these problems are beyond our intellectual or technical solving abilities.

The purpose of a scientific research, which is named clearly in any proper research paper, is obviously, *to identify (find) a reliable solution (or a group of solutions)*.

From the start it must be said that the purpose of a scientific endeavor, a scientific theme, or a scientific publication does not oblige its reaching, but only its *unequivocal formulation.*

According to our technical or intellectual possibilities, we limit ourselves to only parts of the purpose, meaning the objectives. As such, we can deduce that the purpose can consist of one or more objectives, and that the reach of the proposed (or imposed) objectives labels, in the end, our scientific endeavor.

I do not agree with the practice of those pedantic researchers that exaggerate the research objectives, even in the title of the paper, or the ones that diminish the dimension of the purpose, reducing it to a list of minor objectives.

The way in which the purpose is formulated suggests in fact that size and the direction of the path towards the unknown, the steps being the objectives. The serious researcher's ambitions must be contained by his or her possibilities. That is why I do not agree with pretentious (or bombastic) formulations of the purpose, especially when they are not in agreement with the (modest) scientific tools.

Besides purpose and objectives, the research and writing plans for the research papers can also have *tasks*. *The accomplishment* of the scientific research tasks favors and conditions the *reaching of the objectives*, meaning a part of the purpose; for example, *the* *documentation is mandatorily a task*, and not an objective or a purpose in itself. An exception are only the cases in which the research is historical or observational.

The Postulate and the Axiom

The postulate is either a fundamental truth that appears always as evident and need not to be proven, or a logical sentence considered to be the first in a deductive system.

Unlike *the axiom, which represents an unprovable truth, the postulate* represents a truth that is only *presumed to be unprovable.* In plain language, the line between postulate and axiom is not very well outlined, and the replacement of the postulate with the axiom (and vice versa) does not seem to be a mistake. In scientific research, the postulate and the axiom are used carefully and sparingly, being unnecessary to be mentioned all the time.

It is obvious that *in a system or a chain of deductive reasonings, if the postulate is questionable, the conclusion can be false.* That is why it is recommended that some fact-based reasonings that are apparently indubitable should not be made postulates, but be used as arguments.

The Premise and the Presumption

The premise is an initial assertion of a deductive reasoning (its finality being a conclusion) that, unlike the postulate, is accepted as a (conventionally) true specification, and not as an evident truth.

The specification of the premises strengthens the trust in the conclusions, without, however, guaranteeing their truthfulness.

The presumption is an opinion based on appearances; its frequent synonyms are the assumption and the supposition. The presumption is used in the scientific research instead of alternative premises. *The presumption is a (conventionally) true statement, until evidence of the contrary.*

The Hypothesis and the Thesis

Etymologically, the hypothesis comes from the Greek term "hypo" (meaning "under") and "thesis" ("position").

The hypothesis is, generally, a provisional explanation of several incertitudes; in scientific research it holds the place of a temporary solution, of a temporary answer to the question of the research.

In order for the hypothesis to be consistent, it is imperiously necessary for it to refer to the formulated question (or the one that is deductible from the problem), to be in principle observable and verifiable, as well as extrapolatable (*meaning valid also for other similar situations or conjunctures*).

In any way, *the verification of the hypotheses through reasonings and/or experiments leads only to their confirmation or invalidation*. Thus, the conclusion of a scientific (research) endeavor raises (through inference) the hypothesis to the title of *confirmed hypothesis* (sometimes invalidating a hypothesis that is expressed through negation), *but never to the title of thesis.*

Most often, an experiment does not result in the validity of the reciprocal of the hypothesis, thus is unsound for one to draw the conclusion that if something is not confirmed, then it can be invalidated. For such cases, people elaborated methods of (double) verification for both the affirmative hypothesis (through which it is confirmed), and negative hypothesis (through which it is invalidated). The method of double verification contributes to the reduction of the incertitude of the research results.

The knowledge vector *originates* in the premise and it is *addressed* in the thesis. In its trajectory, it makes many gnostic leaps, from inferior to superior knowledge levels: what at the beginning was uncertain, presupposed, just a core of a question, at the end it becomes demonstrated, a logical law, a fact-based reasoning for other stages of knowledge (for other gnostic leaps).

The thesis is the result of the demonstration. It is applied exhaustively, as a logical law (but which admits exceptions, like any other law).

In essence, the thesis is a concisely formulated idea that is valid in any interpretation of its variables. Through its nature, the thesis gives birth to its own negation (antithesis).

The road of scientific knowledge is sinuous, meaning that it has *stages in which we are getting closer or we are stagnating* in the trajectory toward our final goal, meaning what is to get a title of truthful knowledge - the *thesis*. Any sublimation of a stage in the process of scientific knowledge implies the risk to arrive at false statements, at what it can be improperly called a *false thesis.*

If going from the hypothesis, without its verification (through sublimation), directly to the thesis seems, clearly, as a risky leap, not the same thing can be said in the case of the direct passing (again through sublimation) from the confirmed hypothesis, meaning from the conclusion of the research, to the thesis (in other words, to an identically-true law).

A confirmed hypothesis whose validity is only argued, must necessarily be demonstrated in order to become a thesis. Practically, the conclusions of a scientific research are hypotheses that are confirmed most often through experiments and statistical techniques. They refer to groups, samples, and generally the fact-based materials in that scientific research.

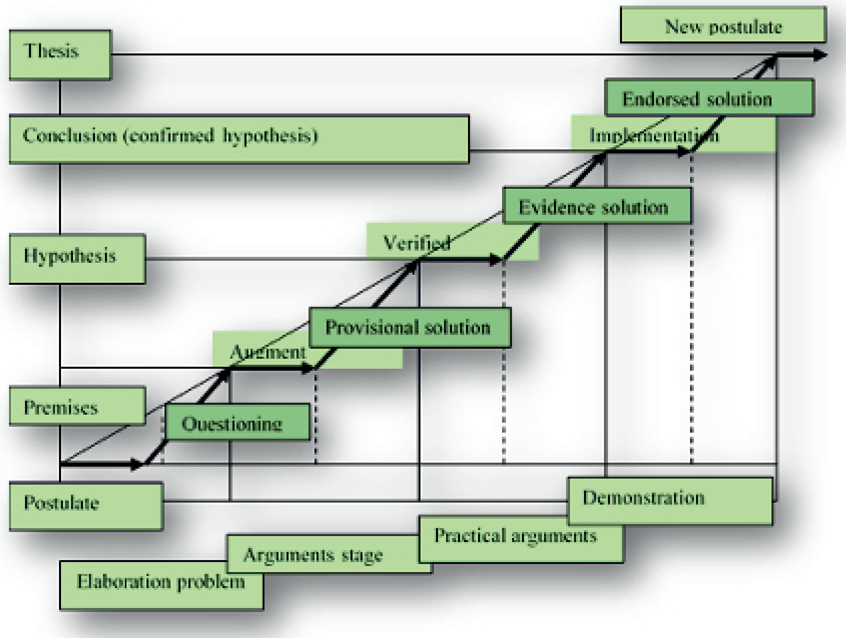
It is risky to transfer the validity of these conclusions to the entire statistical population in all similar situations without validating, without letting the practice to demonstrate the justness of the confirmed hypotheses. If the conclusions are proven to be valid by later practice, or in other words, relatively true, then they become theses, a background of knowledge for other researches.

As seen in the following figure, the *gnostic leap* from one inferior knowledge level to a superior one, with the pretension to be a new postulate, *begins, in a first stage, with the elaboration of the problem.* The formulation of the two assertions, the permissive one and the restrictive one, equates to the announcement of the premises (major and minor one) of any syllogism.

Unlike with the syllogism, in which the announcement of the premises leads to a conclusion, in the case of the problem (scientifically elaborated), the formulation of the assertion leads to an interrogation and puts us in front of a dilemma that does not raise with anything the initial gnoseological (knowledge) level, not eliminating any incertitude.

If we give a temporary answer, no matter how right it is, to the question, we would have a hypothesis.

It is risky (and most of the times wrong) to attribute this answer the title of conclusion, and even riskier to consider it a thesis. However, this stage, during which we elaborate the problem and conceive a (temporary) solution, is an important step toward knowledge, is a *provisional* knowledge.



The path of scientific research or the leap from hypothesis to thesis

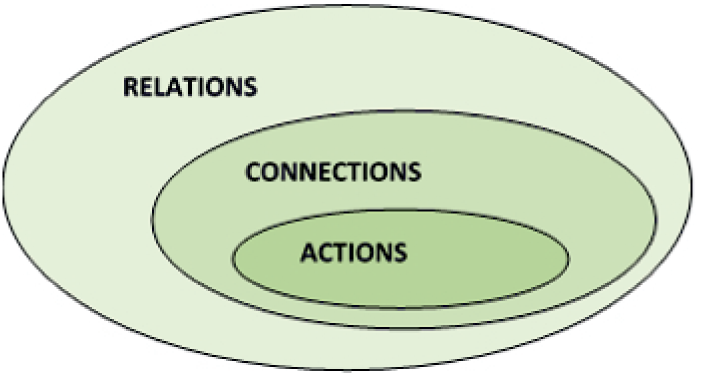
Another stage that follows logically the elaboration of the problem, is the argumentation stage.

Most of the times, the hypotheses, or in other words the temporary answers to the question, are argued through logical inferences, through experimentation with statistical verification procedures (for the hypotheses). In the case of hypothesis confirmation, it becomes, literally, a confirmed hypothesis, a valid conclusion to the (experimental) argumentation dimension.

Thus, the conclusion or confirmed hypothesis is not a thesis, it is not necessarily valid for all the similar situations or for the entire *statistical population which that (experimental) group is a part of*. In order for a confirmed hypothesis to become a thesis, it must be demonstrated. The *demonstration* is made, usually, through practice, time validating it through a larger implementation.

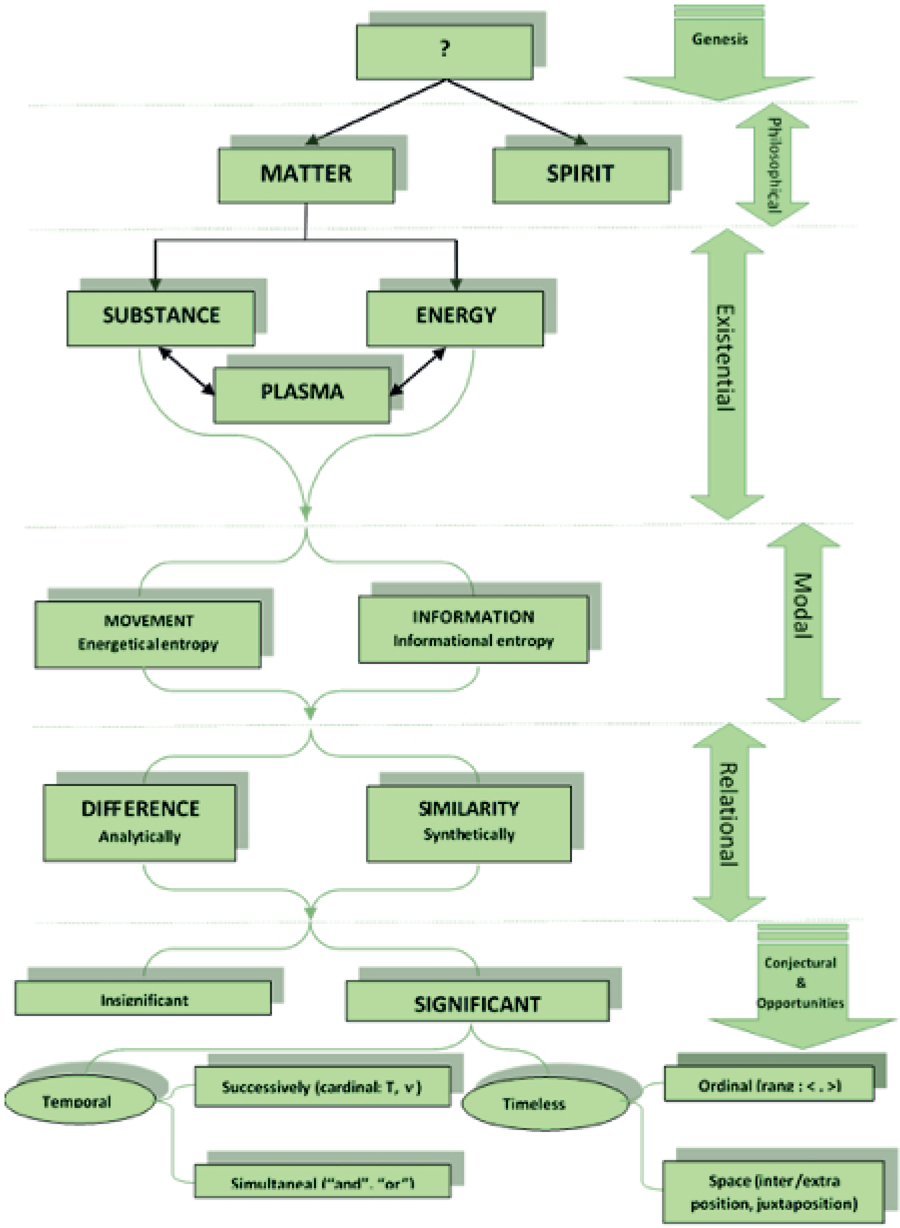
The Relation

Relations include connections and actions. Not all relations are connections and not all connections are actions. For example: between cities A and B there is a relation of distance (the simplest kind). A and B are connected through highway, railroad, etc. Trains and automobiles circulate, there are visits, and other actions.



Modal Operators

If the identification of a signification through modal operators of difference or similarity means comparison, then only the differences and the similarities from a statistical viewpoint can be interpreted through temporal or atemporal operators.



The measurement and the assessment refer to the significant relation aspects, to which, conjecturally and opportunistically, we attribute temporal or atemporal operators.

The measurement of frequency (or period) implies inferior and superior limitations, such as the nictemeral natural frequencies and the Planck frequency, for which the Euclidean geometry disappears completely. Then the simultaneity logical operators ignore the physical ramp of signals. Finally, the rank or the diagrams are measurable or assessable according to a conventional significance threshold.

Opportunity vs. Conjuncture

The opportunity is a temporal characteristic of the reaction to a conjuncture. It must be emphasized the fact that, beside the opportunity, the reaction has also other characteristics, such as magnitude, form, adequation, etc., which, in turn, determine the cost (the effect, the favorable or unfavorable consequence).

Attributes of Noumena and Phenomena

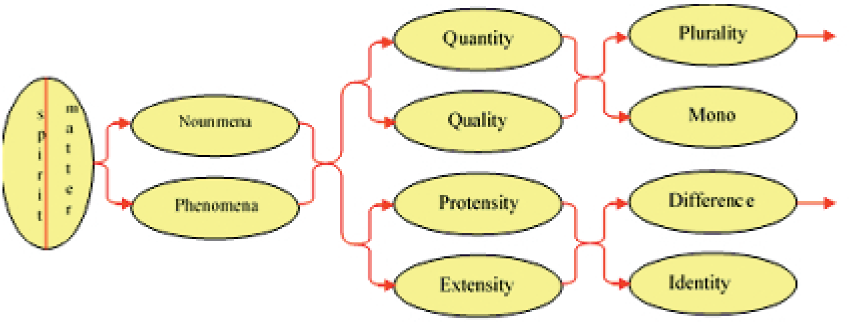
The main attributes, in the sense of characteristics, properties, of noumena and phenomena are grouped in two couples of philosophical categories: quality-quantity and extensiveness-protensiveness (space-time).

In other words, any entity or phenomenon has *four attributes: quality, quantity, extensiveness and protensiveness*.

For example, let us presume that we have 100 bank units, which, quantitatively, means 100. From a scientific point of view, we must clarify what quality the bank units have - are they euros, dollars - as it is also good clarify where do we keep them - in our pockets, in the bank, at home - (extensiveness = space), an whether we received them or we will receive them (protensiveness = time).

Usually, the last two attributes (space and time) are implied and in the common language they do not need clarification. Thus, when a customs officer asks us how much foreign currency we have, it is implied that he refers to the current moment and place (of the dialogue).

In the scientific language, even in the current practice of scientific research, we must clarify the four attributes in a straightforward and unequivocal manner, because they determine the basic notions of our scientific reasonings.



The current option of scientific research: the materialistic approach of noumena and phenomena with four attributes, philosophically grouped in two: quality-quantity and extensiveness-protensiveness (space-time), and which, in their turn, use only two forms of knowledge - plurality and difference.

In regards to the quantity-quality duality, it can be only unique or multiple (mono or pluri-quantitative or qualitative).

I am of the same opinion of those who believe that the entities (or phenomena) that are unique (monads) cannot be researched nor known. This is not the place for a philosophical commentary, but it is useful to remember that the expression "support point" used by Archimedes, or Einstein's "relativity" suggest this aspect of another reference than the one discussed.

Unique entities, such as the divinity, the universe, and even some theoretical concepts, such as the point, the void, etc. cannot be researched in relation to themselves, but need another point of reference. This is not about consistency, but about what the word "plurality" expresses sufficiently clear. For example, between two points we have a distance, between two, three or more points (or objects) we have a relation of "bigger" or "smaller" (according to the point of reference we have chosen).

1. Essay on the "Homo Intellectus" knowledge pattern

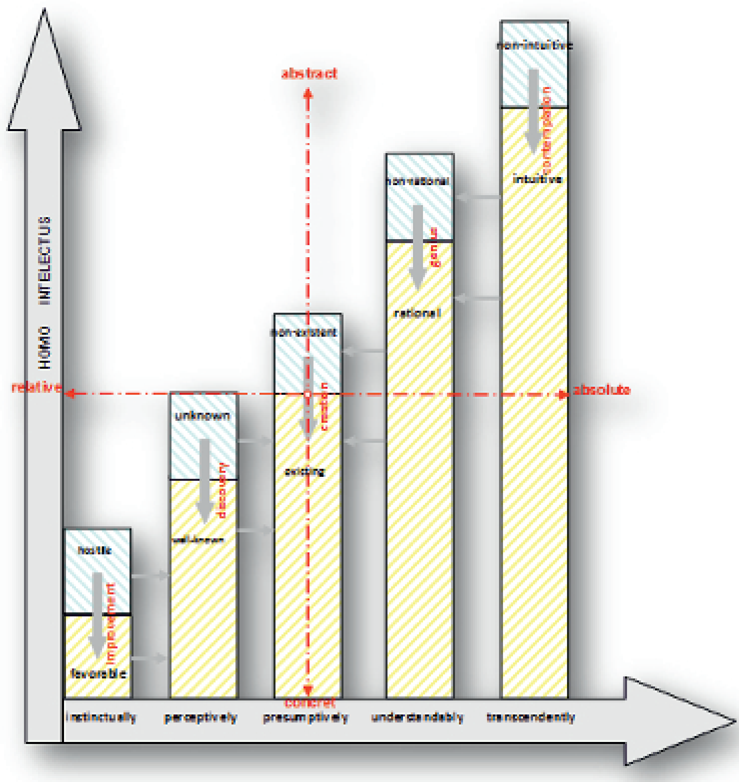
For the "Homo Intellectus", knowledge is not a purpose in itself, but a way of proving the existence of a noumenon or a phenomenon. To prove or demonstrate the existence of something or someone means to elevate the hypothesis to the rank of thesis, meaning, generally, to prove the presumption of existence. Many (yet) unknown noumena and phenomena are, indubitably, existent. One of the ways of proving their existence is to first make them known.

The existent noumenon (thing) or phenomenon, hereinafter referred to as *the existent*, in my opinion, can be placed, philosophically in a suggestive manner, at the intersection between two imaginary orthogonal axes, each with opposing directions. The first axis, horizontal, ties the *relative* to the *absolute*, while the second axis, vertical, ties the *concrete* to the *abstract*.

What I mean is that the *existent* can be proven through multiple ways, one of which being the one through which it is *discovered* something that previously was labeled "unknown"; another way is that through which something inexistent is *invented* through creation, directly, or through geniality and intuition, indirectly.

As it can be seen in the following figure, the simplest form of knowledge, present also in some sub-human species, is the *instinctive* one. With its instinctive tendency to make things concrete and to decide in a relative manner, the "Homo Intellectus", as also some evolved animals, finds practical solutions when something is hostile to him (such as cold rain), generally when something is unfavorable. Knowledge, in such cases, can have the shape of *trial-error* to find a relatively less unfavorable solution. By referring to the aforementioned example, one could think that even an uneducated child would try instinctively to shelter himself from the rain.

Another form of knowledge, more evolved than the instinctive one, but which also comprises it, is the *perceptive* one, based on senses. By accident or not, through comparison, using his senses, *"Homo Intellectus" discovers something new*, acquiring new knowledge, in other words learning from experience (often his own). Through his sense (with the argument "I have seen, I have heard" etc.), *"Homo Intellectus"* transfers from the unknown area to the known area noumena or phenomena to which he gives the status of *existent*.



The pattern of the knowledge evolution ways in Homo Intellectus.
Explanations in the text

It must be mentioned that the perceptive form, even though it was the most used form of knowledge throughout history, with the most contributions to the cultural and scientific heritage of mankind, can produce certain errors. The errors come from both the area of distortions caused by environment (such as the "mirage"), and the deformations caused by physiological translators or by the central part of the perception analysts. Thus, optical illusions are often cataloged, obviously erroneously, as "proofs" for the existence of a hypothetical noumenon or phenomenon. It is even commonly said that "the senses cheat you." Does Nessie, the Loch Ness monster actually exist? Is that actually (more than an illusion) a confusion with an existent animal, this leading to a folkloric imagining?

A form of knowledge more evolved than the perceptive one, which touches the balance between abstract and concrete, and between relative and absolute, is the *awareness* of the knowledge endeavor, a form that I called *preceptive*. In this form, which includes the ones mentioned above, *Homo Intellectus* realizes the fact that he *can create* something that did not exist previously, or something that he things did not exist previously. The novelty can be an *invention*, as long as it contains a progress; otherwise, originality at any cost is not a creation, and even less an invention. In other words, through a spark of skill, through creation, something abstract becomes concrete, meaning it can acquire an existential shape.

In an even more evolved form, *Homo Intellectus* can use the *rational* instrument of knowledge; this can lead, either directly through geniality, or indirectly through creation, to the *existent* (something concrete and relative). History is full of examples when something previously considered irrational and rejected as existential possibility has become existent through genius reason. Above the rational form, but including it and the previously discussed ones, I believe there is the *intuitive* form of knowledge.

This intuitive form of knowledge has the advantage to be initially lacking in constraints, such as, for example, the photonic limitation of speed, the gravitational omnipresence, or other barriers and myths that have been already busted (let us remember only the ancient scientists' idea that bodies heavier than air could never fly through self-propulsion).

The intuition through geniality and creation can lead to existential, but it can lead also to non-rational forms, dead-ends of knowledge. As it appears in the figure mentioned above, of course, schematically and simplified, a noumenon or a phenomenon that is not intuitable initially can become intuitable through *contemplation*. Contemplation, although it is not accepted as a scientific form of knowledge, has been used as such with amazing results by the ancient civilizations, especially the Oriental ones. Intuition and non-intuition (ways that do not yet have a plausible explanation for *Homo Intellectus*) are a part of the transcendental way of indirectly acceding to the existent.

I might add that the existent can be reached also through another way, the *revelation*. The revelation is *offered* to *Homo Intellectus*, not depending only on his will or desire. A hypothetical divinity or an extraterrestrial intelligence can show itself (can prove its existence) to

Homo Intellectus, independently of his will and desire, of reasons that are not comprised in the plan of the two axes that were previously discussed.

2. Essay on the predictive patterns

Prediction (lat. *praedictio*) is a part of the anticipation paradigm together with prognosis, prevision, premonition, etc. Conjuncturally, it is either an anticipatory endeavor, or an anticipated effect. Prediction is largely based on senses and emotions, but it can also be scientific, using logical reasonings, the method of observation of a case or of a repeatable set of events governed by statistical laws.

Predictive models can be transversal or longitudinal, as they refer, respectively, to the duality quantity-quality or the duality protensiveness-extensiveness.

Transversal predictive models are characterized by the magnitude of the group or the population and by the negligible duration of the evolution process. Physical time is ignored, the duration is reduced to the moment, and the process is considered, philosophically, to be happening in present time.

Axiomatically, the predictive models consider the sum of *probability* ($p_{t=0}$) and *improbability* ($q_{t=0}$) to be equal to the *certitude* (C_o), as an existential condition:

$$p_{t=0} + q_{t=0} = C_0$$

p[0,1] = asymptotic
0 = impossible
1 => certainty (C_0)

The longitudinal predictive models are hypothetical. The longitudinal predictive model I elaborated has the following hypothesis:

The certitude is depreciating naturally and specifically. In other words, the farther the anticipated future is, the vaguer the notion of certitude becomes.

$$C_t = C_0 \exp (-k\, t / \tau)$$

k = specific depreciation
τ = the period of predictive incertitude

In the case of this predictable longitudinal model, the existential condition is expressed as follows: *The sum between certitude (C_t) and incertitude (I_t) is always unitary.*

C [1, 0];

$$C_t = 1 - I_t$$

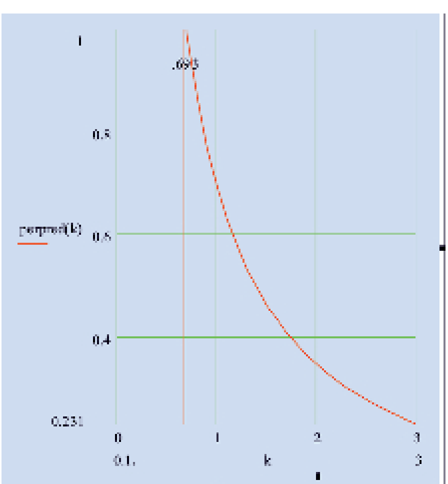
I [0, 1]

The certitude is defined between the *present* time (1) and the *far future* (0), while the incertitude varies from 0, corresponding to the (existential) present, to 1, corresponding to the farthest future.

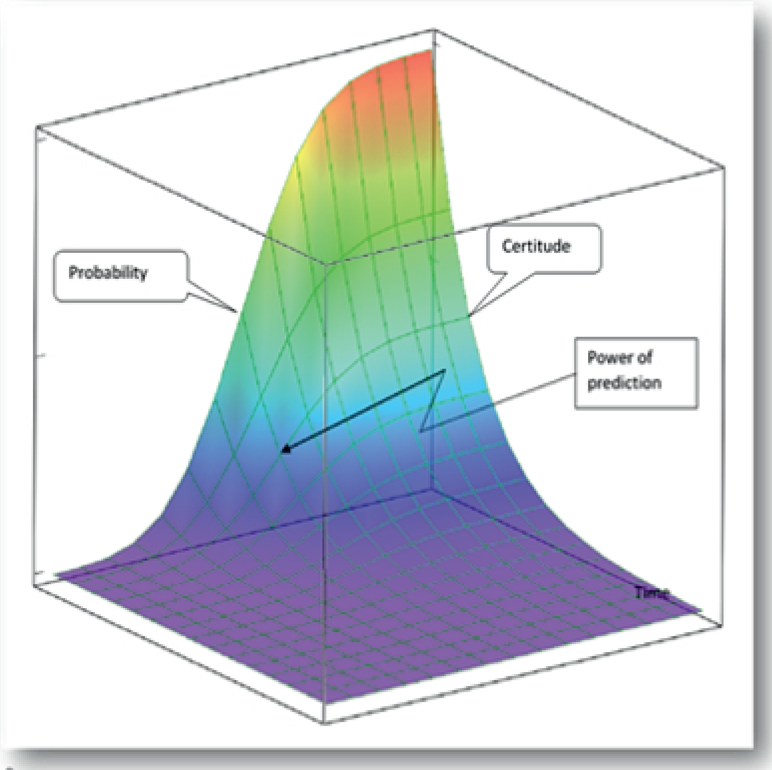
Predictability becomes impossible when certitude and incertitude tend to be equal. This situation outlines the period of predictable incertitude:

$$\tau = (\ln 2)/k \qquad \tau\, k = 0.693$$

It results that, if one knows the specific depreciation, one can calculate the period of predictable incertitude, and vice versa.



The prediction power, logically and similarly to the viabilities, increases as the probability and certitude increase: P(x,t) = prob (x) cert(t)



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It expresses both the transversal and the longitudinal aspect of prediction. The prediction power is very high when the probability is almost maximal, and the depreciation of the certitude is insignificant. In its topographical representation, the lower the level curves are, the lower the prediction power is. Nevertheless, less than half of the maximum level, prediction is impossible, and the situation can be interpreted as a deterministic chaos.

3. Essay on the labeling of measurands

Axiomatically, the categories are subjective. The "alpha-gamma" labeling that I elaborated is attributed to certain noumena or phenomena, subjective categories based on experience, and, of course, in a form that is close to the current human psyche. The "alpha-gamma" labeling reduces, in my opinion, to a minimum the subjective moments of a complex labeling, such as the series-parallel models (where there are emphasized only the landmarks, the priorities, and the compensations). For me, there is a sufficient fact-based reason to be convinced that cells, living matter and organisms, including the humans, react to stimuli and excitants in a way that can be reasonably simplified with the logical-mathematical pattern (*lmp*) of the "alpha-gamma" labeling. The *lmp* implementation of the "alpha-gamma" labeling in computers or robots would mean *to transfer in them a pseudo-human behavior, which as I have said, can borrow rudiments of the operator's personality.*

Based on the hypothesis stating that the rate of labeled quality drop is proportional to its magnitude, I have found that the "alpha-gamma" labeling can be defined by an exponential function dependent on the *proximity* variable (how far away are you from the landmark), on the exigence parameters and on the experience parameters:

$$\mathrm{etiq}(i) := \exp\left(\frac{-\mathrm{accuracy}}{\mathrm{experience}(i)}\cdot \mathrm{proximity}(i)\right) \quad *$$

In the case of multiple characteristics of a noumenon or a phenomenon, the global label takes into account their priority and compensation degree. I admit that the priority dropping rate (μ_i / μ_1) is proportional to the previous hierarchical rank (i), with a power of *preference* (β): $\mu_i / \mu_1 = i^{-\beta}$.

When $\beta = 0$, it results equipriority;

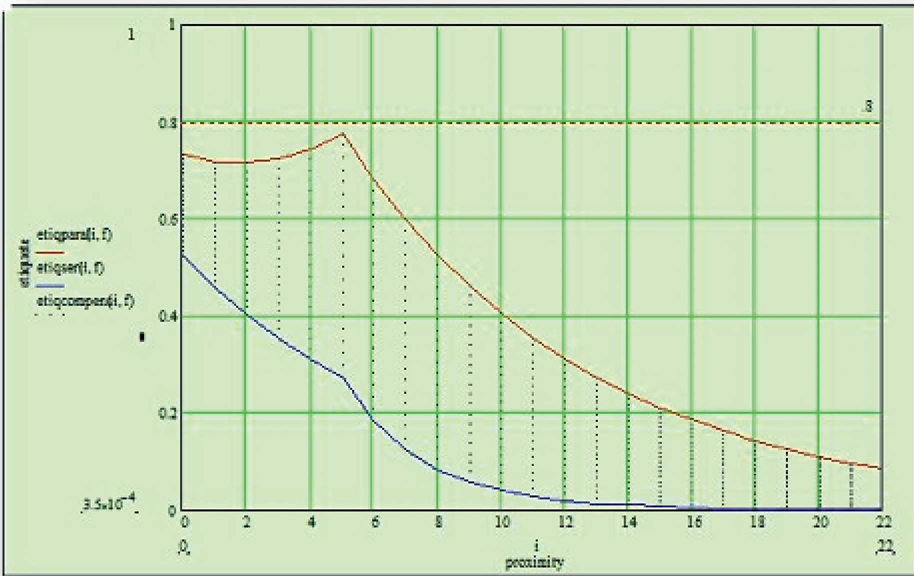
When $\beta = 1.0$, the order is natural;

When $\beta = 1.442$, the order is Napierian.

The compensation of characteristics follows the rule of labeling:

$$Etiq = \phi_i \Sigma \mu_i \, etiq_{(i)} + (1 - \phi_i) \Pi \, \mathrm{etiq}_{(i)}$$

where ϕ_i is a compensation factor. If $\phi_i = 0$, the compensation is null, and the structural scheme of characteristics is *serial*; if $\phi_i = 1$, the compensation is total, and the structural scheme is *parallel*. Otherwise, the compensation is partial and corresponds to a *mixed* structural scheme.



Example of partial compensation for two labeled characteristics In this case one can see that the maximal compensation possibilities correspond to reference 5, and that there is an interval (between 2 and 10) in which the compensation does not go over two value classes.

Let us presume that a computer is instructed for the "alpha-gamma" labeling. At the operator's will, it can label any notion, no matter how vague, for example happiness, and it can do this only by, let's say, three characteristics: health, love, and wealth. To simplify, the computer is asked, this time, to neglect other characteristics (that are otherwise very important), such as freedom, family, longevity, etc. and to consider that the order of the accepted characteristics is a natural one. Natural order means, according to the operator, priority 0.545 for health, 0.273 for love, and 0.182 for wealth, in other words, health is two times more important than love and three times more important than wealth. If for health and love the points of reference are, obviously, maximal (1), for wealth it can be said that the label with its value higher than 0.81 is a reasonable one, which means *very wealthy* (referring to five value classes). Thus, according to the "alpha-gamma" labeling, *very happy* implies a compensation smaller than 8% between characteristics. If we presume that health will deteriorate to a state where it can be labeled with 0.32, then happiness will be, according to the "alpha-gamma" labeling, compromised.

The labeling will be more "personalized" the greater the cumulated experience will be, without it being a simple process of *learning*. The *exigence* parameter can reflect the emotional state of the simulated labeling. Normally, for the mental and biological processes, it has the empirical value of 3 and corresponds to the risk factor of 0.05 of the applicative statistics.

The applications for the *alpha-gamma* labeling can be various, from the simulation of viral cell behavior and the behavior of the paucineuronal networks, to the basic logic circuits *and* and *or* in computers. Simpler, an *and* circuit can transform itself partially or totally in *or* if its compensation will be modified gradually or suddenly from 0 to 1.

It is a known fact that any computer logical scheme, not matter how complex, can be made of basic circuits, *and*, *none* or *or*, subjected to the Boolean algebra. In my opinion, in the current advanced state of computers one can already configure in the *software* the *alpha-gamma* compensating labels, so that inside a computer there would be new environment of vague assessment of the results of the logical schemes, with other numerations, different from the binary one. It is not about configurable hardware, meaning microprocessor networks connected through commanded *switches*, but about a new software environment, possible by configuring the operator's preferences and identifying the compensation variations from the history of the operative repetitions.

In other words, by memorizing the different values of compensation, the computer would identify the state (of mind) of the operator, which, corroborated with the operator's initialization preferences, would realize a pseudo-human behavior.

I must confess that my attempts and my belief in the feasibility of compensating circuits make me hope that a computer of the current generation can already "gestate and host" inside itself another computer that would use a vague logic instead of a Boolean one, the way living organisms do.

4. Essay on the paradigm of value

I am of the opinion that any noumenon or phenomenon has a certain intrinsic *value*. In the context of the subjective equivalence of a certain skill to the intrinsic value of any noumenon or phenomenon, we define *value* as an empirical and conventional attribute, from a psychosocial viewpoint, which conjuncturally or opportunistically will be proportional to the:

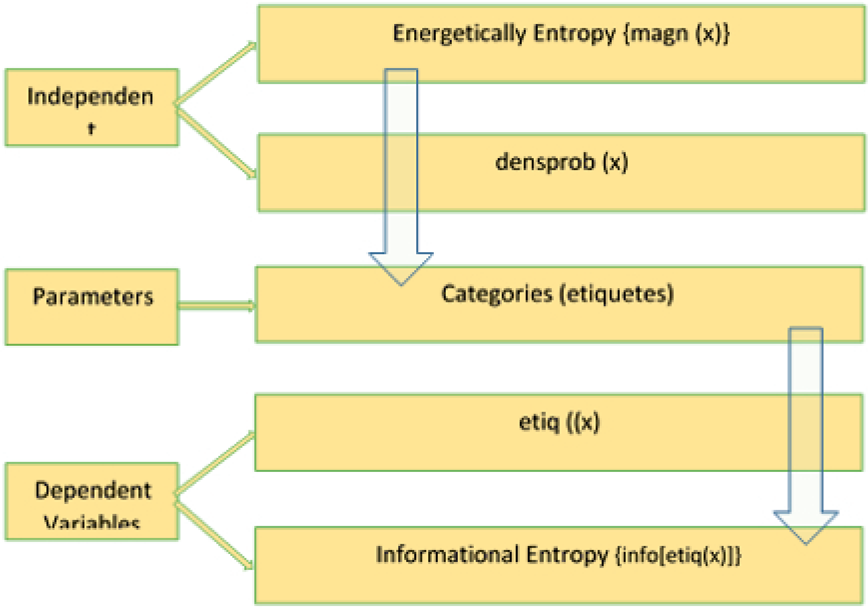
- The manifest interest, the degree of utility, of use, etc., of that noumenon or phenomenon;
- The quantity and/or quality of the effort that was made into acquiring or realizing that noumenon or phenomenon;
- The specific forms of time, such as history, warranty duration, time consumed by that noumenon or phenomenon;
- The rarity, the originality, or other creative aspects included in that noumenon or phenomenon.

The Romanian Language Dictionary gives *value* more meanings than we do in regards to the proportions above. The language extension is natural. I must mention, however, that I do not agree with attributing a skill an extreme-dichotomous form, such as just "valuable" or "lacking in value."

The evaluation is a process of attributing a value by a *competent* decider. Value can be attributed to an unmeasurable characteristic of a noumenon or phenomenon, or can be attributed, generally, to the entire noumenon or phenomenon.

The capitalization is a process of implementation, use or dissemination of a value, as a source of material or spiritual profit.

In this case, labeling is a process of vectorization of the values, meaning getting them in a hierarchy of classes, grades, ranks, intervals, etc., in ordered categories. I must make clear that by "vectorization of values" I understand attributing to a conventional relation between physical (energetic) entropy and informational (cognitive) entropy of that noumenon or phenomenon. I believe that a possible link between the two kinds of known entropies can be made systemically through labeling, as follows:



The logical-mathematical pattern would be:

$$\mathbf{info[etiq(x)] = R_{\alpha\gamma}[energy(x)]}$$

Thus, we arrive at a consistent and (especially) consequential between the two entropic forms of any noumenon or phenomenon through the conventional labeling, such as the "alpha-gamma" one. It is very probable that living matter would have used since immemorial times this form of bond, and an application such as this in robotics would be worrying if it would not be made under strict control.

5. Essay on mental conditioning

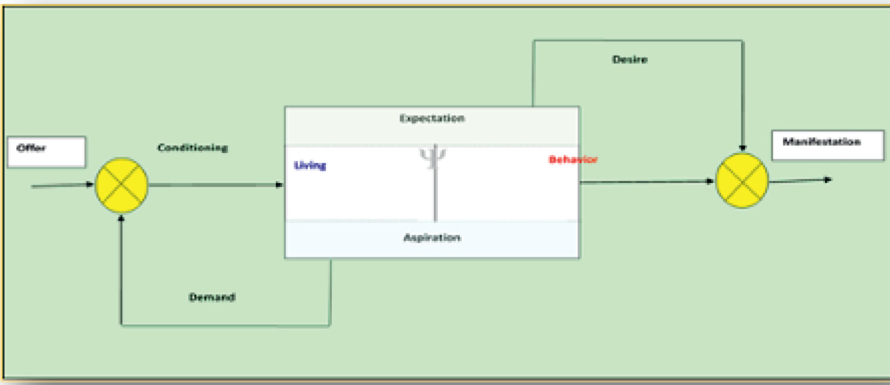
The fetishism of the *very complex human psyche* can be overcome out of ignorance or temerity. I let the reader appreciate my boldness to simplify the relation between two measures of the psychogenic system. On one side, I am referring to the *offer*, as a conjunctural and opportunistic expression of the phenotype agents, and on the other side, to the *manifestation*, as a reactive, observable and interpretable effect. Theoretically, the reaction of the psychogenic system to the offer, as a measure of system entry, can be present or absent. If it is present, then it can adequate or inadequate. Finally, the inadequacy can be too much or too little. As a result, one could emphasize four *fuzzy* value classes of reactivity of the psychogenic system, while the offer has only two value classes. Both value classes are independent of *attitude*, but conditioned by *demand*, as a particular form of *aspiration*.

A first conditioning of the system is observed, formed of the offer/demand ratio, which means a restriction imposed to the transfer function. What results are four value classes of the entry size: supra-unitary, unitary, sub-unitary, and null. In other words, the offer can exceed the demand, it can be equal to the demand, it can be smaller, and, finally, it can be null. The pathogenic case of a null demand or a (infinitely) undetermined ratio is excluded from the commentaries.

Another conditioning, somewhat enigmatic, is the one initiated by the *behavior/attitudes* ratio. The unapparent behavior (comportment) can be manifest only if the specific sphere of attitudes does not inhibit it. I am referring to the the sphere of attitudes, although the causal skill forms, such as the affective, volitional, emotive ones, etc., seem to be determinant. The relation is probably one of the few examples of *feed-before* in cybernetics applied to anthropology, manifested as a protection outlet (the simulated comportment).

As a process state of the system, *living and behavior create harmony, and aspiration and expectation create balance.*

The systemic construction that follows (see the figure) is, by definition, presumptive. It can become a working hypothesis only if we admit *one single solution of adequate behavior for the unitary offer* (in relation to the demand), meaning the status function of the system to be harmonious and balanced.



The systemic model of the conditioned mental relation: offer - manifestation. Explanations in the text

Trying to confirm the working hypothesis, I have simulated the behavior of the system in all possible situations. There is a logical reason for me to believe that the solution of the adequate manifestation is actually the statistical *module* of a *Poisson distribution* for the four degrees of *fuzzy* matches. Thus: NAE=15%; A=35%; NAL=30% and NR=20%.

6. Essay on extrasensory communication in humans

- *Argument*

It is a known fact that each species perceives information in their environment (including the interspecies and intraspecies ones) through specific sensory input (senses), both as sensitivity and especially as relevance.

Next, I will remind you of some now classic facts about the human senses (that do not need bibliographical references).

Experimental studies have proven that the *visible* spectrum in humans is between 397 nm and 723 nm (wavelength), with an acrophase at 560 nm for the fovea (sensitivity) of the cones, in common language with a maximum for the yellow-greenish with the frequency of 535 GHz.

The *audible* spectrum in humans is between 20 and 20000 Hz, with a maximum of sensitivity at about 1000 Hz.

Researches have revealed that in humans the *tactile* sense, as a sub-modality of somesthesia (especially for barosthesia), has a frequency spectrum of the dense medium vibrations between 110^{-1} Hz and 200 Hz, with a maximum at 1.25 Hz.

For the way in which the *taste* receptors are stimulated (in humans are estimated to be over 2000 of such taste buds), multiple chemoreception hypotheses were elaborated. One of these, similarly to the stimulation way through vibrations of the receptor segment of the auditory analyzer, states that the molecules of sapid substances, as ionized solutions, can stimulate through vibrations the cells responsible of the various taste sensations (the attempts to explain through the different nature of chemical substances the different taste sensations are not yet very convincing).

The smell can be explained, also hypothetically, by the oscillations of certain sapid molecules in the gaseous environment, identifiable through the resonators in the peripheral segment of the olfactory analyzer.

- *The problem framework*

Usually, information abolishes an uncertainty, or at least reduces it. I believe that in the case of the human sensory communication (but also in infra-species), information, regarded systemically, belongs only to the receptor, it having the form of signal, signifier or signaler (signal plus significant) during the emission and the form of command, instruction or message, regarding the communication pathways (channels). The communication pathways, including also the peripheral segment of the sense organs, can process signals from a proximal (as form) and sthenic (as strength) viewpoint. The processing of the signifier includes also the degrees of freedom contained in the signification during the emission, and, through *feedback*, also the reception (the central segment, endo-resident anyway, of the sensory analyzers).

- *The problem*
  - *The permissive assertion:*

Let us admit the fact that a deterministic cause has attributed to each of the *N* earth species *n* types of communication with the environment (including intra- and inter-species).

  - *The restrictive assertion:*

Let us admit the fact that these types of communication have, from the point of view of the informational entropy, as main characteristic, the *relevance*, with a minimum of two attributes: *favorable* and *unfavorable*; from the energetic entropy viewpoint, their main characteristic is *sensitivity*, which also has a minim of two attributes: *proximal* and *sthenic*. In other words, let us admit that the spectrum solutions of the communication pathways could have at least probabilities with *Gaussian* repartitions in excess of equality.

  - *Question:*

What are the most probable apexes of frequency (known and hypothetical) of the communication pathways with the environment, in humans?

- *Hypotheses*

Let us presume that *the distribution in the frequency scale of the sensory pathways is not randomized:*

$$d\nu = f(\nu)\left(\frac{n-n_1}{n_m-n_1}\right)^{\beta} dn$$

In other words, the frequency rates that set the sensory pathways apart would be different from one frequency spectrum to another, in a specific human way, where:

n = the rank of the sensory pathway, *n* included in *{N};*

ν = the apex of the frequency spectrum of the sensory pathway;

β = the form factor (lower bend) characteristic to the elastic waves (eventually gravimetric), showing, in my opinion, interspecies differences, both in relation to the infra-human species and phylogenetic.

I believe that *as the rank of the sensory pathway increases, the growth ratio of the frequencies (that distinguish the sensory pathways) decreases, which limits, in a finite interval of frequencies, the species' contact with the environment.*

$$f(\upsilon) = \alpha\left(\frac{\upsilon_m-\upsilon}{\upsilon_m-\upsilon_1}\right)^{\gamma}$$

where

α = an extension factor (compression) of the frequency limits (in the infra-human species);

γ = the form factor (upper bend) characteristic to the electromagnetic waves (eventually nuclear);

νm = the upper limit of natural frequencies (theoretically νm = $1.5 \cdot 10^{25}$ Hz - the Planck frequency, for which the euclidean geometry disappears completely; practically, for evolved species this can be νm = $6.82 \cdot 10^{17}$ Hz - alpha radiation, experimentally proven to be perceived by rats);

ν1= the lower limit of natural frequencies (theoretically ν1 = $2.3 \cdot 10^{-5}$ Hz - nictemeral variations, and practically ν1 = $1 \cdot 10^{-2}$ Hz - Hertzian waves, especially for infra-human species, and ν1 = $1.25 \cdot 10^{0}$ Hz - the tactile apex in humans, as observed by me).

Results

By solving the Lagrange-type equation (1) I have found the following transcendental solution:

$$\mu^{\mu^{(1-\gamma)}} = \exp\left(-\frac{\alpha}{\beta+1}\frac{(n_m-n_1)^{\beta}}{(\upsilon_m-\upsilon_1)}\tau^{(\beta+1)}\right)$$

where I noted thusly:

$$\mu = \left(\frac{\upsilon_m-\upsilon}{\upsilon_m-\upsilon_1}\right)$$

whereas

$$\tau = \left(\frac{n-n_1}{n_m-n_1}\right)$$

I have put natural restrictive conditions, so that the communications windows of the human being with the environment

- do not interfere with areas of background galactic emission;
- overcome the terrestrial background noise threshold (neutrino emissions);
- take into account the (magnetic) field deflections;
- take into account the environment absorptions.

Fitting in the computer the logical-mathematical model represented by the previous transcendent equation, I have identified three plausible solutions that satisfy the criterion of effectiveness (sensitivity and relevance) expressed in the hypotheses. Out of these, the ones of a critical pseudo-aperiodic form ($\gamma > 1$) and having 10 hypothetical pathways present a special interest, being a limit for for the human species (because of the interferences between the frequency spectra of the near sensory pathways).

Next, I present to you the apexes of the natural frequency spectra of the 10 human communication pathways with the environment, as I have identified them:

< 0.01 (Hz)	? (Hertzian waves)
0.013	Tactile
983	Auditory
8.66 · 10^6	? (EM)
6.27 · 10^9	? (Ionic, limitrofic "OH window")
1.14 · 10^10	Taste (limitrofic "Water hole")
2.01 · 10^11	Olfactory (limitrofic O2 window")
1.29 · 10^13	Caloric
5.35 · 10^14	Visual (yellow-green)
1.49 · 10^16	? (UV, X)

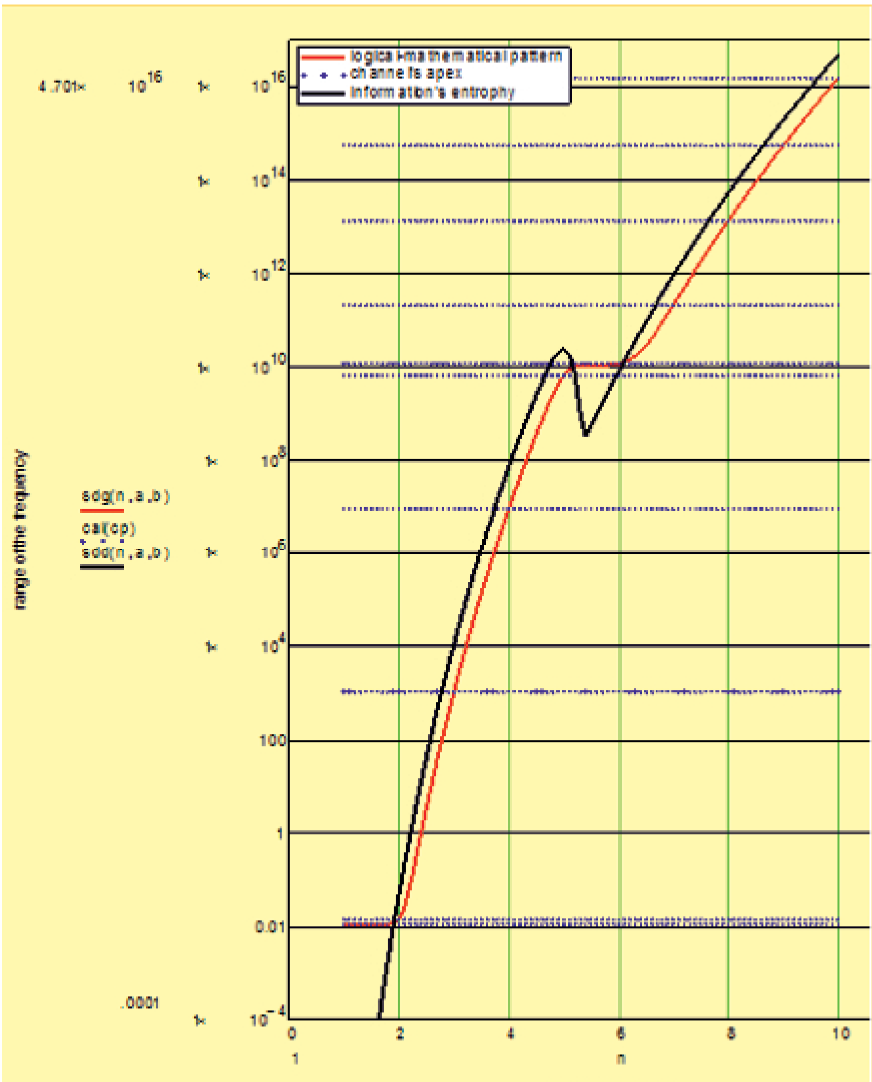
Conclusions regarding the extrasensory communication

► If we accept the previous premises, it results that *the human species, beside its known senses, it also has, atavistically or potentially, other (at the most four) extrasensory pathways of communicating with the environment (inter and intra-species).*

► For the limit situation, *the most probable spectrum apexes of frequency of these hypothetical pathways are the following:*

- < 0.01 Hz (Hertzian waves);

- $8.66 \cdot 10^6$ Hz (EM);
- $6.27 \cdot 10^9$ Hz (Ionic, limitrofic "OH window);
- $1.49 \cdot 10^{16}$ Hz (UV, X).



The periodical (critical pseudo-aperiodic) solution of the frequency spectra apexes for the human (known and hypothetical) communication pathways, according to the effectiveness criterion.

► I find extremely exciting and enigmatic the fact that in all of the fitted situations there is always *a hypothetical communication pathway in the microwaves area, more precisely in the ionized radiations (close to the oxydrilic group)*, and found between the taste and the US electromagnetic radiations.

7. Essay on the paradigm of mind

The paradigm of the mind is set at the intersection between philosophical, neuroscientific and psychological interpretations. In fact, the neurosciences, as L. Zăgrean[1] states, can be considered to be an extremely interdisciplinary field, comprising a multitude of medical, biological, or even "exact" sciences. Other well-known authors (J. R. Searle[2], D.C. Duncan[3]), talk about a philosophy of mind to sustain a branch of the cognitive sciences, manifested through language.

For example, the consciousness can be treated on one hand philosophically as a state or manifestation of the mental *(res cogitans)*, such as in its countless interpretations and historical forms; materialism or idealism, reductionism or holism, behaviorism or introspectivism, etc., and on the other hand, related to artificial intelligence, computer simulations and other software analogies (sometimes people confusing it with consciousness, as mechanisms and reactions to complex stimuli).

It must be mentioned also the attraction of the mental toward psychology and sociology, such as, for example, the collective form (group mentality) or its hybridization with the robots *(res extensa)*, extending even in the "mind as epigenetic factor" *(L. Zăgrean)*.

For starters, I am referring to four basic concepts in the mental sphere: knowledge, consciousness, conscience, and faith. Their value contingency, I believe, is given by a scale with cultural steps (learning) of knowledge: from instinctive knowledge (genotype), passing

[1] L. Zăgrean, *Neuroştiinţe. Principii Fundamentale*, Ed. Univ. "Carol Davila", Bucharest, 2002

[2] J. R. Searle, *Intentionality. An Essay in the Philosophy of Mind,* Cambridge Univ. Press, 1983, and

[3] J. R. Searle, *The Rediscovery of Mind*, Cambridge Mass MIT Press, 1992.
C.D. Dunan, *Inteligenţa materiei*, Ed. EIKON, 2009

through perceptive knowledge (senses) and rational (preceptive), up to intuitive knowledge (plus revelation).

I believe that the *tetrad* of knowledge, consciousness, conscience, and faith can be a philosophical and logical interpretation basis for the contemporary social phenomenon. I am not referring to the semantic layer of those concepts, but to their deeply philosophical content. It seems unsuited to historically analyze here the notional meaning of the four concepts, however I do remind the reader that ever since the writings of ancient wise men, such as Plato and Aristotle, we know that "supreme" genera such as consciousness or religious monads in faith cannot be classified. Kant states that only inside the species the classifications according to the function of the mental in judgments can be divided. For example, species can be opposed (quality - non-quality), while others can be related (quality - quantity). The graphical representations can be Cartesian (the spirit - matter quadrature) or the dualist model mind - brain (D. J. Bohm). For the people interested on the history of the philosophical interpretations of the notions above, L. Zăgrean has a wise recommendation: Jeffrey Mishlove's book[4]. I agree.

In regards to the ideas, I must remind you that Hegel identifies three of its forms: the thesis, as an abstract moment of identity, belonging to the mental; the antithesis, as a dialectical moment, of negation, belonging to the classic reasoning; and the synthesis, as a speculative moment, belonging to the positive reasoning.

There isn't yet a large consensus regarding the definitions of these concepts, almost every author has his own ideas of their notional content, which suggested me to present also, only for a commonly usable lexicon, some possible interpretations regarding the meanings of the four concepts:

The knowledge seen as sets of instinctual instructions (genotype) or as sets of normed notions, available personally and temporally. Examples of instinctual instructions: intrauterine reactions to chemical, thermal stimuli, etc., physiological reactions to smell in children up to 2 years old, etc. Examples of normed notions: self-taught know-how, erudition, etc.

The consciousness seen as a state or ability to evaluate your own

[4] J. Mishlove, *The Roots of Consciousness, The Classic Encyclopedia of Consciousness Studies*, Ed. Tulsa, Okla., 1993

personal knowledge and the effects of endo- and exo-corporal stimulation. Examples: mental reflection to the relevance of stimuli, the culture of discernment (favorable-unfavorable, friendly-hostile, and others), etc.

The conscience seen as a state of being relatively aware of your own existence and your own moral, cognitive and affective processes. Examples: the nuanced culture or feelings and emotions, the sense of spiritual values (honesty, justice, freedom), etc.

The faith seen as a state of awareness of the universal existence and (probably) as a solution (offered) to one's own inability to understand "what is happening to me", the origin and miracle of life, etc.

For whom and for what are these concepts good? I do not believe that someone can answer that right now; I certainly cannot. However, I have the conviction that in the near future the enthusiasm and the immense intellectual and technological resources in advanced research will give us the answer. On the other hand, I believe that the analogy between mental and computer functions, or the analogy between the informational entropy of the brain and the energetic mechanistic entropy lead to a dead end. The analysis of the brain activity through zonal sanguine irrigation or through electrodes on the skull can be, in my opinion, only quantitative and not at all qualitative, as the mental processes are. I do not understand why certain researchers still persist in interpreting the brainwave frequency when it is a well-known fact that actually they are not harmonic, but of *relaxation*, thus being unanalyzable under the Fourier spectrum.

One of the most interesting ideas of cyclical evolution of social phenomenon was explained by Alexandru Partheniu[5] through a *tetrad* of collective mentality. *In memoriam* I feel obligated to digress, because I have collaborated with Al. Partheniu for almost two decades in the field of electrophysiology. Al. Partheniu had inherited his scientific curiosity and even his great courage from his father, Cezar Partheniu, who was a professor at the Romanian Academy of Economic Sciences, a Romanian dignitary, a specialist in economics and finances who dared in 1938 to criticize and ridicule both Hitler and Stalin. Cezar Partheniu had the curiosity and the ability to identify the

[5] Romanian scientist, former Director of the Center for Interdisciplinary Research at the National Physical Educational and Sports University of Bucharest

appearance frequency of certain words that he called "strength words," in the written media from the early 20th century up to World War Two. He observed that the most encountered *strength words* used periodically, in a certain succession, were: *authority, freedom*, *solidarity, justice* and so on. Based on the data collected by his father, Al. Partheniu had developed a theory of a logical tetrad, which, beside the thesis-antithesis duality from the Hegelian *triad*, also comprises *the positive synthesis - negative synthesis duality.* In order to illustrate the periodical succession of the *strength* ideas, Al. Partheniu had used a Cartesian representation with the horizontal axis signifying *cooperation - noncooperation* (discordance), and the vertical axis signifying *order - disorder* (anarchy). The dynamics of the social phenomenon with a dominant mentality is illustrated by a anticlockwise rotating vector that passes through the four quadrants: authority, freedom, solidarity and justice. Thus the four quadrants: (+,+) would mean *harmony (cooperation concomitant with the hierarchy of values),* then (+,-) would mean getting free of *dictatorship* (despotism, tyranny), (-,-) would mean the tendency to get rid of *discordance* (enmity, hostility), while (-,+) would mean the desire to get out of *disorder* (anarchy) through justice, after which the cycle is repeated. The determinism of such a phenomenon is hard to accept. But neither the statistical argument is convincing enough, although it is a known fact that individual deviations from trusting in a phenomenon that is presumed real by a large collectivity of a normal statistical distribution is reciprocally compensated. In the seventies and eighties, the presentation of such a diagnosis and prognosis of social evolution had represented a risk not only for the author, but also for the people who were arguing scientifically on this subject. I remember the polylogues about the logical tetralogy of Al. Partheniu at the "Club of Interdisciplinary Studies" led by Romanian Academy member Ştefan Milcu, under the wing of the Romanian Academy, with scientists from all fields related to anthropology participating in the discussions. I name here just a few of the participants: C. Neacşu, V. Săhleanu, D. C. Duncan, I, Mureşan, V. Stancovici, mainly the most obviously passioned by the secrets of the mind, consciousness or intelligence, by the ontic or gnostic position of information and others. I admit that I have learned from them to respect my interlocutors' opinions, even if I do not share them. For example, C. Neacşu and D. C. Duncan thought that information is an existential (ontic) form of matter, while up to current day, I have not yet given up believing that information and movement are modal forms of knowledge (gnostic), in the sense of informational and energetic entropies. More than that, D. C. Duncan had added also the intelligence to the *genus essentialis*, forming an universal tetrad: energy, substance, information, and intelligence. Referring to conscience, Şt. Milcu was reminding us the crucial moment in the anthropogenesis when the precursor of modern man got up and walked on two legs *(Homo Erectus),* explaining that we are actually talking about a *" moral rectitude" ,* meaning *conscience*, which came up later. I would rather believe that he was subtly homaging the honorable bearers of conscience and was ironizing prudently and concealingly the slogan "work has made the man" or the idea of "superior organization..." (alluding the materialistic conception of Fr. Engels).

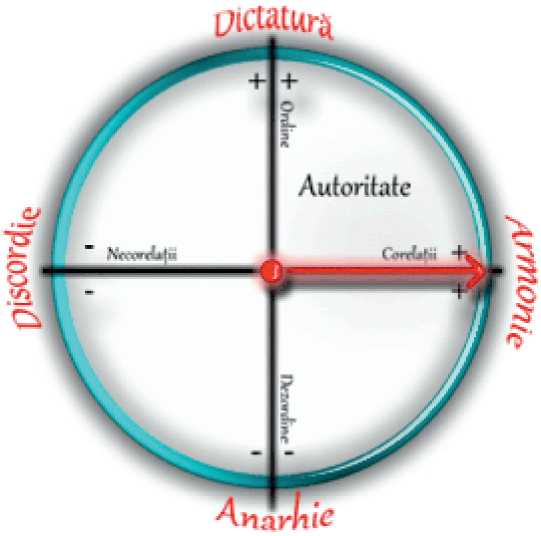


Illustration of the dynamics of the social phenomenon with dominant mentality, made by Alexandru Partheniu. (double click on the figure and wait a few seconds for the animation)

I am ending my digression by observing a few coincidences in the logical tetrad of Al. Partheniu; for example, the rotation period of the vector corresponds to the four Wolf solar cycles (a multiple of 11 years), about the time it takes for the changes in the mentality of a generation to happen (when the parents are about 44 years old, their children are starting to edify their own mentality, and when the same parents become grandparents, both their grandchildren and their children, of about 22 and 44, respectively, are starting to build new mentalities). Al. Partheniu had verified this phenomenon also in other historical contexts, for example the "Solidarnost" in Poland, observing an increased transience in the circulation of the "strength" ideas. It was also him who told me (in the seventies) that Communist mentality will suffer a dramatic change 44 years after the Communist regime was installed in Romania (1945). I find it hard to believe that what has happened in 1989 was a mere coincidence.

Referring to the positive and negative synthesis, I must emphasize what is probably the most important thing - the analogy with the logical circuits in computers*: and, or, nand, nor.*

8. Essay on care

Egotism and altruism are psychological states and manifestations, explained philosophically as two contrary, contradictory and exclusive categories.

Here is what the Romanian Language Dictionary says about these two notions:

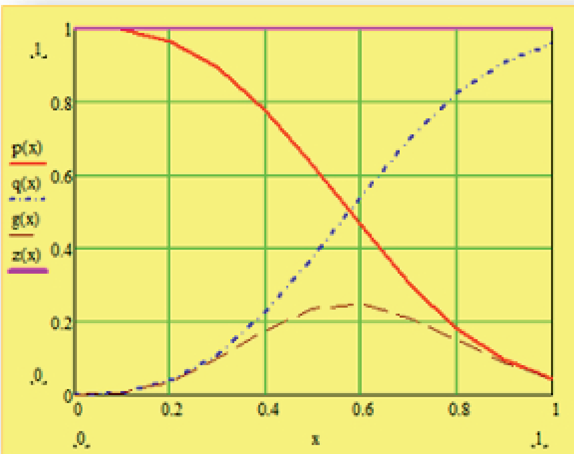
Egotism - n. Attitude of exaggerated preoccupation for one's own personal interests and total neglect of the interests of other people or of the group.

Altruism - n. A benevolent and disinterested attitude in favor of other people; an ethical principle envisaging this attitude.

In my view, *self care and care for others* are psychological states and manifestations that are explained philosophically as being two non-contradictory and fuzzy compensable (classifiable, differentiable, etc.).

The simplest way to represent them is logical-mathematically, through a canonic model with a constant sum and conventional focal distance, and graphically, in an orto-Cartesian system, by an ellipse.

I am using their representation through a non-linear Sigma model (type III), of a sigmoidal shape, with five categories compensable normed (reciprocal and anti-symmetric): *lack, hypo,* *norm, hyper, excess*. In simple language, any of the two states (manifestations, attitudes) can be: inadequate in excess, hypo-adequate, adequate, hyper-adequate, inadequate in lacking (all of them, of course, compensatory related, meaning with a constant sum). A practical fuzzy model could be also the one with four related categories: in excess, predominant, sub-dominant, lacking.



Self care = p(x)
Care for others = q(x)
The relative density of probability for a sample group = g(x)
The constant sum = z(x)
{z(x) = p(x)+q(x)}

Theoretically, the probability density of the self care - care for others ratio should be a Gaussian repartition, but, practically, countless factors, such as culture, tradition, education, relationships and social standards, etc., make this repartition be in excess of equality. I believe that the relation with multiple normed categories can be a useful and necessary indicator in the *public relations* studies.

9. Essay on the knowable universe and gravity

I agree with the *big-bang* hypothesis regarding the expansion of the universe (Stephen Hawking, Roger Penrose etc.), without, however, believing that it represents the zero origin of time. As a result, I do not reject the creationist theory, especially that the initial look of the pseudo-infinite concentration of the universe (of Schwarzschild's "primordial black hole") can be perceived only trivially (a no-entry system, meaning a process without a cause, which gnostically means an effect at least mysterious, in the sense given by Baruch Spinoza). The moving effect of the spectral lines toward red (Alexander Friedmann, Christian Doppler etc.) is a pertinent argument that supports the paradox of the cosmic bodies omni-directionally (probably still accelerated) moving away from a reference point, for example Earth. On the other hand, there are multiple theories (actually hypotheses that were scientifically argued at the moment of their announcement) referring to the relation between the intensity of the gravitational field, the distances and the forces associated with the expanding masses. Thus, I remind you of the quadratic relation theory (Isaac Newton, Henry Cavendish), the hyperbolic-uniform convergent theory, (Christoph Gudermann), the exponential theory (Pierre-Simon Laplace), and the theories regarding the negative pressure of void density (Hendrik Casimir), cosmic inflation (Alan Guth, Alexander Vilenkin) or the one regarding the ulterior genesis of the galaxies (John Covac) etc.

Next, I will dare to elaborate another hypothesis that offers, in my opinion, more progressive interpretations of a practical interest.

Respecting the current calculations, the distances from the sun to other massive cosmic bodies would be between 4.22 light-years (Proxima Centauri) and 27 billion light-years (the cosmic bodies near the edge of the known universe). In such a representation, I remind you that our sun is seen under an angular diameter of 9.35 milisteradian (10^{-3}), while the Proxima Centauri star has only 20 attosteradian (10^{-18}). It is known that the distance between Earth and the Moon is of 1.28 light-seconds, and the distance between Earth and the Sun is of about 500 light-seconds...

In short, it is an axiomatic fact that the diameter of the solar system is several billion times smaller than the one of the knowable universe.

This reason suggests the possibility of a fictional division of the universe in an all-encompassing space (pseudo-spheroid) that contains another relatively minuscule space (ellipsoidal), meaning the solar system. Mathematically we are speaking of two sets (Cantor): a universal set, whose elements represent the meta-galaxies, the galactic clouds, all the galaxies (including the "Milky Way" galaxy) that I call the "far cosmos" (FC), and an included subset (absolute complement) in the FC, whose elements are the sun, the planets, and other cosmic bodies in the solar system (up to the Kuiper belt) that I call the "close cosmos" (CC). The enormous difference in size between the two cosmic parts allows us to position the FC elements in a *spherical shell* space, in the proximity of the maximal density of probability of the substantial and energetic consistency, and the CC elements in the proximity of the sphere center. The relative positions of the FC cosmic bodies and their distances from a point a reference, for example CC, and define a force field whose intensity is proportional to the mass density of these bodies and inversely proportional to a distance function (e.g. Gamma– Euler). As a result, *one can intuit a fictional spherical surface in the spherical shell of the FC in which the field vectors have the same module and radial direction toward the CC. The diametrically opposed vectors annihilate each other, so that the resultant in the proximity of the spheroidal center is null (including for any opposite solid angles)*.

In fact, the same result can be obtained by appealing to the non-gentropic property of the energy (exergy) or of the information manifested in the center of a sphere. The fundamental law of the astral mechanics applied to the FC (inside a sphere) would have the minus sign, meaning an omnipotent rejection (pressure effect) in the CC. The noticeable effect in the CC would be the mutual "attraction" of any material body, as much as they eclipse (in a solid angle) a part of the intensity of the FC force field. Thus, the law of gravitational attraction for the CC can originate in the force field that is assymetrized by those bodies, resulting that famous action of the bodies, as described by Isaac Newton: "as if they were attracted to each other." This hypothesis does not contravene the gravity measure as an intensity of the vector field (Isaac Newton' stationary model, geometric - Albert Einstein, cosmological - Edwin Hubble etc.), but has no similarity with Copernicus' heliocentric model. I must also mention that in this case also the static postulation of the gravity field is only didactic (in the Einsteinian sense). Other simplifications regard density, background radiation, particle fluxes (e.g. heavy mesons), "dark matter" energy, etc.

The temporary acceptance of the above-mentioned hypothesis offers deductively *the idea of reducing or annihilating the gravity of a vehicle through a field shield of the same nature as the one of the FC,* *frontally positioned in the ascension position*, at any chance not posteriorly or interposed in relation to the obstructing cosmic body (e.g. Earth). The relaunch from other rational positions of the dispute between the "material point" and the "geometric point" would reconsider the concept of *real material body* (with concentrated mass up to the molecular level defined by its nature, cumulative volume, density with central tendency, and, probably, motion quantity).

If the CC would be represented in 2D by a circle with a radius of 10 cm, then the FC would graphically correspond to a circle with a gigantic radius, as much as it would be in reality the distance between Earth and the Moon. The huge disproportion explains why the CC might accept the force field lines to be parallel or why the vague expression of proximity in relation to the sphere center could reasonably substitute the geometric rigor. For example, a scuba diver could always be in the center of a visibility sphere (limited by the water transparency), no matter his position (of course not near the shore) in relation to the dimension (large enough) of a lake and its outline.

10. Essay on the homochronism of energy conversions

In what follows, I will try to empirically prove the idea that the homochronism of energy conversions, regardless of their nature, can be different, both in spatial and in relational variation. This idea does not hurt the principle of energy or mass conservation, it just rejects the reasoning of the instantaneous energy variations.

Even though I will use expressions that suggest chemical reactions, I mention that, by analogy, these expressions have an equivalent in any energy conversion. For example, by solvent, one can understand, according to each case, the elastic environment of gases, the molecular or atomic spatial structures, the conductive environments, etc.

There are given a substratum ($\mathbf{S_a}$) and a reactant ($\mathbf{R_e}$) in the present of a solvent ($\mathbf{S_o}$). Let us presume that in adequate conditions they are transforming in a substitute ($\mathbf{S_u}$) and an energy form ($\mathbf{E_{out}}$). The hypothetical energy potential ($\mathbf{E_{in}}$) of the virtual converter system depends on the substantial ($\mathbf{c_i}$) *qualities* (types, etc.), on the respective substantial *quantities* (**m**$_i$), as well as on their *proportions*.

Let us consider that, at the beginning of the conversion, ρ is the density of the reactant in relation to the substratum, and δ is the dilution of the substratum and reactant in the solvent, meaning:

$$\rho = m\,\mathbf{R}_e / m\,\mathbf{S}_a \qquad \delta = m\,\mathbf{S}_o / (m\,\mathbf{S}_a + m\,\mathbf{R}_e)$$

During the conversion, these ratios become time variables: ρ *(t)* and δ *(t)*.

$$m\,\mathbf{S}_a + m\,\mathbf{R}_e + m\,\mathbf{S}_o = m\,\mathbf{S}_a\ \{[\rho(t) + 1][\delta(t) + 1]\}$$

Noting: θ(t) = [ρ(t) + 1][(δ(t) + 1], results that:

$$\mathbf{E}_{in} \approx c(\theta) * m\,\mathbf{S}_a * \theta(t) \qquad (1)$$

Thus, the energy potential of the converter system depends on the mass (quantity) of the substratum m**S**$_a$, on the specificity (quality) of the variable substantial mixture during the conversion [**c(**θ)] and on the extension of the conversion in the substratum mass θ**(t)**.

Next, I will call:

- the extension of the conversion in the substratum mass, θ**(t)** = *proximal factor,*
- the specificity of the substantial mixture, **c(**θ) = *sthenic factor*.

The sthenic factor signifies intrinsic capability, an energy potential of the substratum in conversion. I must emphasize the fact that it is not about the output energy equivalent (**E**$_{out}$) of the substratum mass, such as the "fuel caloric power".

Intuitively, let us admit that the growth rate of the energy potential during the conversion is proportional to the rate of the modifications in the concentration of the substratum and reactant, concomitantly with their dilution in the solvent, in other words, with the extension of the conversion *center* in the substratum:

$$d\,E_{in} = k * c(\theta) * m\,\mathbf{S}_a\ d\,\theta$$

During the conversion, the proximal factor varies continuously in a growing manner.

The spatial extension limit of the conversion center is given by the substantial volume. For this hypothesis, various mathematical models can be constructed, from the simplest, such as the linear, exponential, logarithmic ones, to the complex ones, such as the odd superior degree one, the sigma, etc.

I have chosen a mathematical model that reasonably approximates an accelerated extension of the conversion in its first part, followed by a deceleration in its second part, as the saturation of the reactant is increased, and their dilution in the solvent decreases.

$$\frac{d}{dt}\theta(t) := \alpha \cdot \left[\frac{(\theta m - \theta(t))}{(\theta m - \theta o)}\right]^{\gamma} \cdot \left[\frac{(t - to)}{(tm - to)}\right]^{\beta}$$

An acceptable solution of this differential Lagrange equation seems to be the critical aperiodic one, not a forced oscillation.

I have arrived at the following form:

$$\theta(t) := \left[(\theta m - \theta o) \cdot \left[1 - \exp\left[\frac{-\alpha}{\beta + 1} \cdot \left[\left[\frac{(tm - to)}{(\theta m - \theta o)}\right]\right]^{\beta} \cdot \left[\frac{(t - to)}{(tm - to)}\right]^{\beta + 1}\right]\right] + \theta o\right]^{\gamma}$$

As a result, the proximal factor increases from the initial factor θ_0 to its final value of θ_m, at the beginning accelerated, depending on the factor β, then asymptotic, depending on the decelerating factor α. The γ parameter shows the variation type, which, in the case of the amorphic environments, is aperiodically critical, meaning; $\gamma \cong 1$.

The sthenic factor during the conversion is not constant, depending on the proximal extension of the conversion.

The decreasing rate of the sthenic factor, due to modifications in the substantial ratios during the conversion becomes gradually smaller, as the spatial extension of the conversion is increasing.

A mathematical model that reflects faithfully enough the previous hypothesis, in my opinion, is the following:

$$dc = k_o \cdot c(\theta) \cdot \theta^{k1}\, d\theta$$

This is the convenient solution:

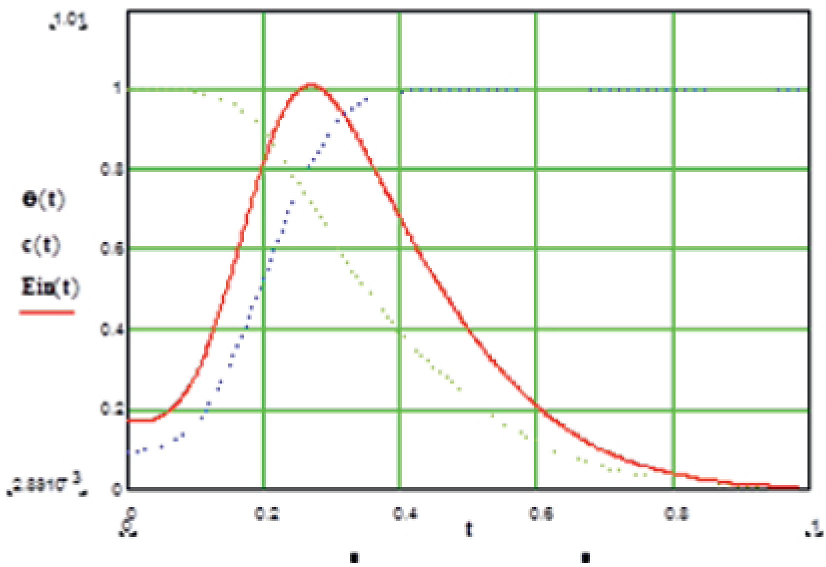
$$c(t) := co \cdot \exp\left[-\varepsilon \cdot \left[(t - to)^{\zeta} \cdot (\theta(t) - \theta o)^{\gamma}\right]\right] \; *$$

where ε and ζ are specific conversion parameters, and c_0 is the equivalent of the initial energy potential.

The energy potential of conversion

Under the previously stated hypothetical conditions, the energy potential during the conversion varies as follows:

$$Ein(t) := c(t) \cdot \theta(t) \cdot msa$$

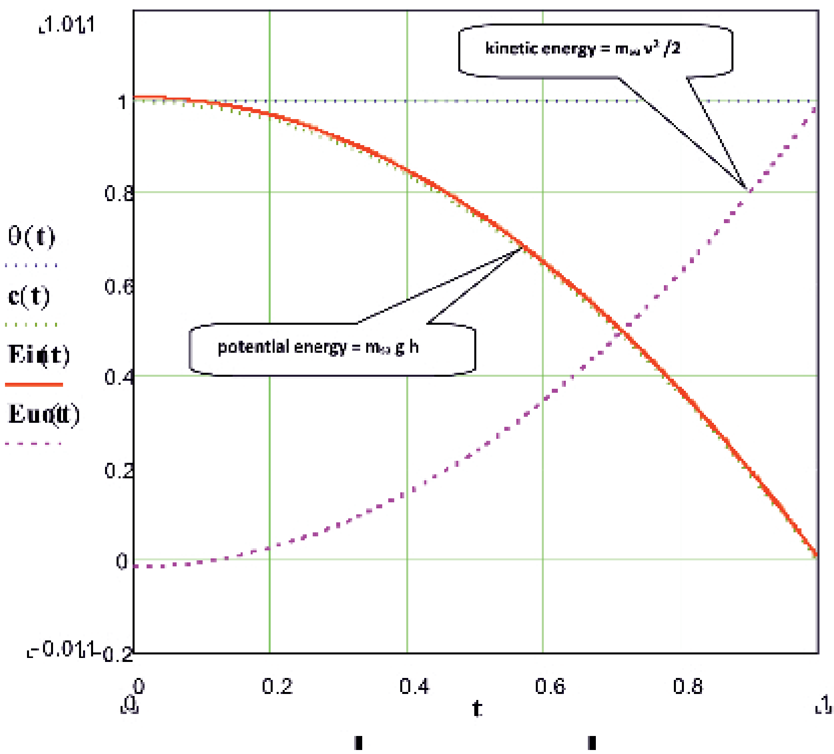


The energy potential variation during the energy conversion. With a blue dotted line, in a constantly growing variation, is represented the proximal factor, while with a green dotted line, in a decreasing variation, is represented the sthenic factor.

If we presume that the proximal factor varies instantaneously in the unitary stage, as is in classic physics, and that the sthenic factor has a specificity of the conversion that is conventionally accepted (e.g. accelerated decreasing, as in the conversion of potential energy in kinetic energy), then the energy potential is the potential energy itself.

Between the energy potential and the energy exited from the system, the principle of energy conservation is kept:

$$E_{out}(t) = U - E_{in}(t)$$



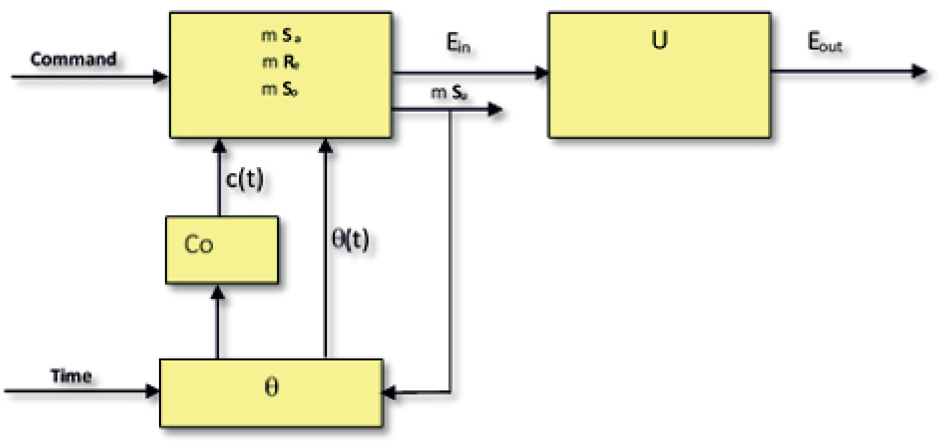
Example of energy conversion, in which the proximal factor increases instantaneously from the initial to the final value, and the sthenic factor varies according to a quadratic law, as it happens in classic physics, during the conversion of potential energy to kinetic energy

In relation to the previous example, where the energy potential is actually the potential energy, the simplest conversion could be the one into kinetic energy. Their variation during the conversion is inverse, as it is illustrated in this figure.

Instead of conclusions

I believe that such simplifications as the one in the previous example, in which the conversion appears and disappears instantaneously, cannot be applied to complex phenomena, such as the ATP degradation in ADP and energy, the photosynthesis processes, photoluminescence, ionic pumps, etc. In these phenomena, but also in simpler ones, such as the thermal engine combustion, the variation of the proximal vector, antagonistic and asynchronous to the sthenic one, makes the transitory regime of conversion have an apex. The theoretical and experimental determination of the apex position can be a problem of optimizing the conversion in the performing models, especially the bionic ones. The argument of the difficulty of experimental determination of the parameters of the proximity factors and of the sthenic factors do not resist in the face of automatic processing.

Next, I am presenting a possible a priori model for the energy conversion, based on the way in which this conversion has been described previously.



The energy conversion model with two asynchronous factors of the transitory regime: the proximal factor θ*(t) and the sthenic factor c(t). Explanations in the text*

Philosophically, any process, including the energy conversion, has a cause. The causes (presented in the model in the figure above as input values, even though they are atypical) try to suggest that any conversion has, at the beginning, a command and a moment of the command that potents differently the input energy E_{in} in the conservatory system U. If the transitory system is neglected (meaning the variation of the input energy potential in the conservatory system, then the conversion becomes classic.

11. Essay on inertia

Regardless whether the space is considered continuous or discrete, absolute or relative, it is cumulative (it respects the rule of addition).

The postulation of the cumulative mass is still debatable. In the terrestrial space and referring to the classic mechanics, the discrete mass of the molecule keeps its substantial identity, and the atomic mass defines the structure of the matter.

For example, it is given a substantial body of any volume *vol* and mass *m*. This body can be divided theoretically in two or more parts of volume, which cumulated reconstitute the whole, as it can be divide also in two or more parts of mass, the smallest being the one of a molecule.

Of practical reasons, the body mass can be concentrated hypothetically in one single point (mass center). It is understood that we are not talking about the mathematical point (without dimensions), but about a point with an infinitesimal volume that must contain at least one group of molecules, so that the substantial nature is not compromised. It is absurd to ask for the concentration of the entire mass in one single molecule, but it is reasonable to accept that the largest part of the body mass can belong to the mass center with small volume, and the rest of the mass could belong to the additional volume. It results a fictional body (model), as a working premise, with an average density consisting in two extreme densities.

I emphasize the essence of my reasoning, which states that the cumulative tendency of the volume (space) is self-evident, the one of the mass is conditioned by the substantial nature and structure, while the tendency of the density is to reach an average (conventional) value. In fact, density is a non-gentropic both energetically and informationally. In other words, the fictional body (model) that simplifies the real body has an average density formed of at least one part with very high density and one part with very low density. It results the possibility of the reaction of certain internal moments of the body.

Under these circumstances, any *action* applied in the mass center m_c of that body could produce a quantity of motion that would propagate as follows:

$$d(mv):=k\cdot\int_{vol} div\cdot grad\left(m_c\right)\cdot d(vol)dt$$

If the action is independent of time, then:

$$\frac{d}{dt}mv=F \qquad F=m\cdot a$$

In other words, the body gets an instantaneous acceleration *a*, without an inertial moment. Otherwise, there is a delay in the propagation, probably equivalent to the resting inertia.

12. Essay on force

The mechanical force is based on the concept of *evidence*, where the effect is so evident that it doesn't need demonstration. All the observations and experiments so far have shown that a certain *mass* is accelerated more as the force is greater, so that another type of result is rejected automatically. Thus, in mechanics, the notion of *force* is assessed through is effect and measured through the acceleration *a* that a body of mass *m* receives. This is also called a Newtonian point of view.

Newton, describing what today is considered to be the universal principle of physics, hesitated saying that two bodies attract each other with a force...; he mentioned, more out of scientific rigorousness than modesty, that *"two bodies behave as if they were attracted to each other with a force..."*

Not even today we know what force is. Nobody has measured force, but only its effects, the most known being *movement, deformation, and balance*. That is why the definitions in prestigious dictionaries (Oxford Dictionary) limit themselves to considering force as a cause, a cause for movement, *a cause for all effects*.

By extension, in a natural tendency of language to develop, there are multiple expressions that include the word *force*: *a tour de force, force of habit, the driving force*, etc.; in all these combinations, the term that interests me represents a different thing than the *force* I am referring here.

Force in biomechanics

In physical education and sports, *force* is the image of muscle contraction. Through contraction, the muscle transforms the chemical energy stored in its macroergic compounds into mechanical energy. Force is perceived as a motor characteristic of the *physical effort performer*, and is measured by the size of the effect of defeating a resisting force, either a weight or another extreme force. Usually the effect is a movement with a certain speed or with a certain variation of speed, a duration of balancing certain opposing forces, a static pressure, etc. Often, force is tied intuitively to the muscle mass, meaning the muscle dimensions, especially their section. The term *mass* referring to muscles is different than the one used in mechanics. *Muscle mass* contributes to the dimension of the cause that produces the acceleration effect on the *mechanical mass.*

In biomechanics, because of the countless restrictions of the performer, the concept of *evidence of the acceleration effect* is less relevant. For this reason, I believe to be more adequate for the characterization of the effect produced by force, the concept of *potentiality*. The active biomechanical force Fa(t), produced predominantly by the muscle converter, has conceptually, a *maximal virtual potential*, meaning a magnitude (Fmax), dependent on the converter substratum, and a *manifestation potential* (y(t)), meaning a certain moment value:

$$Fa(t) = Fmax \cdot y(t)$$

If Fa(t) is larger than the load, the weight (G) or, in general, is a resultant of the resistive forces (G+L), then this difference, called net force[6] Fn(t), produces a movement on a certain trajectory and with a certain acceleration, dependent on the manifestation potential[7] y(t):

$$Fn(t) = Fmax \cdot y(t) - (G + L)$$

[6] *Fn(t)* is the vectorial resultant of all forces that act on the body of mass *m* giving it an acceleration *a,* on the direction of the resultant (D'Alembert's Principle).

[7] In the case of classic mechanics, the force appears and disappears instantaneously, thus y(t) = 1.

The concept of *maximal virtual potential* can be illustrated by the capacity of a tank, such as the gas tank of an automobile; the *manifestation potential* can be assimilated to the section of the pipe that links the tank to the carburetor, together with its command. In fact it is about the different understandings of the notions of *capacity* and *capability*, existent in the English language.

The maximal virtual potential of the biomechanical force and its *manifestation potential* are not notions as abstract as they might appear. It is a known fact that muscle tension, regardless whether it is of an electrochemical or electrostatic nature, comes from the actomyosin processes of ATP degradation through the rotation of these molecules. As a result, it is about a certain *capacity*, represented by a *limited stock* of the conversion substratum (in an individual, in a certain body location, and at a certain time); this notion also includes the *length of pulleys* formed by the body segments (the structure of kinetic chains) and some individual biological *structural qualities* of force transmission.

In regards to *capability*, this notion refers to the ATP re-synthesis speed, the recruiting way of the neuromuscular synapses, the defeat of the inertial forces, etc., all of these relating, as in the case of capacity, to a certain individual, a certain body location and a certain moment.

Outside these biological considerings of manifestation of the biomechanical force, the major restrictions imposed by the way the human body segments are composed, *severely limit the distance* which the net force acts on, the action time of the net force on the resistive force. As a result, the acceleration effect, according to mechanics, is difficult to observe; in exchange, what becomes convenient is the observation of the trajectory and speeds during the significant sequential moments, meaning in most trajectory points.

I must emphasize the fact that in biomechanics force is manifested *concretely*, in the movement of a weight (defeating certain resistive forces), or in the static balance (as a null resultant of the action of multiple forces and associated force moments), or in the pressure on certain slightly deformable biological structures; very rarely, force is manifested in the slowing down of the effect of another force, opposing a contraction (breaking).

The biomechanical movement, in its most frequent one - the motion - is characterized by *trajectory* s(t) and *moment speed* v(t). Both characteristics define completely the *duration* of movement, its *form* (and most often, its variation rate and inflexions), as well as its *magnitude*. I must mention that, from a mechanical standpoint, *the vectorial components in the Frene tried*[8] define movement just as completely; but, in my opinion, these components are not as practical as the *trajectory* and the *module of moment speed*. As an argument, I mention that the computer analysis of biomechanical motions is, at the moment, based on the video capture of successive positions, which allows an easy construction of the trajectory and changing rate of the positions.

In biomechanics, the measure of force can envisage a certain *speed variation*, a *maximal* speed maintained constantly or a certain *trajectory length*. The trajectory length can be expressed also through the duration in which the movement is not qualitatively compromised. In other words, the biomechanical force has three manifestations:

- ► maximum acceleration;
- ► maximum speed;
- ► maximum distance or duration (in which the movement is not distorted or compromised).

From what has been said above, one can observe a certain mathematical rule, the one that, according to the purpose, the measure of force can refer to the *variation in time of the speed*, meaning to the second derivation of space, which is the *acceleration*. The measure of force can also refer to the variation in time of the space, meaning its first derivation, which is the (average) *speed*. Thirdly, the measurement of force can refer simply to the *space* (the covered distance).

In regards to its relation to muscle strength, force is manifested in the so-called *PID mathematical regime* (proportional, integral and differential). It must be said that the idea of proportionality is accepted with difficulty in biomechanics due to the restrictions of force transmission. What I mean is that the human segmental motions are limited by the length of bone pulleys (which are at the most of a few tens of centimeters), of muscle elasticity, joint mobility, etc. During the

[8] A tri-orthogonal reference system, mobile on trajectory

phase (acyclic) motions this means non-linear transitions of the active force values, from small values to larger ones (that can be maximal) and vice versa.

One can conceive, through simplification for a didactic purpose, forms of transitory variation of speed that are *linear, canonical (quadratic functions), exponential, logarithmic*, etc. Intending to perform a deeper analysis, I will use *sigma* or *Hoerl* mathematical models that I consider *"both necessary and sufficiently"* precise to express the non-linear variation of segmental speed. The main argument for this option is, of course, the fact that, unlike in mechanics, the relative movement limitations of body segments impose that the variation of transitory speed has at least one inflexion, meaning a maximum of acceleration[9]. More than that, I believe it is useful to clarify that, from a biomechanical standpoint, the production of mechanical tensions in the muscles is not instantaneous, and the weight of the body segments and active muscles (G) and the load (L) are not suddenly put into motion. Thus, the acceleration produced by active force depends on the way in which the mechanical tension is activated in the muscles and the way in which it is propagated in the kinetic chain formed by the bone pulleys.

Next, I will try to illustrate the idea of non-linear variation of biomechanical movement speed with a mathematical model of vertical jump, generated by the triple extension of body segments in the lower limb joints - the so-called *"Sargent Jump"*. During the spring for the standing vertical jump without rapid flexion, act the largest human muscles, in a short time, and on a relatively small distance. This fact, as well as the simplicity of the motion, made the *Sargent jump* famous. It is often used as an example of power movement, as a measure of maximum (instantaneous) anaerobe power, or simply, as measure for the spring.

Firstly, in analyzing this movement, we must take into account the fact that the temporal-spatial activation of the synergistic muscle synapses is not done instantaneously. Then, in the case of repetitions, we will take into account the fact that the ATP re-synthesis process has a certain latency, and, at one point, cannot resist the effort, diminishing the active force, Fa(t). For the sake of scientific rigorousness, we must

[9] A rigorous analysis of the causes for the biomechanical movements, meaning their forces, must take into account, as a reasonable rule, the existence of a maximum acceleration.

also take into consideration the fact that in starting the motion, the active force defeats (with the sensation of difficulty) the inertial force, Fin, delaying and slowing down even more the increase of speed.

I have enough factual and logical reasons to consider that the type of speed variation depends on the net force and is intermediated by a value called here *admittance* (by analogy with other sciences).

I remind you that admittance is a characteristic of the environment through which a force is propagated. In the case of electrical circuits, for example, admittance is the reverse value of impedance or (often) of electrical resistance, and relates the electrical current to the electrical tension (the electro-motor force). If the admittance is high, then the current will also be high.

In case of biomechanics, if the admittance is high, the movement speed as a result of muscle force action will be also high. In my opinion, admittance (the way in which speed depends on force) is conditioned by a multitude of factors, such as movement-opposing forces, gravitational acceleration, the duration of the action, the promptitude of neuromuscular commands, the state of the contractile performer, the type of re-synthesis of energy substratum, etc. Admittance has, in biomechanics, the expression $[TM^{-1}]$ and appears as a variable coefficient or an individual constant (in the case of maximum speed).

The net biomechanical force, Fn(t), when we are taking into account also the inertial force, Fin(t), depends on the difference between the active force and the (vectorial) sum of all forces opposing the movement (on its direction):

$$Fn(t) := Fa(t) - [(G + L) + Fin(t)]$$

The inertial force, as one knows, is opposed to changing speed, including the null one (rest), being directly proportional to the body mass and the transitory variation of the active force:

$$Fin(t) := -k \cdot \frac{(G + L)}{g} \cdot \frac{d}{dt} y(t)$$

One can notice that when there no rotation movements, the logical-mathematical model of the movement starts from a differential equation:

$$Fn(t) := Fmaxy(t) - k \cdot \frac{(G + L)}{g} \cdot \frac{d}{dt} y(t) - (G + L)$$

The movement speed, as a result of the action of the biomechanical force, one deduces from the work done by the net force on the *limited* distances:

$$Ec(s,t) := \int_0^s Fn(t)\,ds$$

It is given, practical for this example, s = 0.4 m the distance on which the net force acts, representing the 40 cm lift of the body center of gravity during the jump spring, meaning during the triple extension. The net force action is suddenly interrupted after the s spring, corresponding to the duration t = 0.21 seconds, when the lift-off starts (the flight):

$$Fn(t) := \left| \begin{array}{l} Fa(t) - [(G+L) + Fin(t)] \\ 0 \ \text{ if } \ t \geq .21 \end{array} \right.$$

Mechanical work, as everyone knows, is equal to the variation of kinetic energy, of which:

$$v(t) := \left| \begin{array}{l} \sqrt{Ec(s,t)\cdot\left[2\cdot\dfrac{g}{(G+L)}\right]} \\ {[v(.20) - g\cdot(t - .21)]} \ \text{ if } \ t \geq .21 \end{array} \right.$$

During the jump, the ascension speed decreases gradually up to 0, as it reaches maximum height.

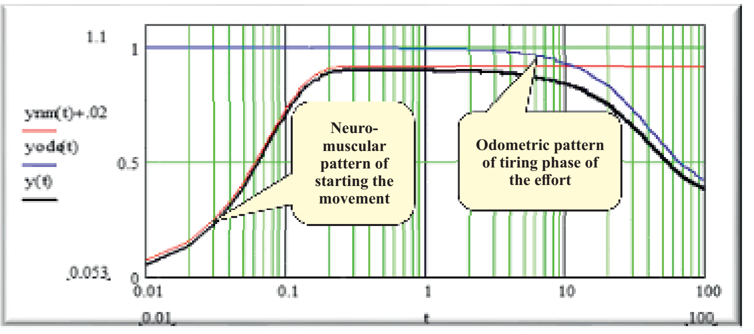
The functions on which the active force variation depends, mainly, are the *sigma models* of the way in which the muscle synapses are spatial-temporally recruited during the effort starting phase, (ynm(t)), and the way in which fatigue appears through the ATP re-synthesis deficit in the case of tiring efforts, *(yodo(t)):*

$ynm(t):=q-q\cdot exp\ \ -a\cdot t^{b}$ *

$yodo(t):=(w-yem)\cdot exp\ \ -c\cdot t^{d}\ \ +yem$*

$y(t):=ynm(t)\cdot(yodo(t))$

The a, b, c, d parameters that appear in these mathematical models personalize the performer (with a pronounced genotype character) and particularizes the moment and the physical effort conditions.



Variation of the net force manifestation functions. The integrals of these functions, together with other variables, determine the value of the speed's admittance.

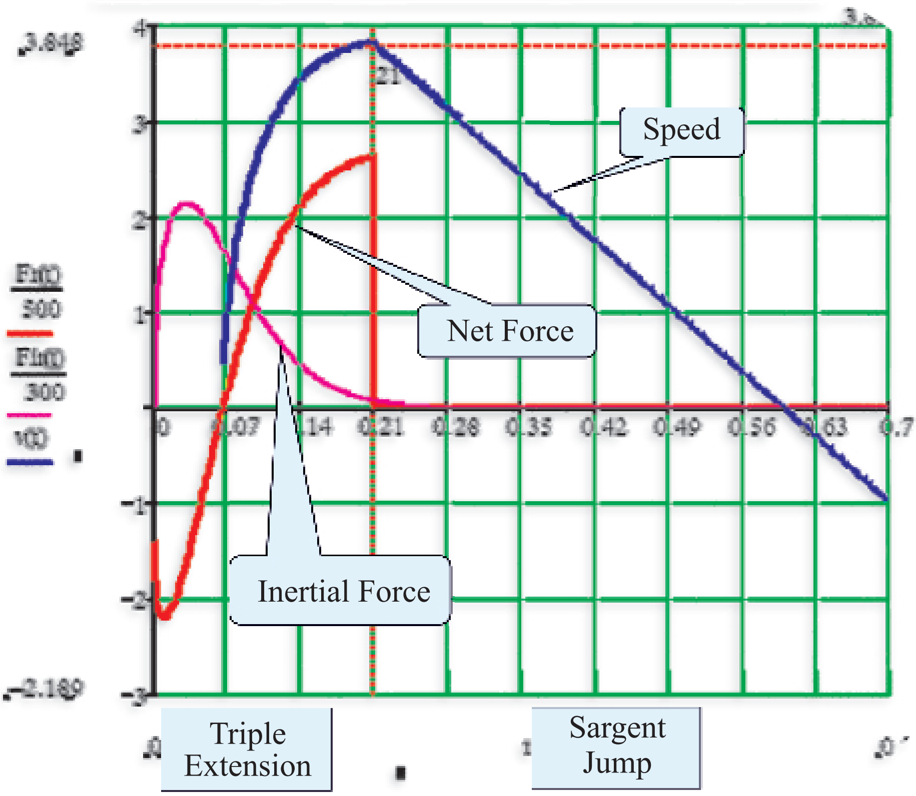
The mathematical moment of spatial-temporally recruiting the synapses, *ynm* contains also a *q* factor, whose significance is tied also on the quality and promptness of muscle commands. The performer fatigue model, *yodo*, contains an individual constant (*yem*), signifying a power reserve for special cases, such as an emergency.

Thus, the admittance, or the value that ties the speed to the active net force on the biologically limited distance is:

$$Y(t) := \frac{\sqrt{[\,Fa(t) - [(G + L) + Fin(t)]\,]\cdot s\cdot \left[2\cdot\frac{g}{(G+L)}\right]}}{Fn(t)}$$

The biomechanical effect, in this case the increase in speed (of the center of gravity) is due to the net force action and depends on the admittance. The restrictions of the kinetic chain (the pulley length, the joint types, etc.) limit the action duration of the force (quantity of movement) as well as speed increase (in this case, up to 3.82 m/s). The jump height will depend only on the square of this take-off value and, obviously, on the gravitational force that opposes the ascendant motion. After approximately 0.39 seconds, the ascension speed is canceled, reaching the maximum jump height of about 80 cm.

In the following figure, the biomechanical values are represented on different scales in order to be seen together. From their simultaneous presentation, one can see that the defeat of the resting inertia is actually a non-instantaneous disappearance of the reaction, that the biomechanical force reaches its peak value after a few tens of hundredths of a seconds, while the speed increases continuously, although non-linearly, up to supporting take-off. In starting the movement, the net force and the inertial force tend to be conserved.



The theoretical variation of the main biomechanical values in the standing high jump without rapid flexion (Sargent jump). Explanations in the text

The variation of speed and of the force that generates it represents in this figure an example of jump of a fictional athlete, but its characteristics are close to reality. For example, this athlete has a weight of 71 kg, a height of 1.80 m, he can lift 163 Kg in semi-flexion, he uses about 80% of the virtual maximum force potential, and about 90% of its explosive manifestation potential. I have chosen these values in order to simulate the aimed behavior and effect (the maximum jump height), modifying in turn the various parameters in a facilitating and restrictive sense. A few explanations are needed; thus, it is known a certain significant correlation between body height and the optimal amplitude of the flexion (30 cm for 1.70, 40 cm for 1.80, 45-50 cm for 1.90 m etc.), while the maximum anaerobic power - constant for (this or any) athlete, corporal location and a certain given moment - shows that he can lift with low speed a weight so heavy that this, together with the athlete's weight, would not be more than his maximum force.

From the computerized simulations made with this logical-mathematical model it results several interesting cases that deserve, in my opinion, our attention. Thus, if the fictional athlete would have used his full maximum force and explosive manifestation potential, he would have jumped 120 cm! If he had used only his maximum acceleration capability corresponding to the same extension, he would have jumped 96 cm. Finally, if he had about 190 cm and a spring corresponding to that height, but with the same body weight and maximum force, he would have jumped 118 cm. I remind you that the logical-mathematical models are simplifications of the reality, and that the transfer of the conclusions obtained from the computer simulation into reality implies risks. Paradoxically, the risks are higher as the model is more sophisticated. This the logical-mathematical model did not take into account multiple factors, such as the jump technique, the temperature of the performer and of the environment, the psychological attitudes and aptitudes, etc. What interested me was only the biomechanical point of view on the active force, compared to other viewpoints, such as the mechanical, methodical, or anatomical-functional ones. As a curiosity, such a model can explain why a flea can jump about 200 times higher than its own height, why a wild cat can jump about 6 times its own height, or why an athlete, in order to be a good jumper, must have a certain somatic configuration.

As I have stated before, the admittance Y(t) links the effect to the cause; in this case, it relates the speed of lifting the center of gravity during the net force jump spring:

$$v(t) = Y(t) \cdot Fn(t)$$

From my calculations resulted that during the explosive force manifestations, the admittance varies differently from the active force and depends on the resultant of the resistive forces. Admittance characterizes especially the structural or genetic aspects of the environment in which the active force is manifested, and less the difference between active force and resistive forces. In other words, the height of the standing high jump as measurement of the spring can be different in two athletes with the same maximum force (capacity) but with different manifestation potentiality (capability).

These biomechanical considerings tied to the manifestation of force during maximum acceleration, translated in the methodical language through the explosive force expression, show the necessity and the possibility for the strength training of jumpers and throwers (or of any other athlete practicing sudden segmental motions) to direct themselves toward increasing the admittance. In simple words, this means the judicious practice of certain means addressing the neuromuscular commands. For example, lifting relatively light weights using maximum speed, starting at the coach's signal. Each lift must be signaled, and the frequency of the lifts will be low.

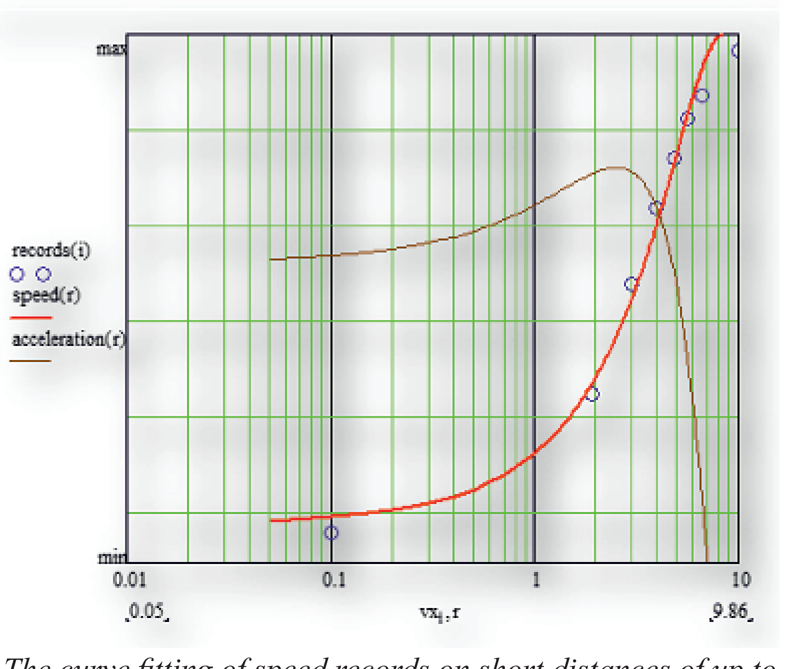
I must emphasize that the relationship between the movement speed in the direction of the biomechanical net force that produces it, and this force is one of pseudo-proportionality. More precisely, *the maximum movement speed on the distance that is restricted by biological considerings is proportional to the square root of the resultant from the forces that generate this movement, on its direction.* The stronger the biomechanical net force is, the higher the (square) movement speed of that body is. The speed increase is nonlinear in relation to the increase of the net force (because of admittance, which is also dependent on the net force and the individual structural factors); it is extremely slow anyway, which proves that speed is a motor skill that is hard to perfect. With this emphasis I want to avoid the interpretation confusion referring to the resistive force, relating to V.A. Hill's relationship[10]; this relationship states that as the resistive force increases, the maximum movement speed decreases. I make one more clarification, that, in some cases, *the biomechanical net force is the resultant of all forces that act, including the ones that facilitate movement,* so it does not refer always only to the difference between active muscle strength and the resultant of resistive forces.

[10] The Hill relationship will be commented in the section referring to the biomechanics of speed.

The similitude of this relationship (between the the movement speed in the direction of the biomechanical net force that produces it, and this force) with others in the classic sciences, such as Ohm's law[11] in electricity or the relation between the flow of fluids and their hydrostatic pressure, is not accidental.

Just as in the acyclical movements, where the inertial force and the admittance oppose the increase in speed (acceleration), during the start of the athletic speed events, the inertia, but especially the slow increase of admittance, make the maximum acceleration to be reached only after a few seconds. The phenomenon is treated as a transitory phase.

To illustrate the way in which the net force acts during the transitory phase and give an acceleration to the athlete's body, meaning a gradual increase in speed during the sprint events, we simulated the behavior of a fictional athlete who, theoretically, would hold every world record of speed on short distances.



The curve fitting of speed records on short distances of up to 100 m shows that the running speed of the fictional athlete increases nonlinearly continuously (red line), the movement being at first accelerated, then decelerated. A maximum acceleration can be observed about 2-3 seconds after start.

[11] Ohm's law in a local form: the electrical current in a circuit is higher as the admittance is higher and the electro-motor force is higher.

The acceleration chart (the continuous black line) in the figure above suggests that the force manifestation in the fictional athlete happens during maximum acceleration. Not accidentally, during the sprint, the maximum acceleration appears 2-3 seconds after the movement started; this happens also physiologically with the maximization of the anaerobe processes of ATP degradation. Thus, the start in sprint events can also be assessed and measured as a manifestation of explosive force. *Theoretically, the measurement of the explosive force should be the duration in which the acceleration increases to maximum.*

Practically, however, even after the acceleration decreases, the speed continues to increase, a bit slower, stabilizing itself to a maximal value. Thus, the moment in which speed becomes maximal is much easier to observe and coincides, in acyclical movements, with taking-off during the jumps or with the moment of letting go of the object in the throwing events. In a car, the acceleration characteristic is measured conventionally by the time it reaches the speed of 100 km/hour. In humans, the distance on which force acts is relatively small and differs a lot from one movement to another. That is why the standardization in explosive force measurement is inadequate.

The measurement of explosive force can be done indirectly by *effect*. For example, the height of the jumps without spring running depend on the final speed of movement, meaning on the speed during take-off, as also depend the distances of throws without spring. That is why it is a lot more comfortable to highlight or calculate the *final speed* than the moment of maximum acceleration. This final speed expresses analytically the average acceleration on the duration or distance of mechanical work. When fatigue is out of the question, the correlation between average and maximum acceleration is significant at a really convenient threshold, which allows replacing one value with another. In other words, and coming back to the first example, the maximum height of the standing high jump can be a measure of explosive force, of maximum instantaneous anaerobe power, or of spring, depending if we are interested in the causal, process, or effect expression.

After the transitory phase there is a quasi-stable phase, in which the maximum speed depends on the biomechanical net force that reached its maximum value and somewhat constant, but included and depending on admittance.

The quasi-stable phase represents the *manifestation of the maximum speed of active force*, a phase in which, in my opinion, deserves to be treated separately with the title of *biomechanics of speed*.

13. Essay on the speed of motor acts in humans

In physical education and sports, speed is considered to be a motor quality or a skill that characterizes muscle contraction. Thus, is the duration of total contraction touch is small, the speed is high, and vice versa. This characteristic of the performer of physical effort is transmitted through pulleys and kinetic chains to a body movement or to a moved object, which turns speed a characteristic of *performing* a motor action, such as running. In certain situations, speed can characterize repetition or alternation of a movement within a conventionally established time interval, replacing the frequency and be called repetition speed, ultimately replacing the motor reaction latency, being wrongly called *reaction speed.*

In biomechanics, speed is a characteristic of the movement that is produced by net force. Through the causal clarification, the biomechanical speed is closely tied to the anatomical-functional characteristics of the performer and it differentiates from what it is understood in mechanics by the speed of a mobile or a material dot.

Biomechanical speed is perfectly determined if its *moment speed* and *trajectory* are known. In mechanics, movement is defined just as precise, usually vectorial, with a mobile *Frene tried*. In fact, the vectorial form says the same thing about trajectory and moment speeds, but more complicatedly.

Beside the moment speed, which means the speed in each significant position or in each temporal sequence of the moment, biomechanics also uses the *average speed* and *final speed* forms (especially for the limited segmental movements).

The measurement of the *average biomechanical speed* is a ratio between the distance or the trajectory length and the duration in which this distance or trajectory was covered. *The final speed* or the speed in any moment of movement is defined by the *derivate*[12] of that position. The derivate, this apparently complicated mathematical convention, should not scare anyone, because the computers can calculate it almost instantaneously.

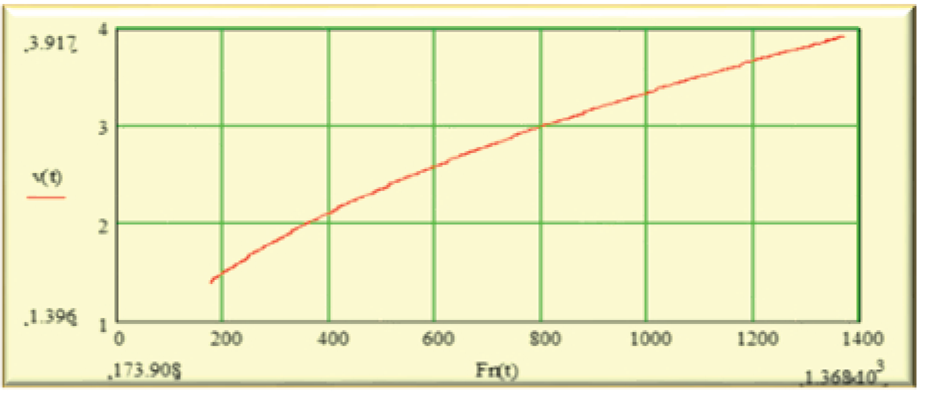
During the sudden segmental movements, when they start from resting position, the final speed is excellently approximated by the double of average speed. For example, if the duration of the spring of a standing jump is 0.5 seconds, and the center of gravity was raised by 0.40 m, then the average speed is 0.40/0.5 = 0.8 m/s, and the final speed is 1.6 m/s. In sports, for the simplification of communication, it is often said about a sprinter that he has a speed of, let's say, 10 seconds over 100 m. For the same reason, we also used the expression *good reaction speed*, for example, to characterize the motor reaction latency of 140 milliseconds. Expressing speed through time units is, of course, incorrect, but it is not a serious mistake, if the referring distance is constant or conventionally pre-established.

In most sports, top performance is based on *maximum speed* and the *duration* in which this or a close speed is maintained. From biomechanics we know that maximum speed is reached at the end of the phase during which the acceleration is positive (of the explosive force action) and lasts for a relatively short time, from a few seconds in the ordinary man to 30 s in elite athletes. Causally, maximum speed is determined by the *difference* between the *active force* and the *resultant of the resistive forces* (meaning the net force), through the personalized value called *admittance:*

$$v(t):=Y(t)\cdot Fn(t)$$

Without going into calculations and invoking the premises of the logical-mathematical model that links the performance speed to the active force, we can say that the *maximum speed* depends mainly on the size of the *active force*, the *weight* of the body segment or of the body (G) that is in motion, of the *load* or the opposing forces (L), of the *distance* of the mechanical work, of the *individual factors* (for example q) included in the admittance, etc. It is important to retain that causally, *the maximum biomechanical speed increases with the active force.*

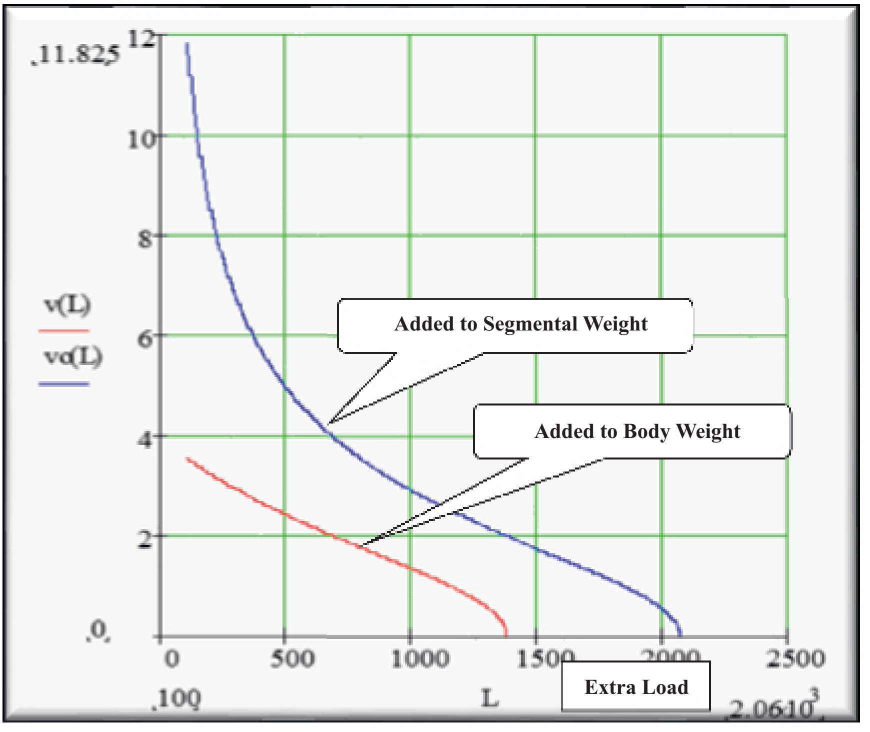
[12] The limit of the ratio between the variation of the proximal space and the variation corresponding to time, when it tends to zero.



The relationship of increase of the maximum biomechanical speed concomitantly with the increase in the net force. Example for the standing vertical jump spring with a flexion of 0.40 m

Both from the example above and from other movements, it results that the *progress rate* of the maximum speed in relation to the increase in the active force is *small*. As a result, it is confirmed that speed is a motor quality or a skill that is hard to perfect, with a pronounced genetic character. For example, for a speed progress measured through the spring difference from 78 cm to 134 cm (meaning reaching a worldwide top performance), the athlete should improve in lifting a weight from semi-flexion from 163 kg to 263 kg! This condition would not be everything, because we still don't know how the admittance is modified, as a contractile environment factor, to a progress of 100 kg for the active force manifested during extremely low speeds.

On the other hand, if the *load* (L) or the resultant of the resistive forces *increases*, *the net force decreases*, and implicitly the *maximal speed of that movement decreases*.



Example of decrease in the performance speed as the load or the resultant of the opposing forces increases. Reference to the triple extension

As it can be seen in the figure above, *the performance speed decreases inversely proportional to the resistive force.* In other words, if the athlete lifts in triple extension only his own weight, the maximum speed is close to 4 m/s, and if weights are added, his lifting speed decreases, up to, at the limit, not being able to lift from flexion (the red curve). Particularizing for the example above, we must show that if to the athlete is added to his own weight of 700 N (71 kg) a weight of 1600 N (approx. 164 kg), he will not be able to raise himself, his performance speed becoming zero (admittance is considered in the calculations).

This inversely proportional relationship between the performance speed and the resistive speed has been studied by multiple authors, the best known one being A.V. Hill. It was deduced experimentally in the laboratory on a rabbit subject, a live rabbit muscle that was de-inserted. The muscle was stimulated to contract it, with various hanging weights, measuring its contraction speed. The obtained chart was an *equilateral hyperbole*, described in the equation:

$$(F + a) \cdot (V + b) = (Fmax + a) \cdot b = const.$$

where F is the hanging weight, generally being the resultant of the resistant force; V is the contraction speed of the striated muscle, generally being the speed of that movement in the direction of the net force (the resultant of all forces). The equation also has the constant "a" that signifies the muscle's own weight, representing the weight of the body segment or the body that is moved, as well as the constant "b," signifying the minimum movement speed of a maximum load.

I must mention also other mathematical models of the inversely proportional relationship between the movement speed and the opposing resistive force. Thus, it is well known the exponential model of Fenn & Marsh, in which F = Fmax exp(-kV), the empirical models of Pallisar or Aubert, etc. All these models describe actually the conservation tendency of maximal tendency, and graphically they are almost identical.

To these empirical models, I am adding a theoretical one, deduced rationally from the example above, the one of the standing vertical jump (Sargent Jump).

Let us take into consideration the maximum power[13] of the muscle contraction for the triple extension lift of the body weight G over the distance s during the time te, obtaining the average speed Vmed and the final speed Vmax, approximatively equal to the double average speed. After the take-off, the kinetic energy transforms completely in potential energy when the maximum height of the jump h is reached.

$$Pmax = G \cdot s/t_e + G \cdot h/t_e$$

Through simple transformations, we have:

$$Pmax = G \cdot (Vmed + 1/2g \cdot k/s \cdot Vmed^3)$$

and later:

$$(F + a) \cdot (V + b) = Pmax$$

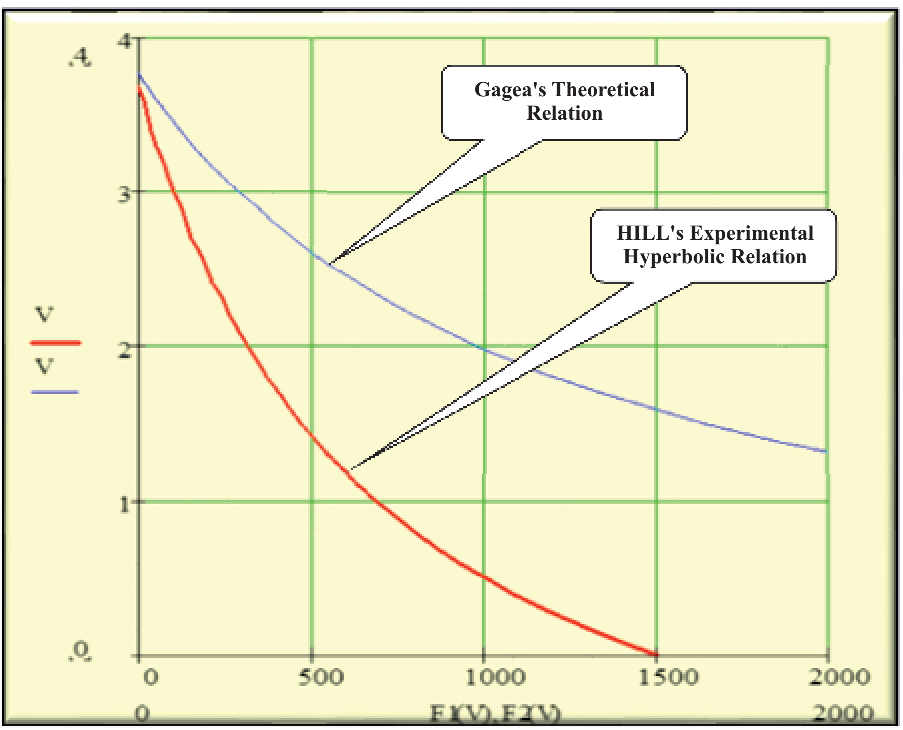
The expression above is very similar to HILL's: the constant "a" has also the significance of the athlete's own weight (a = G, in this case), F is a resistive force (it can be a weight that is added to the athlete), V is the average speed of the extension movement, and "b", unlike in HILL's equation, has here the significance of a parameter ($b = 1/2g \cdot k/s \cdot Vmed^3$) that depends on the gravitational acceleration g, on

[13] I called it the "maximum anaerobe instantaneous power" (Gagea, 1995)

the manifestation potentiality of the active force k, the distance s over which this movement is performed, and finally the average speed to the third power. For a graphical representation, the following forms were preferred:

$$F1(V) := \left[\frac{(Fmax + a)\cdot b}{V + b}\right] - a$$

$$F2(V) := \left(\frac{Pmax}{V + c\cdot V^3}\right) \quad a$$



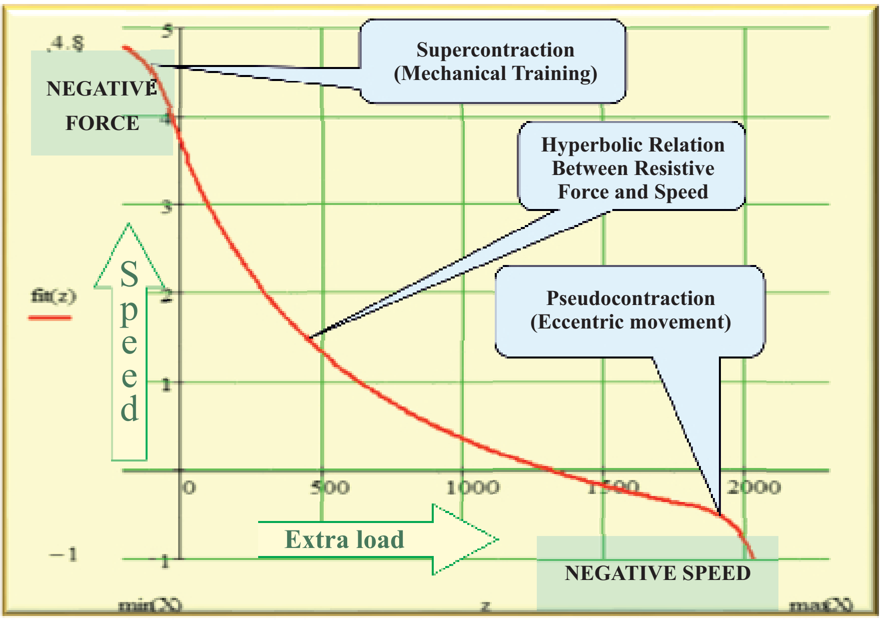
An illustration of the way in which the performance speed decreases when the load or the resistive force increases

The main quality of the hyperbole is that in any of its points, the product between the coordinates tends to be constant. In other words, the product between the resistive force and the performance speed is constant, which is concordant with the premise[14]. To exemplify, let us imagine an athlete who performs a physical effort at a strength-developing exercise machine (lat pull-down machine, ergometer, etc.).

[14] For a certain moment, a certain body location and the same individual, the power is constant.

The athlete pulls the handle and lifts a certain weight F_1 at the speed V_1. Theoretically, if the weight will be double, meaning $F_2 = 2 \cdot F_1$, then the lifting speed will be half of the original one, meaning $V_2 = 0.5 \cdot V_1$. HILL's hyperbolic relation shows that the product F1V1 is equal to F2·V2 and tends to be constant, because the athlete's strength is constant until fatigue sets in. Because of the constants introduced by Hill in the hyperbolic relation above, the product between the resistive *force* (added to the own weight "a") and the performance *speed* never reaches zero. Thus, even if there isn't any extra load F, the athlete still has to move his body segment weight or his own body weight.

In the case of isometrics, it is considered that the pressure in the biological deformable tissue involved in effort equates to a movement at a minimal speed "b". The theoretical relation between the net force and the performance speed that I presented, together with Hill's relation, try to argue the fact that the speed/resistive force modification rate is smaller, at least for the triple extension movement, when we take into account the limitation of the mechanical work distance.



The hyperbolic relation between the performance speed and the resistive force is altered in quadrant IV (negative speed), when the movement becomes eccentric (of breaking). The same happens in quadrant II (negative force), when the speed becomes super-maximal (because the resultant of external forces facilitates movement, instead of opposing it). More explanations in the text

In practical, extreme situations, Hill's hyperbolic relation, as well as other theoretical mathematical models that relates the performance speed with the resistive force, no longer correspond to the reality. Thus, when the load or the resultant of resistive forces is higher than the active force, there is a breaking movement, the speed becomes conventionally negative, and the hyperbolic curve is distorted, going into quadrant IV of the Cartesian representation. I have called this movement *"pseudo-contraction."* During pseudo-contraction, the breaking speed increases with the load, which becomes extremely risky for the segmental or body integrity (I am referring mainly to injuries). Up to a load that is 15% larger than the maximum one (corresponding to isometrics), the advantage of the effectiveness of strength development is so tempting that it abolishes the risk.

In the other extremity of the hyperbolic curve it can happen that the sum of the resistive forces do not oppose the movement, but facilitate it, becoming conventionally negative. In other words, the movement, instead of being broken by the external force, it is accelerated above the natural possibilities of the performer. In such real situations (such as, for example, track running behind a bicycle, etc.), the hyperbolic curve is distorted going in quadrant II, and the speed becomes super-maximal. I have called this movement a *"super-contraction."*

Super-contractions address directly to the development of speed. Trainings or means that produce a super-contraction are known as "mechanical trainings or means" and are successfully used to develop speed, despite the injury risks. An already classic example argues that if the athletes in a group perform 8-10 special plyometric jumps at the end of each training, for 6 weeks, the progress of performance speed measured by the spring, can be, in average, up to 30% higher than in a witness group performing the same training effort, but without the special plyometric jumps.

The fact that the plyometric jumps are *special* means here that they refer to *super-contractions.* Practically, these super-contractions can be obtained using rubber tourniquets suspended at one end and tied to the athlete's waist at the other end. When the athlete jumps down from a high stand, he stretches the tourniquet, and the ulterior take-off is facilitated. Biomechanically, this means that the tension in the tourniquet is added to the active force, and the spring speed is increased super-maximally. Another simpler way to facilitate the jump take-off would be to be helped by two partners, who during the take-off push upwards the athlete, whom they support from his armpits.

As closing words, I am summarizing the main ideas referring to the biomechanical speed:

► The biomechanical performance speed depends directly proportional on the active force and the admittance of the contractile environment. The progress rate in its development decreases as the active force increases, proving its close dependence more on the genotype factor than on the phenotype one.

► The biomechanical performance speed is inversely proportional to the resistive force. The larger the weight to be lifted, the load, or, in general, the resistive force, the lower the performance speed is, so that their product is always constant (according to the premise - for a moment, a certain body location and the same individual).

► When the resistive force is higher than the active force, the movement becomes eccentric (breaking), the biomechanical speed increases uncontrollably at the same time with the load or the resistive forces (risk of injury).

► When the resultant of external forces does not oppose the movement but facilitates it (becoming conventionally negative), then the biomechanical speed is increased uncontrollably beyond the natural limits, becoming super-maximal. This circumstance is good for the development of maximal performance speed, but carries high risks of injury.

14. Essay on the endurance of motor acts in humans

Etymologically, the term *endurance* comes from the Latin word *indurare*, meaning difficulty in resisting fatigue or pain. In Romanian, it was introduced, probably to differentiate the motor skill of *resisting a relatively high intensity effort* from *resisting long term efforts*, both producing fatigue, with a sensation of discomfort and exhaustion similar to pain.

This resistance decreases as fatigue increases and ends when unbearable fatigue sets in. In biomechanics, resistance refers to the unacceptable degradation of movement and to the physiological causes that produce it. Each sport or physical effort has its specific forms of physiological or mental manifestation of fatigue, of movement degradation, especially motor coordination. As a result, a standardization of the biomechanical resistance is hard to achieve and is probably useless anyway. Unlike biomechanics, mechanics developed a somewhat independent subject called strength of materials, in which the resistance limits refer to irreversible degradations, such as material breaking, which cannot be reproduced in humans. It is true that in humans we know the resistance limits of bones or certain biological tissues[15], but this characteristic of resistance has nothing to do with the resistance that I am talking about in this essay.

The *fatigue* syndrome has varied and countless causes. From a biomechanical standpoint, the increase in fatigue or decrease in resistance is seen as a decrease in muscle strength, as an inability to perform a physical effort of a certain intensity for a long time. I admit that the exclusive focus of biomechanics on the energy aspect of physical effort makes it difficult to explain the unacceptable degradation of movement in some sports, such as shooting, or others that are based on precision. The alteration of coordination or the skill problems associated with physical effort energy suggest other forms of resistance, which the old subjects that are related to biomechanics are already studying (ergophysiology and the methods of developing the motor skills).

In biomechanics, the decrease in muscle strength during physical effort is seen as a natural thing, which shows that the energy uptake is more that the energy intake. At least seven hypotheses are known to explain this phenomenon. The most plausible one refers to the *inability to re-synthesize* completely and rapidly the ATP, a molecule that through degradation produces the energy of the muscle converter. I must also highlight the hypothesis of *autointoxication* with energy waste, or the one regarding the *homeostasis* processes. The

[15] Deduced from trials on non-living tissue.

decrease in the force determines the decrease in speed, which accelerates the decrease in the energy flow, meaning power.

The higher the effort intensity is, such as the running speed, the sooner the exhaustion of energy reserves happens. The natural homeostatic defensive system of the body, manifested through fatigue, makes the athlete reduce automatically the power and give up the effort before the complete exhaustion of his energy reserves.

As I mentioned in the previous paragraphs, the performance speed decreases with the net force and the admittance. I am exemplifying the way in which muscle power decreases in a beginner athlete who runs 400 m in about 90 s.

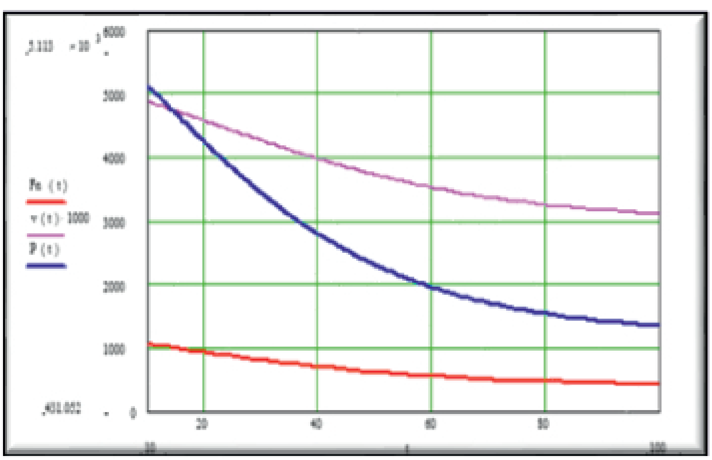
$$v(t) := Y(t)\cdot Fn(t)$$

$$Fn(t) := \eta\cdot Fa(t) - \mu\cdot(G + L)$$

$$Y(t) := \frac{\kappa(t)\sqrt{Fn(t)}}{Fn(t)}$$

$$P(t) := Fn(t)\cdot v(t)$$

In the formulas above, unlike in the ones in the previous paragraphs referring to vertical jumping, there are the coefficients η, μ, κ, which means that during running, the forces are not collinear.



Example of the way in which strength, speed, and power decrease in a beginner athlete who runs 400 m in about 90 s. After about 10 seconds from the start, fatigue sets in, and the running speed drops below 5 m/s. The chart suggests that this athlete finishes the event almost exhausted.

For world class athletes, the power decrease starts after the first 30 seconds, meaning after about 280 m of running at a maximum speed, being present in all athletic events, from the 400 m one to the marathon (which lasts over 7000 seconds).

I am arguing the way in which muscle power decreases during running through a theoretical experiment, in which a virtual athlete would hold, fictitiously, all the track running records in all resistance-based running events. By fitting the record curve I have noticed that the theoretical way that approximates the decreasing rate of power during running in top world athletes can be described as an equilateral hyperbole:

$$(P - Prez) \cdot t = const.,$$

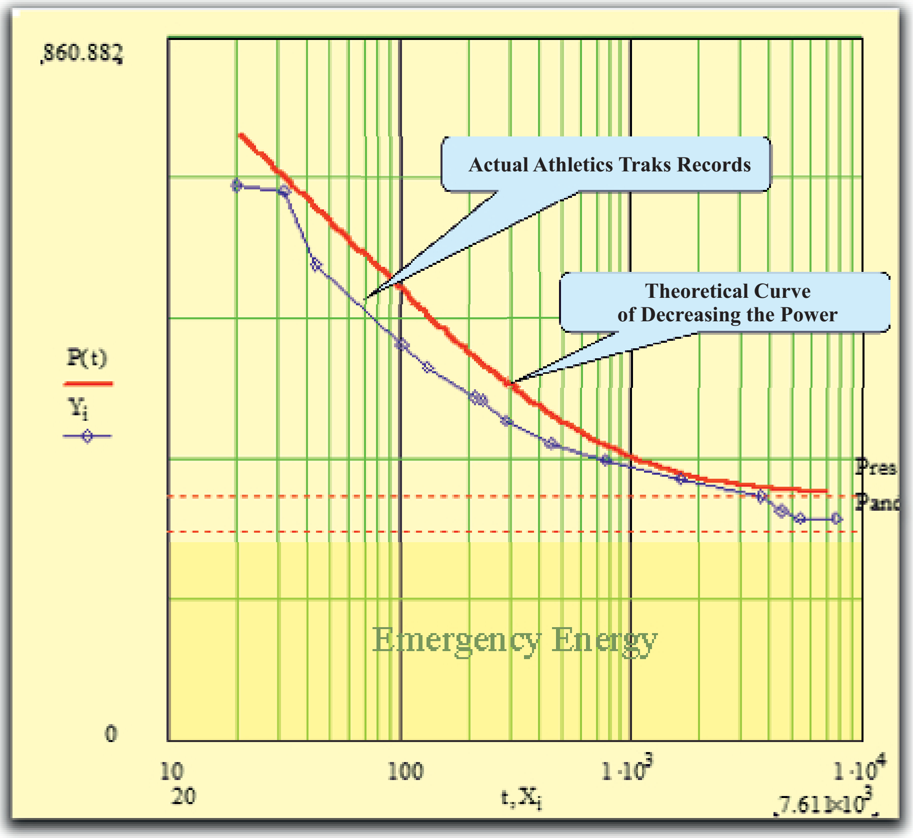
where P is the total power, Prez is the power reserve (unaccessible under normal circumstances), thus (P-Prez) is the outputted accessible power, and t is the duration of its outputting by the muscle performer. During tiring efforts, the net force decreases because of the active force that must defeat the rubbing forces with the ground and air, meaning to displace the body weight G at the speed v. The decrease in the net force, but also the admittance determines the decrease of speed and, implicitly to muscle power. The above formula expresses concisely the fact that is the effort intensity, in this case the outputted power, is high, then the duration of the effort is low. In other words, *energy tends to conserve itself during tiring efforts*.

In the following figure, one can see that the dots on the real record curve are not aligned (differing from the line of dots of a theoretical hyperbole).

The explanations can be orientated in two directions:

- the actual athletic records do not represent yet the limit of human performances, the real energy system is not perfectly conservative, and probably, the declaration of the exhaustion moment is subjective, psychogenic;
- the hyperbolic moment is not satisfyingly faithful to the stated law.

The most important thing to observe is the fact that both the experimental model based on real records and the hyperbolic curve that approximates it tend asymptotically toward a power reserve Prez, which if outputted on the duration t, would indicate a surprisingly large energy reserve.



The theoretical characteristic of energy conservation during tiring efforts, deduced by fitting the world records for middle or long distance running events.

Probably, as in almost any other physiological situations[16], this reserve energy (approx. 40% of the total one) has a preventive role, of survival or of emergency. It is to suspect that once the resistance or endurance develops, this reserve would increase proportionally, as it is also possible that the partial access to it would be possible trough training.

It results logically that the *measure of resistance*, in general, and of endurance in particular, is the *energy* that is available or consumed

[16] The brain uses only a small percentage of its energy potential, the liver can ensure the body's survival with only 10% of its functionality, and a top athlete can have a cardiac output over 10 times higher than an ordinary person, etc.

near the proximity (limit) of the reserve energy. It is biomechanically defined in all tiring efforts by the product between the two dimensions of energy: the outputted power (P - Prez) and the duration of outputting, t. Thus two ways of measuring are outlined: either by the duration of the effort performed with a certain outputted power (intensity), or by the maximum output of power performed over a pre-established duration.

With a certain indulgence, an analogy can be made between the measurement of resistance during tiring efforts (especially in sports), and the measurement of autonomy in motoring. An automobile can cover 1000 km if it has an economic consumption of 5 liters for 100 km, and a 50 l tank, or it can go for 10 hours with an average speed of 100 km/hour. The same automobile can run at a maximum speed of, let's say, 160 km/hour, during which it consumes 10 liters per 100 km, covering 500 km, or covering this distance in 3 hours and 8 minutes.

If we accept the convention that endurance is for long term efforts and of relatively low intensity, then its measure can be the duration in which a conventionally low intensity effort is performed, or in which a relatively large distance is covered (meaning a certain relatively low speed). It is understood that at the end of the effort, the performer must show or state that he is exhausted.

The resistance, unlike the endurance, is for the relatively high intensity efforts, and by necessity, of relatively short duration.

As a result, the same quantity of available energy can be consumed over a relatively short time at a relatively high intensity, or over a long time at a relatively low intensity.

Unfortunately, physical education and sports do not have norms, not even clear standards, for the intensities at which the duration of the performed effort could measure the resistance or the endurance. The difficulty of the standardization of measuring and measurement procedures for resistance and endurance is understandable, certainly because of the diversity of tiring efforts, but especially because of the subjective assessment of fatigue. The current practical solutions are numerous, but they reflect so specifically the resistance and endurance that a conceptual consensus is hard to achieve. For example, the biochemical tests of the humors, the ones of cardio-respiratory activity and reactivity, of the neuromuscular system, etc. assess or measure the biological echo of tiring efforts. In a systemic analysis, these biological tests refer to the reactivity of the body, understood systemically as a functional block; in this sense, the measure of resistance or endurance should refer to the system inputs and outputs. On the other hand, not all biological tests that are frequently applied are significantly correlated to a significance threshold in relation to resistance and endurance. Thus, the maximal oxygen uptake assessed through the correlation with the measured heart rate, and then related to the capacity to perform a resistance aerobe effort is an approximation that is hard to accept (outside a certain conventional deviation). Neither the identification of the steering threshold of the lactic acid concentration lacks criticism as an assessment procedure for resistance or endurance.

The Cooper Test[17] (used in particular in soccer players) measures the resistance through the distance covered by running at a relatively low intensity (about 90 seconds over 400 m, meaning an average speed of 4.5 m/s) or conditioned by the duration of running (5 min). The norms for the professional soccer players are over 1350 m, which means an average speed of 4.5 m/s, maintained for 300 s.

Rowing establishes and codifies certain strokes that are proposed or achieved rhythms (stroke rate, cadence), corresponding to certain durations for conventional distances. In other words, it is about certain average speeds, certain intensities, maintained over pre-established distances or durations.

The middle-distance and long-distance running events also have conventionally pre-established certain intensities or certain speeds; for example, as the famous Olympic and world champion Gabriela Szabo states, it is about the duration of 3 minutes and 40 seconds over a distance of 1000 m, or an average speed of 4.5 m/s maintained for many kilometers. The first statement is about *time* related to *distance*, meaning the reverse of speed, while the second statement is about *distance* related to *time*, meaning actual speed.

When the efforts are repeated or are cyclical, we are talking about period, rate, cadence, or respectively, frequency, rhythm or pulsations. The tests performed on exercise simulators, exercise bicycles, or treadmills seem to be much more objective in assessing the resistance, by the fact that the performed mechanical work can be measured with acceptable accuracy. By knowing the outputted power, one can measure the duration of effort performance up to the point in

[17] The Cooper Test, as cited in Barrow, H. and R. McGee, index 9, pp 207

which movement becomes unacceptably distorted or the rhythm can no longer be maintained; there is also the situation in which the subject quits. Although these machines measure sufficiently accurate the *energy* uptake, meaning the product between the outputted *power* and the *duration* of outputting, only the *ratio between these values makes the difference between resistance and endurance.* The power (usually expressed in Watts) - effort duration (expressed in minutes) ratio can make the difference between resistance and endurance. Practically, however, a certain intensity is imposed (no less than 67% of the maximal one), and by measuring the effort duration one can assess the *resistance*. Thus, if one measures the maximum power, then imposing an effort intensity at 33% of the maximal one (sometimes 50%), the *endurance* will be assessed through the duration of maintaining the imposed effort intensity constant.

As for norms, they vary so much in relation to athletic training experience, age, gender, etc. that biomechanically it seems useless to look for certain relations (between the outputted power and duration of outputting) to differentiate the resistance measurement from the endurance measurement.

15. Essay on the physical effort capacity in humans

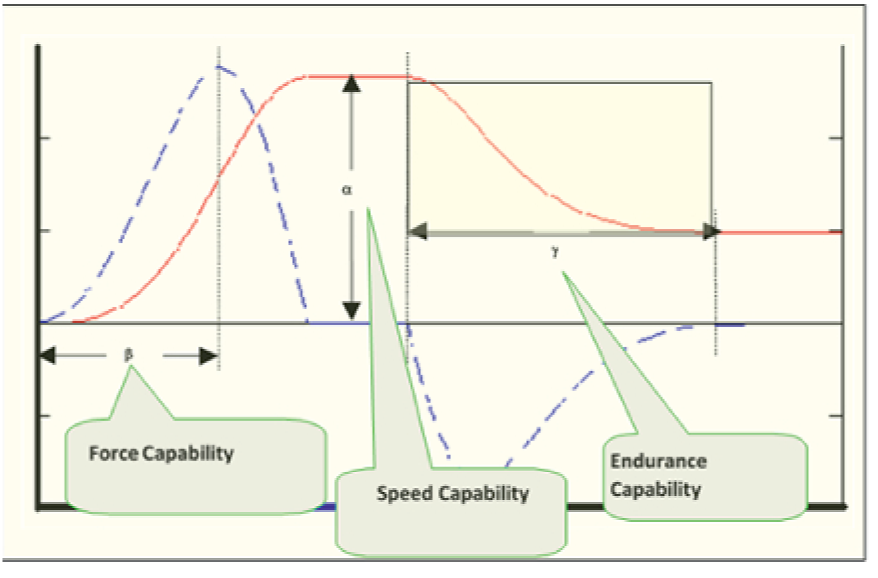
In many motor circumstances, such as professional sports, the *general effort capacity* is composed, theoretically and in individual proportions, of three conservative forms, so that *each individual can be characterized by a certain maximum muscle power, a certain time of reaching it, and a certain duration of maintaining a fraction (conventionally ½*) of this power. A deeper analysis can identify arguments to support the pertinent analogy with the three main characteristics of an automobile engine - power (or its maximum speed), the time it takes to accelerate to a certain speed and its fuel consumption in relation to distance units (or its autonomy).

The idea of general effort capacity can be expressed clearly and concisely in the mathematical language through an integral-differential equation (*of the PID type*), with constant (for one given moment) and individualized coefficients.

$General\ effort\ cap = \alpha / (\alpha+\beta+\gamma) \cdot P + \beta / (\alpha+\beta+\gamma) \cdot dP/dt + \gamma / (\alpha+\beta+\gamma) \cdot \int P dt$

The paragraphs above are trying to suggest that the energy output, meaning muscle power (P), is essential for the human motor skills, being able to take various forms (such as the ones in the well-known expressions: speed force, resistance force, etc.), according to the proportions given through these coefficients to each term.

In biomechanics, I believe, it is improper to speak of force, speed, and duration separately, but only together, as power or energy. The various manifestation forms of power: *differential* (force), *proportional* to the maximal power (speed) or *integral* (resistance), characterize together, but in varied proportions, the human capacity and capability of physical effort. The performer of the physical education and sport exercise or means will have, as a consequence, his own way to manifest his energy output.



The physical effort capability, structured in three terms: force, speed, and endurance. Explanations in the text

By extension, in physical education and sports one can say that a physical exercise, a means, an effort or a training has a certain motor component of force, speed, or resistance, or combinations of the three, depending on the one or two predominant manifestation forms of the power described above.

The availability differentiates the maximum capacity from the moment capability (in its turn dependent on the state of the body, of the previous effort, etc.), while the structure of the effort potential refers to the three terms of the effort capability and their coefficients:

The force - represented by the power variation in the inertial phase and the coefficient $\beta / (\alpha+\beta+\gamma)$;

The speed – represented by the maximum power and the coefficient $\alpha / (\alpha+\beta+\gamma)$*;*

The endurance - represented by the power accumulation or the available energy and the coefficient $\gamma / (\alpha+\beta+\gamma)$.

Although the comparison seems forced, I return to the main characteristics of an automobile engine:

- *The maximum speed* at a standard load, meaning maximum power;
- *The maximum force*, expressed by the acceleration during start up (conventionally, the time in seconds that is necessary to reach the speed of 100 km/hour);
- *The autonomy* at a minimal fuel consumption (or conventionally l/100 km).

With a stretch, one can make an analogy between the characteristics of an automobile and the global effort capacity of an athlete. Thus, an athlete can develop a maximal speed for a relatively short duration, he can accelerate over a distance relatively small or he can perform a tiring effort of a conventional intensity for a certain duration. The great variety of sports and their restrictive regulations allows different forms of manifestation of power, accessible to countless combinations between its manifestations. In simple words, any talented athlete can find a sport where he or she can excel. Usually, an athlete can excel in a certain combination or or proportion of motor skills, for example: acceleration and speed, speed and resistance, etc. There are also situations in which an athlete performs an effort based exclusively on force (for example, the traction of an immense weight in extreme sports). In this case, the manifestation of force is a low acceleration in relation to a heavy weight (mass), while the effort speed and duration are negligible. What I mean to say is that in biomechanics, acceleration, but especially speed, is defined also for small values. In other words, the snail also has a speed, or the automobile with a flat tire and pushed by the driver also has an acceleration. In sports, speed and acceleration are perceived suddenly as high values, with creates some communication difficulties.

The training methodology has countless diagrams that combine empirically the effort regimes of the sports training goals. These diagrams suggest the way in which the athlete's power is exploited to ensure a corresponding output. In simple language, it is about promptness, power (as maximum force is understood) and the quantity of available energy (resistance). About an athlete one can say he has power, he manifests it promptly and maintains it for a sufficient amount of time, which in biomechanics it translates to the characteristics of effort capability (relative or absolute): α, β, γ.

The laws of biomechanics do not contravene to the laws of mechanics, they are taking into account only the phases of physical effort, which is specific to biology. In biology, the maximal effort is outlined by two transitory phases. In mechanics, the mechanical work appears and disappears instantaneously.

Afterword

Today's society is based on science and, indubitably, the future society will be based even more on science. By paraphrasing a well-known idea of Michel de Montaigne (*Essais*), it can be said that science becomes more and more a tool of society; but it will remain, in its essence, always a jewel of the human spirit. The progress of society turns back as a feedback on the research tools. Currently, in most advanced researches, bold hypotheses are expressed concisely through logical-mathematical models, and their argumentation is made through computer simulations (that reasonably simplify the reality), generating through logical inference new hypotheses with increased verisimilitude potential.

I have no choice, I have to support my critical readers… In their essence, the essays that claim to be scientific can be criticized (and rejected) if:

- The ideas claiming to be original do not have a solid bibliographical foundation,
- The nonsense solutions are presented as bold hypotheses,
- The hypothesis becomes thesis without demonstration and without public validation,
- The conclusions do not have anything progressive.

In regard to their form, the essays are less exposed to criticism, because, usually, they express opinions, unfinished attempts, and their style can be closer to literature than science.

I would be glad to know that some of my essays have been useful to someone.

I will be grateful to the people who will communicate me constructive criticism:

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APPENDIX

About author

Adrian Gagea
Emeritus Honorary Member of the
International University Sports Federation.

He was Professor of Biomechanics at the Department of Medical Disciplines, Faculty of Kinesiology, University of Physical Education and Sports in Bucharest and doctoral supervisor to 83 doctoral students. As a Director of the Interdisciplinary Research Center "Alexander Partheniu" of UNEFS, he published over one hundred of scientific papers and 16 books. He patented (in collaboration) nine patents of electrophysiology and biomechanics. He was 18 times national champion in Athletics (Shot-Put) and has held several national records. He was elected Auditor of FISU for six consecutive terms of four years each (1991-2015).

He often likes to say that most important in the life is to be lucky.