

The following is Michel Serres's essay "Eternal Return" in *Hermes IV: Distribution*. Paris: Les Editions de Minuit, 1977. pp. 115-124. Original translation by Taylor Adkins on 10/10/07

Philosophers glorify Nietzsche for having suddenly rejoined the Greeks through their fulgurating intuition of the Eternal Return. Either from an ignorance of ethics or incomprehension of the general figure that this thesis takes in his philosophy, I reduce this to a vision of the world. Vision with the meaning of sight, and world with the sense of the world. All simply.

If time is considered in geometrical figures by optical interceptions and a mechanism of movements, the Eternal Return is cosmological. In that case, the solar system (and it only) has been calculated by Laplace. *Celestial Mechanics* and the *Exposition of the System of the World* established rigorously, for the first time, the mechanical invariability of the large axes for the planetary orbits. The stars turn forever. This eternal return reduces the world to the exclusion of the universe, and reduces mechanism to the exclusion of other sciences. Neither the Greeks nor the classical age ever obtained this demonstration. Conversely, the time that we consider is reversible.

If the time that one endorses is that of a formation, of bodies as spheres, and with which one tries to surpass mechanical reversibility, then, if there is return, it is cosmogonic. However, cosmogony enters science little by little around the middle of the 18th century, with Thomas Wright and Buffon. If Laplace has erased the latter in the seventh note of the *Exposition*, the former has inspired Kant. *Natural History and the Theory of the Sky* marks the appearance of the Eternal Return in scientific cosmogony.

However, again, Laplace like Kant (at the origin of hypotheses that an ignorant history combines, but who have only this point in common) starts from a primary nebular state, the dissemination in any point of the space of a cloud of particles. Return to Epicurus, Leucippus and Democritus, reintroduction of atomism in the exact sciences again and again.

The Eternal Return as a vision of the world is a crushing intuition either from Laplace, if it is cosmological, or from Kant, if it is cosmogonic. And the return to the Ionian physicists is an accomplished gesture both by Laplace and Kant. Nietzsche got up at midday and his predecessors at dawn. Hence, it is shown that the world of the philosophers belongs to people who themselves rise late, in order to speak about the sun.

Kant takes the word cosmogony with the literal sense of production or genealogy of an order. Throughout the most general course of natural history, a distribution becomes systematic. The history of the world produces the order of the world. And this history is natural because the laws that work through it are interior to matter and space, and not exterior to them. In order for cosmogony to be the primary ground where one makes physical and mechanical laws function historically, without them exceeding the field of their jurisdiction. Leibniz produces the world through metaphysical mechanism. Kant produces it by a mechanical physics. He obtains a reciprocal application of exact knowledge over time. The law of the system, currently effective in the established order, is originally a law of distribution: displaced in time, it produces the contemporary system and the contemporary order and is not produced by them. It is not uninteresting to observe that before the birth of the century of its history the solution to some of its problems was indicated in the broadest order and the longest time. Better than the solution, the most general condition for a family of problems and solutions: the reciprocal application of the natural encyclopedic ensemble on a chronic line of formation. The application in one sense, and for a

human time, names itself the history of the sciences; in the other, and generalized with the totality of possible time, it names itself a cosmogony. In the middle of the 18th century, both disciplines appear at the same time. The first two examples of the operator (x-logy, x-gony) are the most general.

Time is no longer produced through a system, the system is through time. There was a time when the system had no place. This time one fears naming pre-systematic. It is cut out from its successor, this question is posed, already. It exists in parallel with the catastrophic hypotheses in order to explain the formation of the world (Buffon and the wrenching of the sun by the shock of a comet, of a torrent of matter, and of the discontinuist hypotheses to explain the appearance of the sciences). The idea of an epistemological cut is proper at these times, as in Kant, Comte and many others. The continuist hypothesis also exists. The quarrel over Greek science is only one example. Does the continuation of the Egyptians and the Babylonians, the harpedonaptas and the magi, intersect with these by a miracle? But, about that, we will speak elsewhere.

Cosmogony is the natural path which goes from the distribution to the system. The original *distribution* is a dissemination, a dispersion of atomic particles, in the manner of a Democritean chaos. A relatively homogeneous occupation of any space by a thin material of low density. The *system*, on the contrary, separates relatively dense clouds from the enormous and relatively vacuous lacunae. One already presents paradoxical definitions of order and disorder: chaos is relatively homogeneous, the system is the heterogeneous difference; where is the order? *Geometrically*, I want to say in position and site, the separated clusters are not disseminated more randomly—and, again, it doesn't matter where, it is aleatory everywhere, it is the same homogeneity—, they are gathered and are bound in an exact area of space, according to the perspective of whether one draws a plane from our point of view by the crown of the Milky Way; prolonged ad infinitum, this plane appears to attract the greatest number of stars, all the more rare as some are very dispersed. Kant names this provision a *systematic distribution*. However, it is the same for the system of the world in the narrow sense: the spheres of planets are traced all the more closely to the vicinity of the celestial equatorial plane. They occupy, in the sphere, a very narrow crown. Hence a succession of analogies which reverse the opinion of those who believed in the words of those who announced the Copernican revolution as a decisive blow, a trauma driven to the heart of human narcissism. There are unnoticed analogies along the common plane of systematic distribution. The solar system finds itself everywhere. In the largest: the stars pile up around the common plane of our galaxy; the nonstellar spots are themselves milky ways, seen sometimes as circular and sometimes as elliptical, which proves that their components are ordered around a common plane. In the smallest: the matter of a star in the star is maximized in the vicinity of the equatorial plane of rotation, the satellites are distributed similarly around their planet, and the elementary particles around other atoms. Kant thus approximates the model of Böhr. What, then, is a system? Any provision of matter similar to the solar system, i.e. any provision similar to the system of the Earth and its satellite, the Moon. Narcissism is in excellent health, thank you. Consequently, and *mechanically*, a system is a system only because it is centered. Rotation is the systematic movement par excellence and the only one. Terrestrial movement has a geocentric center, the lunar movement has a center, the Earth, their common movement and that of the planets has a center, the Sun, its movement, real, the stars, seemingly fixed for the observer on a historical scale [1], revolve around a common center, each nebula has its own, as one can see it, without much else nearby. Consequently, any cluster is already proper in the mode of Böhr, and the total system of the universe refers to a single pole. There is a center of the universe. By this total system of recommended analogies, one wonders if cosmogony is not in a way motionless in time, nearly stable, but only *homothetic* in space. Hypothesis, homothesis. The question here would be put: how the

planetary diagram, that of the sun, but also mine, I am and have the moon, how this diagram, given at the level of the particles, ends up *reproducing* itself for the totality of the Universe. But it is already reproduced, from the large to small, from the system to the particle. One looks in the path of the plentiful multiplicity from the small systems to the largest unity. But this way, one has already traced it in the other direction. The former is none other than the small, hidden, the invisible lower part, bearing in itself, already, the centered system, structure, as one says, of the visible, in fact reproducing those. Homothesis, hypothesis. The disseminated atoms, the semina, are less corpuscles than munduscles. This immobility of reproduction is the theoretical inscription of the eternal return, for the first time. The origin of the macrocosm is the microcosm. Production and reproduction. That is false, of course, under the terms of the principle of Galileo: things do not reproduce in size in the same way. Few philosophical systems are informed by it. Space is heterogeneous to the laws. In short, what is a system, here? A planned unity, on a common plane, for space, and centered, with a common pole, for movement. All this without exterior. Isn't this definition, valid for a system of the Universe, valid universally, for any system? Universally, I understand by this, for our culture.

From the distribution to the system. The distribution is in a Democritean cloud. Chaos redistributes in a multiplicity of insulated clusters, making a quasi-vacuum around planets or future stars, by the double effect of Newtonian attraction and its opposite repulsion. Primary mechanical fault: if, indeed, the distribution, either in its atomic elements, or in the dispersed clusters, is devoid of initial speed, it can only gather, in the long term, into a single mass. Parti, as well, has a primary nebula. Laplace avoids this fault: his chaotic cluster is made of an elastic gas turning with the same angular velocity as its central condensation, under the terms of an original movement whose cause eludes mechanism or, at least cosmogony. His nebula is a nebula in the cosmological sense, not with the meaning of Democritus, but in the sense of Messier or Herschell. It is through this movement that the differentiation of planets is produced on the level of the solar equator. In other words, either the circular motion is primary, given, unengendered, perpetuating into a cosmological stability; or it is only secondary, generated by two forces starting from a stable distribution, when fatally, a second time, the cosmogonic eternal return enters into matter. If the nebula in Democritus is given by itself from a capacity to forming itself in a differentiated-centered [*différencié-centré*] system, the cosmogonic eternal return is already there. Laplace avoids this by reduction: it is given at the beginning with a nebula centered around the movement of rotation.

I said that, fatally, Kantian chaos would collect in a single mass. *Theory of the Sky* envisions this, but only at the end of the world. All of time from a differentiated, multiple and rotary system, cosmological time, which should be quasi-null from the perspective of the hypotheses, is widened by the enormous time of the world. The question is of evaluating the duration of the parentheses. A few seconds or a billion. Let us come to pulsation.

There exists, as we have seen, a geometrical center of the whole universe, a single pole for its movements. By the parallelism of space and time, this umbilical point is originary. Among primitive chaos, it is a matrix of the system. In order for it to be a geometrical and mechanical center, it is necessary that the greatest mass of the universe is amassed here. The differentiation and the relative density of the particles in a cloud are dispersed on a scale which presents a maximum. This heaviest atom attracts with it the strongest mass. Therefore, by sequence, the most powerful attraction, and so on. The pole is spatial, and the focus is mechanical, because the center is material. In a cosmogony of matter, movement, space, it is necessarily the maximum navel of formation, and any other local center

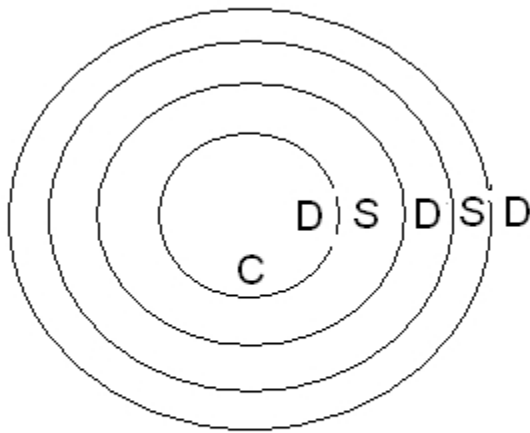
relates and refers to it. The remarkable thing, for narcissism at least, is that we live within the nearest vicinity of all of this: since it is impossible for us to still see abstract chaos, far from its sphere of influence, we see only systems.

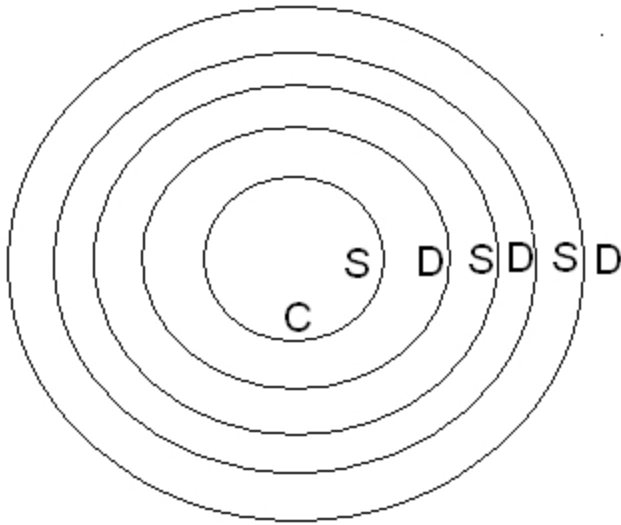
The formation of the world is thus not an isolated event, an instantaneous operation. It is ceaseless, it is a continuous formation. The center, constituted once and for all, diffuses its efficacy on the surrounding chaos. It forms a local, spherical system, occupied especially in its equatorial crown, where the local clusters turn around it with increasing eccentricities. At the limit, at the edge of the sphere, the planets become comets, and little by little, the comets escape from the path of system. Chaos still reigns at the exterior of the formed sphere. But, as attraction is unbounded, this edge is common to the perfect, cosmological system within the chaos, which is no longer primitive but indefinitely contemporary, this edge is itself effective, it extends, it gradually systematizes the Democritean distribution. "Creation is never terminated. It began one day, but it will never finish." The innovation, the formation is instead the membrane between the form and the formless. Hence the expanding universe, the term is entirely Kantian. What is present and unceasingly effective: the center and the periphery, it is here and it is there. Hence the law of time: the closer the event takes place to the pole, the shorter it is, until it crushes the time of systematic formation; as it is narrow, more so is it long. We found a similar law in the hypothesis of the big-bang where the duration of production set out again in three states, a negligible fraction of a second, a few seconds, and a billion years. Consequently, the theory of the sky lengthens the duration with a deviation of the distance to the center—the formation increases its patience.

That is to say maintaining the state of the world at a time T , unspecified, in the continuation of the centuries. At this moment corresponds a distance D considered from the center towards the edge of the mobile crown. It is the moment of formation of local clusters on the periphery: there it is the youngest world. On the radial of a length D , by running from the edge towards the center, the worlds already born are increasingly old. And the oldest is in the vicinity of the pole. At a precise time, to which a precise length responds, this oldest world starts to die. The differentiated bodies pile up towards the center, fall, and are its ruin. But this aging and death which follow gradually reach extremely long distances. The pole is then, and at the same time, the navel of formation for the most remote periphery, and the vortex of death for a close sphere. The worlds formed for a time T are bordered by the ruins of the dead world and the chaos of formless nature. The system is a spherical, radially mobile crown, of which the interior has died and the exterior will be born. Expanding on one side, degradation on the other. Hence the model: the center, of life and death; the distribution, a solid crown, the system; a second distribution. Cosmogony, in fact, goes from one dissemination to another by way of a system. Cosmology is between two cosmogonies.

How does this occur in reality? Any body in space slows down in its rotational movement around the center, or by the residual particles of space, or by the actions of tides. Let us notice, with this passage, that with the *Dialectic of Nature* (p. 52) Engels glorifies Kant for "two brilliant assumptions:" primary chaotic distribution and the deceleration of rotation by the periodic pull of the seas. They are both principal requisites for the Return in *Theory of the Sky*. There is a cosmological eternal return, with the manner of Laplace, that in the condition of eliminating the physical constraints of the stars, considers them as points or mechanical solids. In the contrary case, Kant, I believe, had some hesitancy, a fear of perpetual movement of the first type. Consequently, in the long term, the fall of bodies on their central sun becomes inevitable. It accrues in a fulgurating way a cooled incandescence: extraordinary expansion, explosion, new dissemination in space of the material particles constituting the whole of

these bodies. After a time when the cooling is achieved, we find the chaos of Epicurus. The first state, the last state. The process, then, starts again. Around the palingenetic center, the new distribution, resulting from the system, reforms a system, expands through its periphery, whereas the systems, arriving, time after time to their hour of death, turn over to the distribution. Second fault, to wait until the heat cools: it is the perpetual movement of the second type “the phoenix of nature burns only to revive from its ashes.” Center, system, distribution. Center, distribution, system, distribution. Thus ad infinitum. A stone in the water, a maintained focus, circles, successive waves which are not arrested.





Both models are the projection of the sphere on its common level of systematic distribution. Each systematic crown is limited by two crowns of distribution, and vice versa. There are two fundamental states, according to whether in the vicinity of the center there is a system or a distribution. At the exterior, there is always distribution, stable, on standby for the action of the center, primary, eternal.

This universe of pulsations combines in a common fabric three exemplary concepts of the history of sciences. *The fixed point, the fixed plane, and the cloud.* They appear in this order in the course of the chronology, and they are even combined in this order in Kantian cosmogony. The cloud is quite primitive, but it breaks down instantaneously, as soon as the center, which is primitive, in its turn appears, including the remainder eternally. It is then ejected to the exterior, on standby as stock for all the new worlds to come. And reconstituted by the death of worlds while returning to the center. The Epicurean cloud is matrix and corpse, dustbin and rebirth. Absolutely primitive, absolutely last, and periodically interstitial. The center is generative, umbilical, productive, mortal. As for the crowns of systems, they are legalized by relative points, as dispersed centers referred primarily to the pole, the relatively fixed points and the plane respective to their distribution. It is on a common plane that one recognizes that a distribution is not a cloud, and it is at this common point that one recognizes that it is a system. The fixed plane is a transition, chronologically dated, between the fixed point and the cloud. That is true for Kantian cosmogony, and that remains true for the history of the sciences. This is what I wanted to demonstrate.

One then obtains the triangle according to:

D

C D

C S D

C D S D

C S D S D

C D S D S D

C S D S D S D

The distribution is the first state, it breaks down instantaneously, and the center is formed all at once. This center forms a system within its vicinity and the distribution remains outside. Then the crowns start to be produced by pulsations. The distribution cloud of the preceding system is the distribution stock of the following system. What remains stable: the center, the exterior distribution, the universal stock, ad infinitum. What changes is the triangle in the triangle. The universe is expanding but the model is quasi-stationary. Kant links, in one stroke, both fundamental cosmogonic models, by a curious pre-critical realization of the *Transcendental Dialectic*. Since each crown passes, by pulsation, from a phase of system to a phase of distribution and conversely, the Eternal Return is the operator and the engine of the expansion.

Poinsot, let us know it, established the statics of the solar world around the invariability of an equatorial plan. The common plane, in Kant, established as an intermediary between the dissemination and the center, marks the average concept of systematic distribution. The order is reversed, in celestial statics, and the plane and the couple relativizes the old royal function of the pole. But the end of the *Memories of the Equator* enlarges the question beyond the planetary system. Let us suppose for a moment that the fixed plane, eternal, invariant, is precisely subjected to variations. Like Bradley or everyone else, the swing of systematic constants leads Poinsot to find cosmogonic time. (I truly believe that it will be said one day of Bradley that, to have made the stars move, our final sitting, our reparable confidence, introduced us to the century of generalized suspicion, by a cosmogony at the time of formation, by this pre-systematic time of interpretation, and by the swing of the suns to the philosophy of universal attraction). Nevertheless, the fixed plane would move imperceptibly. If so, an action foreign to the system has efficacy over it. Our sun depicts itself as a sphere slowly revolving around some remote center. Then a very small couple alters the position of the general couple registered on the invariant table. The demonstration starts again, through repetition of the engine of the history of the sciences: a renewed swerve between invariance and variation. A new plane fixes by widening, a new center, a new major couple. And so on. Can one conceive an end of history? Yes, if there is an end of the space of the world, i.e. a total system, absolutely independent of an exterior action which could disturb its movements. Let us suppose that this exists. It joins a common center of gravity. It is the center of Kant. It is in rest. There is no reason why it goes here rather than there, no conceivable reason for Bradley that anything is there at all, since the system is without exterior. Then, through symmetry, all the forces are balanced: the great whole is perfectly motionless in absolute space. You deposit yourself now, at least in thought, at this point. You would not see any described surface that is not counterbalanced by another. You will thus be unable to determine *any plane*. If there is an absolute center, there is no longer a plane.

At the limit, any cosmology disappears. The center can only be the origin of relative movement. Pass to the limit, to the end of history or to the end of space, and any science evaporates. It is thus only a science that is relative, from a determined cut in an exterior put outside of parentheses: only our system concerns us, it is relative, but infinitesimally altered, by our usage and from our science. Its quasi-invariance measures the solidity of knowledge, and its utility in relation to us. Positivism comes from being born. Poincaré teaches mechanism to a young polytechnician. August Comte, who, again, and like everyone else in the 19th century, will announce an Eternal Return. Astronomy installs, for the century of history and thermodynamics, the most universal running-time meters: they are eternities.

[1] The idea of a common plane of distribution is borrowed by Kant from Thomas Wright: the idea of the movement of the stars is from Bradley. He never stopped celebrating Bradley.

One talks a great deal about the Copernican revolution. Has Copernicus established the heliocentric system? The response is evidently negative. Its reasoning could be only geometrical and kinetic. They were thus in dispute because of the equivalence of hypotheses, already stated by the Greek astronomers. Hence the hesitation of the classical age: Descartes, Pascal and Leibniz. These three, contrary to the legend, were not afraid of prison. Two among them, in effect, defended infinitism, just like Giordano Bruno who was burnt at the stake. If they feared the prison of Galileo, why weren't they terrified by the butchery of Bruno? In fact, they applied the only scientific method, knowledge of the equivalence of hypotheses, geometrical and kinetic. The Copernican solution was elegant, but undemonstrated.

It was the same with Bradley. For those who inserted evidence of the phenomena of the aberration of the light, it was *physically true* that the sun was in the center. Not geometrically or mechanically, but as a physical phenomenon. However, two philosophers read Bradley: Kant and Comte. Even if one will forgive me, I will thus go back only to this time.

The following is a translation of Michel Serres's essay "Mathematization of Empiricism." from *Hermes II: L'Interférence*. Paris: Editions de Minuit, 1972. 195-200. Original translation by Taylor Adkins 11/03/07.

The law known as Fechner-Weber's law can be written $S = K \log I$, and read: sensation grows like the logarithm of the stimulus [1]. The definition of Information, in the contemporary sense, can be written $I = K \log P$, and read: information grows like the logarithm of the number of equally probable states [2]. Can the analogy of formation result in thinking the analogy of the alleged phenomena?

1. The notion of information is used in physics and communication theory in a way independent from the sense of the message that transports it. A succession of letters forming a word deprived of sense for whomever contains an easily calculable quantity of information. This magnitude does not have any relation to knowledge, in its traditional meaning. It is independent of the sense of the message, it is it thus of the observer.

The notion of sensation is used in psychology in a way independent from the value and the sense of the same scale where it is placed, even of the stimulus which produces it. A continuation of stimuli forming a sequence deprived of sense for whomever gives place to sensations [3] over the significance of which psychophysiology avoids being questioned. And, again, this calculation is independent of the gnoseological index of the stimulus and the sensation, it is it also from any perceiving subject.

In both cases, mathematization is possible in the exclusive condition to put between brackets the question of sense and the ego. The philosophical tradition would stick readily to the contrary thought, knowledge of which one could formalize only the absolute transparency of sense, and that on the contrary, nonsense is abstract. However, it is only because information is not knowledge, and is not knowledge-of-something, it is only because the sensation is rough (at least, even at the zero degree of its development), that it is easy to formalize the conditions of its emergence (at least, temporally).

Hence the parallel: just as the mathematical approach effectuates itself over the chance and the probability—the nonsense of nature, i.e. the complement of the whole of our knowledge, taken overall [4], of the same relates it to the stimulus and the feeling, as they are nonsenses, on the level of the animal receiver.

As it is the automatic integrator of nonsense, the sensory organ—the body—is the receptor of information in calculable quantity. Information and sensation are absolute (independent) magnitudes and on the inside of sense [5]: they are formalizable and abstract.

2. The comparison of two laws eventually imposes the idea that the growth of information is the general (structural?) expression of which Fechner's formula is only a singular model, the translation of a structure in a singular region. It is possible that it is more generally still about a law of decreasing outputs, whose marginalist economy gives models in other regions. Conversely, the singular case of the sensation gives place to the manipulation of high numbers (in "natural life" and not only in the laboratory) that integrated information could have a weight on an entropic scale [6].

3. The introduction of the notion of probability [7] in psychophysiology is not new. Since 1932, Houston ended, in his research on the law connecting the sensation to the stimulus, with a formula which

corresponds to Gauss's law of errors, from which he draws the traditional integral from probability. Testing on the phenomena of brightness, even Houston does not fear to affirm that sensation is strictly proportional to the number of nervous fibers concerned [8]. In the same way, Piéron compares the physiological mechanism generated by the stimulus with the recruitment (in the aleatory sense) of aesthesions [9]. Lastly, the intensity of the stimulus would correspond, in its growth, with the increase in the number of the cortical elements sending their orders [10]. All would occur then as if the rise in the intensity of the stimulus and the increase in sensation put into play a higher number of phenomena or states concerned, of which it suffices to say that they also pose that the distribution of the stimulative phenomena or the information flow in the circuits neuronic obeys this law, simplest of the random states.

The sensory receiver would function completely then, as a whole, like an automatic calculator of the quantity of information. Each sensory apparatus could be defined by this quantity.

4. Information theory allows a new approach to the problem of Error and Approximation in physical experimentation [11]. For example, Brillouin discusses, in chapter XV of its work, the traditional problem of the error to the measure a length, shared in intervals. It would be then interesting to translate Fechner's laws [12] on the perceived intervals, initially in terms of error analysis, then in this same calculation interpreted in informational terms: statistical errors to the measure *through* the sensory organ of a measurable scale of intensities. That could make it possible to calculate the precision [13] of such a body, and to give an account of the perceived interval itself.

One would undoubtedly find, renewed or deepened, in the discussions of Favard [14] on significant space, that it would be necessary to compare to the insensible limits of the psychophysicists, the sensory indetermination of Favard and the indetermination of measurement in Brillouin. The differential threshold would be bordered on the left and on the right by two interpretable intervals as errors, and formalizable as such. One could calculate the cost in the negentropy of discernability, and how it grows if one asked the receiving body to refine its intervals [15].

It is known that Information theory is capable of calculating the precision that could not exceed, in such and such conditions, an applied science: beyond ad infinitum grows the cost in negentropy of a given observation. The analogy supposed here would make it possible to obtain a (calculable) reason to be threshold of appearance of a new sensation: the cost in negentropy that the organization should spend to lower this threshold, i.e. to refine the interval, would be incompatible with the operation of the sensory apparatus, even with the total balance of the organization. Even with the state of project, of calculation appears intuitive, and seems to correspond to commonplace experiments. One would then obtain a definition of each apparatus (within the meaning of the definition of a radar) according to the negentropy that it can spend for its optimal discrimination: this definition would return to reason of the perceptible intervals.

Hence the two definitions of each apparatus: by the quantity of information which it is able to integrate (positive definition), by the negentropy that it is able to spend to reach such a limit of discernability, i.e. to operate its choices in the uncertainty of stimulative dispersion (definition by precision). While uniting, in a suitable formula, the definition through the result and the definition through the conditional capacity, there would be a good calculation of output for a given sensory apparatus. Again, each one of them would be defined by this output.

There one would obtain a new philosophical approach to the old problem of the error of the senses, which would then give up its Eastern context of illusion—already absorbed by optics, acoustics, etc.—to come to its true context, namely its random context. Conversely, one could mathematize the degree of truth (by quantity and precision) offered by an empirical theory, even at the level of its abstract beginning. If empiricism is probabilist, then it is quantifiable: that would be true, at the same time, of the significant experience and the scientific experiment.

5. There is thus a positive solution to the problem of the continuity between the sensory experience and the scientific experiment, which Bachelard, among others, had solved through the negative. It seems that the assertion of discontinuity is due to a superficial analysis of the operating conditions of the sensory apparatuses: the analysis of the scientific observation was scientific, the analysis of the sensory observation was only common sense; consequently, discontinuity was already under the conditions of the epistemological explanation. If, on the contrary, the latter is rebalanced, by an also scientific analysis of the two types of observation, one finds continuity easily: the sensory apparatus functions in a way similar to a reading device. In the same way, one compared the brute results and direct sensible knowledge, and all the strategic pageantry of knowledge by methodically regulated experimentation: discontinuity lay again under the conditions of the epistemological explanation. If this one is rebalanced, by comparing results and results, operation and operation, only continuity and gradation are found, not rupture.

6. The information flow in the nervous circuits would then be calculable as well as the circulation of the messages in an unspecified network of communication. Sensation would then give results which one could infer, by models, the same provision of the neuronal systems. One could introduce, by this skew, topology and graph theory, in the psychophysiology of the nervous system, now understood as a simple network of a circulation of messages carrying information.

Note: If the magnitude of a star is m , I its luminous intensity, and I_0 the intensity of a source of reference, one obtains the formula $I/I_0 = I_0^{-4} (m - M_0)$ i.e. $4 (m - M_0) = \log I_0 / I$. In other words, $M = K \log I$. It is another example of the same formulation. It was fatal that Information theory became, in the long term, the general and exact epistemology of what one formerly called observation, vaguely.

1. H. Piéron, *La Sensation, guide de vie*, Gallimard, 1945, pp. 331.

2. C. Brillouin, *La Science et la théorie de l'information*, ch.1.

3. Or more than units of sensations; cf. the notions of *neural quantum* (Stevens, Morgan et Volkman, 1941) or of *neuroquantum* (Piéron, 1932). Another remark: the property of additivity est enlightened in these two cases (Brillouin, p.1 ; Piéron, p. 375).

4. It would be interesting to note that the methodical strategy is all the more global as it relates to non-knowledge, that it is located in the measurement of the growth of our information. The knowledge of non-knowledge is global (from philosophy to the calculation of probabilities), the only sense which nonsense can present is molar, unifying, totalizing. The knowledge of knowledge is regional, molecular, local: strategic or tactical methods.

5. Would the body be initially the global integrator of a global non-knowledge?
6. Brillouin's remark, p. 280. Also, p. 250: the law of compatible degradation with Carnot's generalized principle can have a sense at the level of sensory information: maybe the process of habit.
7. Piéron, p. 335.
8. *Ibid.*, 371, 376.
9. From aesthesis, meaning the perception of the external world by the senses [Translator's note].
10. *Ibid.*, 370, 372.
11. Brillouin, p. 59.
12. Our first translation was of an aleatory or probabilistic type. One can think that the discussions of the metaphysical characteristics of this law were dazzled by the traditional infinitesimal enunciation that one gives it.
13. The term precision has the operational definition of the inverse of compared error.
14. Favard, *Espace et dimension*, Albin-Michel, 1950. The physical continuum, p.17 (impossibility of recovering the principle of identity).
15. One cannot miss being struck by the analogy of formalization. ΔS (sensation) is proportional to $\Delta I / I$ relative increase (intensity): in addition, if the error is Δx , the relative error is $\Delta x / x$, and the compared error $\Delta L / x$, L being the overall length of the segment that one measures. Fechner's law is quite translatable for error analysis.