NOTES ON THE PHILOSOPHY OF PHYSICS

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Abstract:

The way space has been thought by physics remains an obstacle to the coherent integration between its various theories. The Authors seek, with the help of a fundamental analogy, to present a new path for their complete unification.

I

1. "The gravitational field *is* space". This idea summarises Einstein's General Theory of Relativity and enables *force* to be thought of as a *curvature*, thereby reducing Mechanics to Geometry. The *Principle of Equivalence* postulated in the present paper enables *scales* and *rulers* to be calibrated, just like *clocks*, whose calibration was achieved thanks to the Theory of Special Relativity through the constancy of the speed of light for all inertial systems. Using the same method, in this paper we deliberate on the meaning of *temperature*, and put forward a new theory that covers not only rulers, clocks and scales, but also *thermometers*. To this end, we propose to use the concept of *curvature* (of space-time) to provide a solution to the problem we seek to solve.

2. In order to illustrate what we propose to do in this paper, let us use the ideal gases equation. If, in equilibrium, PV = NkT, it can easily be demonstrated that by rewriting this as F/S = NkT/V, we obtain T/F = V/S·(1/Nk), where F is force and S is surface. The *analogy* between *force* and *temperature* can be seen here in graphical form. It illustrates the problem we propose to solve: just like *force* (the force of gravity, that is, weight), *temperature* (of the contents of the container) is also a kind of *curvature* (of the space-time present here). For greater clarity, let us write this as T = f (R)·(1/Nk), where R is Einstein-Riemann's curvature.

3. But, this being so, we are forced to recognise that the traditional interpretation of what is meant by temperature cannot be correct. It is rather merely an *approximation* of what temperature really is. In the *probabilistic* aspects of Statistical Mechanics a more intimate relationship between thermal phenomena and gravitational phenomena is hidden. That is, *geometry* and *heat*, the *gravitational field* and the *thermal field*, are names for the same thing. Just as we must not fail to take into account the *plastic aspects* of heat, so we must not disregard the *thermal aspects* of space. *Rulers* and *thermometers* being two instruments for measuring the same thing, we should seek to clarify what this really means.

4. The *discreet*, *scalar, temporal*, *irreversible* nature of thermal phenomena must have a *plastic version*, just as the *oriented*, *vectorial, spatial*, *reversible* nature of gravitational (mechanical) phenomena – that is, the nature of what is meant by the curvature of space-time – must have a *thermal version*. This *new principle of equivalence* should produce an *Equation*, of which Statistical Mechanics and the General Theory of Relativity may be understood as *approximations*. All phenomena which bring together these two theories should be able to be more easily explained as expressions of what we are seeking in this paper.

5. Take the case, for example, of the seemingly contradictory way *entropic processes* are presented in the *two phenomenologies* (thermal and gravitational) above. The frontier regarded as *equilibrium* in thermodynamics should be characterised *geometrically* in the new framework. This is also the case with *black holes*, whose temperature may be obtained, with the help of statistical methods, as might be expected, by the complexification of the coordinates used in the solution of Einstein's equation. It is also the case that *Quantum Mechanics* itself may now be understood as a kind of unfinished *bridge* linking the thermal and the gravitational, leading to paradoxes that should be able to be eliminated by means of a new *doctrine of time*.

6. I would like to stress that in this formulation of Physics the question of time undergoes a radical transformation, the term no longer being used. *Time* is henceforth merely the *name* given to the processes that must be explained with the help of rulers and thermometers, and the theory – outlined here – that seeks to explain the relationship between them. Having thus far presented itself in a dual-faceted form, time may be understood in either *thermal* or *plastic* terms. In order that this should not be so, the *irreversibility* of thermal phenomena must be able to be read as *polarity* of gravitational (mechanical) phenomena – and vice versa. Inherited equations must be corrected in order for them to be compatible for all *scales* of Nature.

7. Considering that, from a dimensional point of view, $T\,d^3 = K = G/k\,(h/c)^2$, we have $T = K/d^3$, where a K is a new *fundamental constant*. Taking into account the ideal gas equation, we obtain $N\,(Kk) = PV^2$. But if $G = c^2 \cdot d/m$, we have $K = d/m \cdot h^2/k$ and $PV^2 = d/m \cdot Nh^2$. Considering that $d/m = G/c^2 = Q = \lim \varphi(R)$, where $\varphi(R)$ is a function of the *curvature of space-time*, we have $PV^2 = NQh^2$. If we consider that PV^2 may be understood as an additional function of the curvature $\varphi*(R)$, we have $\varphi*(R) = NQh^2$. In the knowledge that N is, for equilibrium, a constant of the theory of gases, the following question arises: what *meaning* should be assigned to N in the new context?

8. I propose that N should henceforth be understood as part of a *succession* of natural numbers which enables the description of the entire *spectrum* of states of matter, of which it is merely a *particular case*. But this means that the *quantification* of space-time should be able to be applied not only to thermal phenomena but also to gravitational phenomena at all scales of Nature. We then have $\varphi*(R) = N*Qh^2$, where N* acquires different values for each state of matter, ranging from *photonic gas* to the *black hole*, including the Cosmos, the galaxy, the star and its planetary system, and the atom and its particles.

9. Here, N* = N is merely the value known as (thermodynamic) *equilibrium*, for which there is a *change of sign* for the curvature of space-time. For this value, the fundamental equations of Statistical Mechanics and General Relativity – understood here as *approximations* of the General Theory – are now equivalent: both can be used to describe an object characterised equally by its thermal aspects or its gravitational aspects. I would like to point out that for N* = 1, we obtain, thus, the following *definition* of h: $h^2 = \varphi*(R)/Q$. To conclude, I would add that the theory proposed in this paper enables the problem of so-called 'dark' mass and energy to be seen in a new light: perhaps they are just the “ether” without which, in the absence of a better idea, physics today cannot do. This is what I seek to do by *postulating* a new *limit*, the *fundamental constant* of which all other constants may came to be understood as functions.

II

1. In electromagnetic radiation one can see a kind of *horizon* of the whole range of phenomena studied in Physics. This should help us to think about the *three ideas* that gave rise to the theories that history has bequeathed us. These theories may be classified in accordance with the following: *path*, *wave* and *heat* are directing images of all reflection, conditioning, from the outset, its course and difficulty. I therefore propose to explore the following analogy: the *paths* studied in Mechanics are for *Geometrical Optics* as *material waves* are for *Undulatory optics* and *heat* is for what I term *Thermal Optics*.

2. Thus, I postulate an equivalence between three different types of *clock*: *rulers*, pulses and *thermometers* should be able to be standardised in an integrated manner. *Time* is understood here as a function of the so-called "velocity" of the process under study (the *distance* travelled, the *number of pulsations* occurred, or the *temperature/volume* difference), whereby the three types of the theory mentioned above should be characterised as follows:

Path:	Mass	Velocity ($V_1 = d/t$)	Energy
Wave:	Amplitude	Velocity ($V_2 = \lambda \cdot \nu$)	Energy
Heat:	Pressure	Velocity ($V_3 = T/vol.$)	Energy

3. *Mass*, *pressure* and *amplitude* should be understood as the expression of an *equivalence* between the *three theoretical models*. They reflect the way in which *velocity* and *energy* are related in each case, by means of a *system of constants*. Just as, in the case of *paths* – where *energy* is understood as the product of the *mass* of the body in motion and the square of its *velocity* – we obtained, for the limit of the velocity ($V_1 = c$), something that may be understood as a *limit of mass/curvature*, we should also explore the meaning of the limits of "velocity" proposed for the other two models, with respect to their *amplitude* and *pressure*.

4. Thus, if $E \rightarrow mc^2$ and $E/d \rightarrow L_1 = c^4/G$, where $c = d/t$ for the distance travelled by light in a vacuum, we have:

   For the wave: $E \rightarrow f_2$ (amplitude) and $L_2 = f_2^*$ (c, h), where $c = \lambda \cdot \nu$ e $\nu = n \text{ sec}^{-1}$ for the number of pulsations of electromagnetic radiation

   For heat: $E \rightarrow f_3$ (pressure) and $L_3 = f_3^*$ (c_0, k), where c_0 = T/vol. for the *photonic thermometer*.

   I propose, therefore, that the limits of "velocity" suggested here should be understood as leading to *two other constants* (*amplitude and pressure*) which should, by analogy with paths, have the dimensions of a *surface or volumetric energy density* (E/d^2, E/d^3), and should appear as *functions* of the "limit of velocity" of the process in question (c, c_0) and another fundamental constant (h, k).

5. This being so, perhaps one can understand *mass*, *action* and *entropy* as three expressions – mechanical, undulatory, and thermal – of the same fundamental resistance to change, the same *inertia*. That is: the *mass/curvature* relationship should have an equivalence in the other two models – *action/amplitude* and *entropy/pressure*. This equivalence may be shown by studying the consequences of the *limits of velocity* corresponding to the respective processes, as proposed above. Just as $E = mc^2$ where $v \rightarrow c$, we have $E = h \cdot \nu_L$ where $\nu \rightarrow \nu_L$ and $E = k \cdot T_L$ where $T \rightarrow T_L$.

III

1. I have stated that the *mass/curvature* equivalence proposed by Einstein in his theory of General Relativity should lead us to explore the meaning of two other equivalences – *action/amplitude* and *entropy/pressure* – whose wave and thermal effects may be found when using the analogy, which always holds here, between the radiant and material aspects of reality. *Matter*, *radiation* and *space* are aspects of one and the same thing, and should therefore be understood as such. *Content* and *form* of the world cannot be dissociated: there is no content without container and no container without content. Indeed, the difference between the *geometric*, *wave* and *thermal* aspects of radiation expresses something of essential importance that should not be ignored in the construction of the theoretical models used to think about processes involving *masses*.

2. Just as geometrical optics led, with Einstein, to the discovery of a relationship between space and matter, which may be seen in the way *Newton's constant* can be broken down into parts ($G = c^2 \cdot d/m$), so we should think about the new equivalences of *action/amplitude* (in the case of waves) and *entropy/pressure* (in the case of heat) as horizons expressed by means of a limit quotient. Thus two other *constants* associated with the wave and heat aspects of radiation – which I term C_0^* and C_0^{**}, where $C_0^* = H/\text{amplitude}^2$ and $C_0^{**} = P/S = T/d^3$ – should correspond to $d/m = G/c^2 = C_0$ (where H is an action, P a pressure, and S an entropy).

3. *Entropy* and *pressure*, *action* and *amplitude*, *mass* and *curvature* should be related in such a way that the system of equivalences contained herein is rendered formally patent. Thus I hold that:

$$C_0^{**} = T/d^3 = P/S = S/H = H/\text{ amplitude}^2 = \text{amplitude}^2/d = d/m = C_0$$

Taking into account the constants of proportionality (C_1, C_2, where $S/H = C_1 \cdot C_0^{**}$ and $amplitude^2/d = C_2 \cdot C_0$), I would stress that the first two quotients (*P/S* and *S/H*) relate to *Thermics*, while the second two (*amplitude²/d* and *d/m*) are useful for the construction of *Mechanics* (*Metric*). The middle quotient ($C_0^* = H/amplitude^2$) should thus be read as a fundamental relationship of *Wave Physics*.

4. But if this is so, we get two other relationships:

   - $H^2 = S \cdot amplitude^2$
   - $Amplitude^4 = H \cdot d$

   From which it follows that: $H^2 / amplitude^4 = (H / amplitude^2)^2 = S \cdot amplitude^2 / H \cdot d$
   If $S/H = C_1 \cdot C_0^{**}$, and $amplitude^2 / d = C_2 \cdot C_0$, we have: $(H / amplitude^2)^2 = (C_1 \cdot C_0^{**})\ (C_2 \cdot C_0)$, that is: $C_0^{*2} = (H / amplitude^2)^2 = (C_1 \cdot C_2)\ (C_0^{**} \cdot C_0)$. This means that the quotient for Wave Optics expressed here should be able to be deduced from the relationship between the two *constants* associated with the study of Thermal and Geometrical Optics (C_0^{**} e C_0). If $C_0^{**} = T/d^3$ and $C_0 = G/c^2$, $C_0 \cdot C_0^{**} = T \cdot G/d^3 \cdot c^2 = T/m \cdot 1/d^2$. And we get $C_0^{*2} = C_1 \cdot C_2\ (T/m \cdot 1/d^2)$. For $m = m^*$, the value of the mass of the particle which may be involved in the process, we have: $C_0^{*2} = (C_1 \cdot C_2 / m^*)\ (T/d^2)$.

5. While in the case of the *Theory of Trajectories* and *Heat Theory* – Mechanics and Thermics – it was possible to associate two *horizons* represented by two *limits* (*mass/curvature* and *entropy/pressure*) with the study of the processes involved, we should now be able to do the same for *Wave Theory*. The relationship between *action* and *amplitude* is now understood as a consequence of the relationship between temperature and the surface which it is associated with. Wave Theory, in the scheme presented here, is the designation of the relationship between the *Thermal* and the *Metric* (*Mechanical*): *action* and *amplitude* are related to the two previous topics by means of the above-mentioned quotients with *entropy* (for action) and *curvature* (for amplitude), respectively. That is: $S/H = H/amplitude^2 = amplitude^2 / d$. I would like to resume what has been said by a new scheme:

   Pressure → Entropy → [Action ←→ Amplitude] ← Curvature ← Mass

   Thermics → Undulatory Physics ← Metrics
   $(T / d^3 = C_0^{**})$ $(H / d^2 = C_0^*)$ $(d / m = C_0)$

6. Quantum Mechanics is nothing but the consequence of the trouble that Physics has found itself in when thinking about its two great doctrines – the Thermal and the Metric – in order not to reduce the Thermal to the Metric. The values obtained by using Quantum Mechanics equations should thus be able to be deduced from the equivalences presented above. The idea of curvature (of Einstein's space/time) allows us to see the relationship between temperature and space in a new light – it enables temperature to be read as a kind of curvature, thus allowing for a new interpretation of heat processes. Avoiding the paradoxes of Quantum Mechanics, Wave Theory may thus assume the role that it should have been assigned from the start: a *conceptual device* for thinking about the link between the *metric* and the *thermal*, *matter* and *radiation*, *trajectory* and *heat*, *content* and *container*, without contradiction.

A.	Temperature	Frequency	Velocity
B.	Entropy	Action	Mass
C.	Thermal Energy (entropy x temp) (pressutre x vol)	Wave Energy (action x frequency) (X x surface)	Kinetic Energy (mass x velocity^2) (force x distance)
D.	Volumetric Density of energy (pressure)	Surface Density of energy (X)	Linear Density of energy (force)
E.	Volume (energy/pressure)	Surface (energy/X)	Distance (energy/force)
F.	Thermal clock	Wave clock	Mechanical clock

1. The table shown above may be interpreted as the key to establishing a fundamental equivalence between the spectra of *velocities*, *frequencies* and *temperatures* involved in the processes studied in Physics. In all cases subject to a threshold value – c in the case of the velocity of bodies in motion – the above-mentioned spectra should be in keeping with a function of the *quotient* of the *densities of energy* and *mass* present in them. *Temperature* and *velocity* are such that it is as if one were the inverse of the other, and the frequencies that characterize wave phenomena should express the quotient of the densities in a specific manner.

2. That is, *Wave Theory* may be understood as a kind of interface between *Thermodynamics* (Thermics) and *Mechanics* (Geometry). It is the expression of an *equilibrium* which prevents one of the above-mentioned densities (energy and mass) from tending to prevail over the other, with its markedly thermal or mechanical consequences. Temperature and velocity reflect the curvature of space in different ways. Just as mass "warps" space by closing it, so entropy "unfolds" space by opening it. Indeed, mass is to velocity as entropy is to temperature.

3. If we have, as pairs of factors which each have energy as their product, temperature/entropy, on the one hand, and mass/velocity on the other hand, then the relationship between action and frequency should be able to be interpreted in the light of the analogy contained therein. We thus have: *frequency* between *temperature* and *velocity;* and *action* between *entropy* and *mass.* If entropy is the origin of a process of which mass is the end, action should be understood as the fundamental characteristic of its entire path. That is, *entropy* is transformed into *mass* by means of an *action* (which also means that *temperature* is transformed into *velocity* by means of a *periodicity).* The world is a process of cooling that manifests itself as a phenomenon of colossal proportions with ondulatory features.

4. Exploring the other possibility that the table provides us with, the equivalence referred to above may be formulated in an even clearer manner. When thinking about *energy* as the product of the other three pairs indicated in it ($P \cdot d^3$, $X \cdot d^2$, $F \cdot d$), the table enables its *quality* to be highlighted. Temperatures, frequencies and velocities now appear, indeed, as reflecting the *dimensionality* of space itself.

$$S \cdot T = P \cdot d^3 \Leftrightarrow P/S = T/ d^3$$

$$H \cdot v = X \cdot d^2 \Leftrightarrow X/H = v/ d^2$$

$$M \cdot v^2 = F \cdot d \Leftrightarrow F/M = v^2/ d$$

5. *Thermal gradients, wave amplitudes* and *gravitational differentials* should be understood as expressions of the *method* chosen for the study of the "subject" in question and the measuring device used here (thermometer, clock and ruler) - they are merely three ways of talking about *space*, that is, three ways of expressing the *quotient* of the *densities* of *mass* and *energy*. Just as I was able to state that *Action* was to be found between *Mass* and *Entropy* (and Frequency to be found between Velocity and Temperature), I may now state that: X is to be found between Force and Pressure, just as Surface is between Distance and Volume.

6. The *Theory of Gravitation, Electromagnetism* and *Thermodynamics* provided three ways for exploring the boundaries that the History of Physics has bequeathed us (G, c, h, k). The *equivalence* that I seek to establish is based on the conviction that it is through the exploration of the consequences contained in the *structural character* of space itself that the difficulties in which Physics finds itself may be overcome. Interface between Thermodynamics and the Theory of Gravitation, *Wave Theory* will provide the stage for testing these new ideas: *quotient of densities* and *structure of space* should be able to lead to the replacement of *Quantum Mechanics* with a new *framework* in which all paradoxes are absent.

V

1. The *mathematical* theory which I have sought to expound in my *Notes on the Philosophy of Physics* is, to a large extent, incomplete. The concepts of *entropy* and *curvature*, *energy* and *mass*, and *temperature* and *volume*, should be able to be unified in a simple and direct way, without necessary recourse to the theories which spawned them. To speak of *space* is to speak of *heat* – the paradoxes of *Metrics* reflect the paradoxes of *Thermics*. *Rulers* and *thermometers* are, in fact, the instruments that Physics uses to measure *time*.

2. *General Theory of Physics* should therefore do without *watches.* Pulse, frequency and rhythm are nothing but names for the *transformation* of energy into mass, that is, temperature into volume. The cooling process that presents itself as the Cosmos is a phenomenon with *periodic features*. Clarification of that which the *relationship* between rulers and thermometers *truly signifies* should put an end to the difficulties that Physics continues to struggle with.

3. The fact that the *product* of the limits that are now presented as *fundamental constants* have the *dimensions* of a temperature multiplied by a volume, in my view, increases support for the interpretation I propose in this paper. When considering $K = G/k\ (h/c)^2 = T \cdot d^3$ as a truly fundamental *constant* of Physics, we can see in G, k, h and c variables with a constant product. The theories we have at our disposal today should, in this case, be understood as *approximations*.

4. If, on the other hand, we consider that K may be regarded as a *function of functions* which appears as a *succession* (K_n) bounded by a value (K_0) to be determined ($K_{n \Rightarrow} K_0$), considering that $K = (h \cdot h/m \cdot k) \cdot d$, we may explore the meaning of *equivalence,* proposed above, between *entropy*, *action* and *mass*:

$$K_n = T \cdot d^3 = (T \cdot d^2) \cdot d = (H \cdot H/M \cdot S) \cdot d = K^* \cdot d$$

If $K^* = K_1^* \cdot K_2^*$ then $H = K_1^* \cdot M$ and $H = K_2^* \cdot S$, where H is *action*, M is *mass,* and S is entropy. If we consider that $K^* \cdot d = K^* \cdot d = K^* \cdot n \cdot d_0$, for $d = n \cdot d_0$ we obtain a *function* whose values are a *succession* of *natural numbers* corresponding to different *stages* of the cosmic process.

5. The considerations set out above seek to provide a contribution to the clarification of the reasons behind the efforts made in recent years to achieve the overall unification of Physics. The question of *time,* in its most profound meaning, refers to a different issue which in Physics is always left unresolved, for *methodological* reasons: that of *sense.* By putting time aside, Physics could take a further step towards the goal for which it has been able to provide much evidence throughout its long history – the construction of a coherent and comprehensive *Theory* of everything which may be subject to *measurement*.

VI

1. If we consider that the process of the cooling (or heating) of the world can be thought of as a process of the transformation of radiant energy into mass energy (and vice versa), we cannot but take into account that this should occur in the context of the concomitant creation (or destruction) space. Just as we may imagine the possibility of associating a constant number of elementary amounts of radiant energy (photons) with each elementary amount of mass at rest, so we should also be able to associate a number of elementary amounts of space with it. The transformation of photons into fragments of space should obey the following rule:

   $$N_0 \text{ (photons)} = N_1 \text{ (amounts of mass)} + N_2 \text{ (amounts of space)}$$

   With the value of the elementary amount of mass n_1 photons and the value of the elementary amount of space n_2 photons, we have, for the *quotient* mass / space, the value of $n_1 N_1 / n_2 N_2 = N$, where N belongs to a set of natural numbers whose values range from N * to N **.

2. In the light of this, mass should be able to be understood as *one* aspect of the transformation of radiant energy into space (and vice versa); it may be considered as a kind of *residue* left over from the basic transformation process. The transformation referred to above presents itself to us as *motion/change*, in the various manifestations studied in the History of Physics: gravitational, wave-like, and thermal. Thus, studying Physics here should be nothing but a means of *accounting* for the amounts involved in the various processes (*mass*, *photonic*, and *spatial).* Replacing the concepts used in previous theories, this accounting process should be able to be used to think about *velocities*, *pulses* and *temperatures* in a radically simplified form, through the generalised use of arithmetic in the study of natural processes.

3. The equivalence between traditional approaches to the study of the various processes should therefore become manifest. For example, I can see, in the concept of *curvature* (of space/time) bequeathed to us by Einstein, an indication of the relevance of that which we are seeking here. Indeed, *space* should no longer be understood as a mere recipient of the energy contained in it, but rather as an expression of the transformation of this energy, as significant – if not more so – than that which Physics has called *mass.*The equivalence between the instruments of measurement used in Physics should lead to a theory that could reduce the set of parameters to a single parameter (as to some extent was attempted in the General Theory of Relativity, by standardising - through the concept of curvature – rulers, clocks and scales).

4. Discussing the transformation of energy or the transformation of space should thus be one and the same thing, *mass* and *velocity*, *action* and *frequency*, and *entropy* and *temperature* being nothing but three ways of talking about this transformation. This may help us to understand the meaning of the *dimensional nature* of the product of the principal constants of Physics. Indeed, we know that:

   $$G/k \cdot (h/c)^2 = K = T \cdot d^3$$

   which may be understood as one more proof of the relevance of the theory outlined above.

VII

1. The following tables illustrate the importance of the relationship between the three branches of Physics known as the Theory of Heat, Wave Theory and the Theory of Trajectories, making the unifying link between them explicit by clarifying the system of equivalences that underlies it.

P	X	F
S	H	M

Volumetric density of energy	Surface density of energy	Linear density of energy
Spatial energy	Radiant energy	Mass energy

with P ~~is~~ for pressure, S for entropy, X for energy/amplitude^2, H for action, F for force and M for mass. Thus we get:

$$P = S \cdot T / d^3 \text{ , } X = H \cdot \omega / d^2 \text{ e } F = M \cdot v^2 / d$$

And for $P \cdot F = X^2$, we have $S \cdot M = H^2 \cdot C$, where $C = 1 / Td^3$.

2. If we consider that $1 / T\, d^3 = 1 / K$, where $K = G / k \cdot (h / c)^2 = Td^3$ and considering $C = 1 / K$, we find the *analogy* contained in the vertical columns of the tables above. Indeed, we may state that, for a given quantity of energy, just as the product of its *volumetric density* and its *linear density* is equal to the square of its *surface density*, so the product of its *spatial* amount and its *mass* amount is equal to the square of its *radiant* amount. We may call S *spatial energy* because, based on the dimensionality of the constant K, we understand temperature as a *measure of space*.

3. Taking into account that, as stated in Note VI, *space*, *mass* and *radiation* may be understood as being discrete, that is, the result of a sum of elementary amounts, we can now formulate the equation referred to in Paragraph 1 in order to make its nature explicit:

   from: $S \cdot M = H^2 \cdot C$, where $C = 1 / K$ e $K = G / k \cdot (h / c)^2$

   we have: $(S \cdot M / H^2) \cdot K = 1$, that is: $(G \cdot h^2 \cdot S \cdot M) / k \cdot c^2 \cdot H^2 = 1$

   and, with $G = c^2 \cdot d_0 / m_0$, we have, $S / k \cdot M / m_0 \cdot h^2 / H^2 = 1 / d_0$

   considering that: $n_1 = S / k$, $n_2 = M / m_0$ e $n_3 = H / h$

   we finally get: $(n_1 \cdot n_2) / n_3^{\,2} = 1 / d_0$

4. We observe that for a value of constant mass $M = N \cdot m_0$, we have $n_1 / n_3^{\,2} = 1 / Nd_0$, which means, we believe, that under these circumstances, radiant energy is completely transformed into spatial energy (and vice versa). We would like to add that k, m_0, d_0 and h may, as a result, be understood as *variables* of constant product. Indeed, their value may change, as long as the result of the above operation does not change. That is: $k_n m_n / h_n^{\,2} = 1/K_n$, with $K = T_n \cdot d^3_n$. Finally, let us recall that where H* = Hilbert-Einstein action, we obtain $H^{*2} = n_3^{\,2} h^2 = n_1 n_2 d_0 h^2$. And, with $n_2 = N$ and $S = k \log\Omega$ we have $H^{*2} = \log\Omega \cdot$constant where $\log\Omega = n_1$ (the fact that the heat equation can be used to define the *Ricci flow* is fully justified here). We believe that we have thus presented a simple way of reducing Physics to an *arithmetic system* of relationships between its variables.

VIII

"The Thermodynamics of General Relativity, that is, the Statistical Mechanics of the *quanta* of space remains in its infancy", says Carlo Rovelli in his latest essay. In this regard, to conclude what I previously stated, I would like to add the following:

1. Contrary to that which has been the general belief of physicists, there can be no complete ideal description of any natural system. The *theory of trajectories* of bodies in motion is nothing but the product of wishful thinking: an attempt at describing reality by means of a model. Therefore, it should not assume ontological primacy over other theoretical approaches.

2. The statistical interpretation of heat which derives from the idea set out above is not the best interpretation of the phenomenon that it represents – on the contrary, the *dissipation* of heat should be understood as the *fundamental process* to which all other theories are subsidiary. It is because heat dissipates that *there is* motion. The meaning assigned here to the concept of a*verage* (of speed, energy, etc.) derives from a false interpretation of the phenomenon: motion (trajectory) is like heat, while heat is not like motion.

3. The true sense of the word *temperature* should, it seems to me, be understood on the basis of the function K, previously defined as $K = T\, d^3$. That is, "temperature" is the inverse of "volume". If we consider that $S = E/T$, where $T = K/d^3$, we then have $S \cdot K = E \cdot d^3$. Postulating a maximum value for the entropy of the world, $E \cdot d^3$ has $S \cdot K$ as its limit, thus rendering perceptible the energetic nature of space itself.

4. The error that has prevented Thermodynamics from being attributed its due relevance in order that Physics may be unified in a single equation may be summarised in a simple statement: the whole cannot be understood on the basis of its parts – it is the opposite that is true. This means that the theory of trajectories should be thought of as a kind of thermodynamic limit, an ideal horizon, and not the contrary.

5. As stated in previous notes, the volumetric, surface and linear density of energy have as their analogy entropy, action and mass. The equation put forward in Note VII ($S \cdot M = H^2 \cdot C$, where $C = 1 / Td^3$) may be understood as the expression of a *Generalised Quantum Mechanics*. General Relativity and Thermodynamics should be able to be deduced as two borderline cases of this equation. Consequently, current Quantum Mechanics is nothing but the result of the persistent inability of Physicists to unify the two previous theories without mediation.

6. If we use Einstein's formulation for action and that of Boltzman for entropy, we obtain: $k \cdot \log\Omega \cdot M = H^2 \cdot C$, where $C = 1 / Td^3$ and H^2 is the square of Hilbert-Einstein action. For a constant mass, we obtain an equivalence which, in its analytic Hamiltonian reformulation establishes a fundamental relationship between space and time, through a kind of thermal polarity. Big bang and big crunch (black hole) are names for the difference between radiant energy and mass energy. They render manifest the energetic nature of space itself. For a given amount of energy, *dissipation* and *concentration* should be able to be shown in the way in which temperature and volume are related, that is, the value of K.

7. While the constancy of $K = Td^3$ is very plausible for a constant mass, this may not be the case for worlds with different mass contents. These should be able to be presented as different values of K. Thus, the current constants of Physics – of which K is a kind of product: $K = G/k \cdot (h/c)^2$ – should be able to be understood as variables of a function whose values determine the course of events which we call the Cosmos: $K_i \ni [K_0, K_n]$.

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