The Idiosyncrasies of Anticipation in Demiurgic Physical Unification with Teleparallelism

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It is really important that the scientific community becomes conscious that anticipation has a physical background.
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Abstract
In their accompanying paper, the present authors have reached a more physical version of the equations of structure of a Kaluza-Klein space that emerges from Finslerian teleparallelism (TP). Those equations pertain to "the physical field" (actually its potential), including the quantum sector. This is *demiurgic TP*. We signify, as Élie Cartan did, that the field equations imply that spacetime is teleparallel, and not just simply compatible with TP. A "mother of the physics" results, for lack of a better name, meaning that physical "systems" -i.e. concepts, formulas and physical theories- emerge from it. We take only a few timid steps in the study of the idiosyncratic manifestation of anticipation in such a theory. Our study of emergence will, we hope, help others deal more authoritatively with anticipation for this new frontier of natural science theory.
Keywords: anticipation, emergence, reductionism, unification, teleparallelism.

1. Introduction

In an accompanying paper (Vargas-Torr, 2005e), we have obtained a closed system of geometric equations for the structure of a very special space. We now show, to within limitations of space and youth of the theory, that physics emerges from the equations of appropriate classical (i.e. non-gauge) structures. We then take the first steps in the study of anticipation in the theory of "demiurgic teleparallelism" (TP) (see section 2) .

Very little of what is to be found in this paper is well known. Points of contact with the work of others are sporadic. On the mathematical side, we have used Finsler bundles, here as in previous papers, but very few Finsler geometers deal with them. We use the Kähler (1962) calculus, and his namesake equation. But even practitioners of the algebra (Clifford's) that underlies it are rarely familiar with that calculus, much less with Kähler equations that involve tensor-valued differential forms. The mathematical novelty actually goes beyond what has been described in the accompanying paper. For instance, the equations of structure of our Kaluza-Klein (KK) (type of) space transcend those of spaces endowed with standard connections, which the theory of moving frames provide. Our geometry is more than just a theory of those frames. This is a subject raised but unresolved by Cartan (1922a, "Sur les equations...", Oeuvres Complètes). We have shown (Vargas-Torr, 2005c) that it relates to his description in the same paper of distributions of energy-momenta as bivector-valued (rather than vector-valued) differential 3-forms. Similarities prompts us to use the term KK for our new structure. Our results in previous publications and a few new ones are put together here in the form of the first exposition of demiurgic TP, though brief because of limitations of space.

Our methods are the little understood Cartan's methods, based on his view of generalized geometry as an application of the theory of integrability of differential systems. Let ω^{μ} be the soldering forms ("square root of the metric"). Let $\omega_B{}^A$ be the differential 1-forms for the affine connection, which is not Levi-Civita's in this paper (we use capital indices to indicate that the dimension need not be 3 or 4, associated with Latin and Greek characters). Those differential forms are the invariants that define an affinely connected manifold by constituting the input in the system of differential equations $dP=\omega^A e_A$ and $de_B=\omega_B{}^A e_A$. This system, essential to the moving frame method, is not integrable in general, and yet it is not customary to write $\not{d}P=\omega^A e_A$ and $\not{d}e_B$. Let $\wedge$ denote, as usual, exterior product. ddP designates the result of formally exterior differentiating $d(\omega^A e_A)$ to obtain $(d\omega^A-\omega^B\wedge\omega_B{}^A)e_A$, like in all of Cartan's work on affine and Euclidean differential geometry (See also, among others, Chern, 1948, formulas 66, 77 and those in between 79 and 80). Authors, however, avoid writing down ddP and dde_A. Thus d^2 is not zero, also in Kähler, unless applied to scalar-valued differential forms. From dP, one also gets the space-time metric, $dP\cdot dP$, which is viewed from an alternative perspective in our KK space (Vargas-Torr, 2005e).

Of great importance is that the scalar valued differential forms of Cartan and Kähler are functions of curves, surfaces, hypersurfaces, etc, rather than anti-symmetric multilinear functions of vectors. Correspondingly, components in the Kähler calculus have, in addition to the superscripts, two series of subscripts, respectively for integrands, which live on the manifold and do not depend on connection, and for multilinear functions of vectors, which live on bundles of the manifold and are connection dependent. Understanding Kähler's work is the test of understanding Cartan. Modern interpreters of the latter's work misinterpret dP, and thus ω^A. The single series of subscripts in their quantities is usually the wrong one.

The contents of the paper is organized as follows. In section 2, we explain what *demiurgic TP* is. Its virtually canonical field equations (Vargas-Torr, 2005e) constitute a closed differential system (i.e. without external input) for the differential invariants that define this geometry. There is nothing physical in it; every physical concept must emerge. Emergence here is like one face of a coin, the other face being reductionism. These are not antithetical concepts. In section 3, we deal with the emergence of particles and their equations of motion, and in section 4 with the emergence of traditional physical theories from geometry, not yet from demiurgic physics. In section 5, we deal with emergence from demiurgism itself. Notice our avoiding the term quantum. The torsion sector of demiurgism is based on a quantum equation; its curvature (gravitational) sector is not. That is the way in which the interactions emerge in demiurgism. Our steps on anticipation (section 6) are very modest, given the subject's complexity and that anticipation in physics was foreign to us until very recently.

2. Demiurgic Teleparallelism

The concept of demiurgic TP (or demiurgic theory) is due to Cartan (See Debever, 1979) when discussing an attempt by Einstein (1930) at a unified theory of the physical field based on TP (property of an affine connection of defining path-independent equality of vectors at a distance). The field equations of a demiurge or builder of a universe must show that his world is teleparallel. Physicists doing TP, on the other hand, take it for granted; their field equations need not imply TP, just be consistent with it. Let $\Omega_\nu^{\,\mu}$ be the scalar-valued differential 2-forms that constitute the components of the 2-tensor-valued differential 2-form known as affine curvature. One of the terms in the first Bianchi identity is given by $\omega^\mu \wedge \Omega_\nu^{\,\mu}$, the other terms combining to form the exterior covariant derivative of the torsion. Cartan used $\omega^\mu \wedge \Omega_\nu^{\,\mu} = 0$ as example of an equation compatible with both Riemannian and TP geometries (Debever, 1979). A differential system where said equation were the only one involving the affine curvature would not be demiurgic. Since there was no mention of curvature, that attempt by Einstein was that of a physicist, not of a demiurge. His limited knowledge of connections prevented him from realizing that such course of action was even incompatible with his thesis of logical homogeneity of geometry and theoretical physics (Einstein, 1934): when one adds to the propositions of geometry the proposition that the bodies of the physics behave like the frames of the geometry. He used as example Euclidean geometry and the "physics" of Greek times. Cartan successfully started demiurgic TP (Vargas-Torr, 1999).

There is only one physics and many geometries. We anticipate that Finslerian TP and our related KK-type geometry (Vargas-Torr, 2005e) should be used for implementing Einstein thesis. The latter arises canonically from the former. Both result in the process of enforcing Clifford-algebraic structure, in addition to geometric equality, the group-subgroup-subsubgroup complex of Lorentzian geometry and principal fiber bundle structure. The first equation of structure of that KK space reads $\underline{\partial}\aleph = \hat{a} \vee \aleph$, where $\hat{a}$ is, say, $\boldsymbol{u} \vee d\wp$ (Vargas-Torr, 2005e). In principle, the symbol $\vee$ in $\hat{a} \vee \aleph$ stands for Clifford product in both algebras, namely of differential forms and of the tangent tensors constituting their valuedness factors. The second equation of structure is the statement in terms of metric curvature and torsion of the vanishing of the affine curvature. We write it down later. The differential system that both together constitute is meant to be satisfied at any point in a fermion, boson, superconductor, vacuum, brain, etc. It does not apply to systems, whether physical or biological. In demiurgism, systems must be viewed as emergent. Reduction from demiurgism to physical systems might in principle involve loosing contents that might remain in reduction to living systems.

Our demiurgism is strong, unlike the weak one of post-Levi-Civita general relativity (GR), where one identifies metric and affine curvatures under the term Riemannian curvature, implicitly assuming null torsion. It is weak because the field equations specify only a contraction of the curvature. Through integration, one obtains the metric and thus the curvature, not just the Einstein tensor (The extra information is in symmetries of the metric or in initial conditions). With regards to this issue, Cartan (1922a) stated:

"It is very remarkable that Einstein's gravitational equations only evolve ten linear combinations of Riemann's 20 symbols; another 10 linear combinations exist... It is

quite disconcerting that only the last ten quantities have been considered by physicists" (emphasis in original).

In retrospect, GR might have adopted a teleparallel metric compatible connection in the 1920's, rather than the Levi-Civita (LC) connection, born in 1917. If we view Einstein's equations as pertaining only to the metric curvature and making no assumptions about the affine connection (and thus about the affine curvature and the torsion), GR is not demiurgic, but a physicist's work, since the Einstein equations by themselves do not specify the torsion. With the LC connection, the torsion becomes automatically zero, even if LC could not have known this at the time.

Key to the understanding of our reformulation of the equations of structure of our KK space is the realization that the specification of the torsion is not as straightforward as that of the curvature (Vargas-Torr, 2005e). This asymmetry between structure equations (also between Bianchi identities) is due to non-symmetry of the roles of ω^{μ} and $\omega_{\nu}^{\ \lambda}$ in the connection equations (Vargas-Torr, 2005c, sec. 3). In TP, the first Bianchi *identity* implies that the torsion's exterior covariant derivative is zero. Hence there is redundancy in specifying the full torsion through the first equation of structure. The new first equation of structure is quantum mechanical.

3. Emergence of the Particle Picture

In this section, we deal with emergence of particles and their equations of motion.

3.1 The Emergence of Particles

The solutions of the equations of structure of demiurgic TP have not yet been solved. However, Muraskin (1995) has solved by computer his sophisticated system

$$\Gamma^{\iota}_{\chi\kappa,\lambda} = \Gamma^{\iota}_{\kappa\mu}\Gamma^{\mu}_{\chi\lambda} + \Gamma^{\iota}_{\chi\mu}\Gamma^{\mu}_{\chi\lambda} - \Gamma^{\mu}_{\chi\kappa}\Gamma^{\iota}_{\mu\lambda}, \qquad (1)$$

of geometric non-linear equations in four dimensions. His work speaks of the wide collection of solutions that a complicated system may have (Our demiurgic system is more sophisticated than Muraskin's). Consider a differentiable manifold endowed with torsion and the flat space-time metric. In orthonormal frames dual to a Cartesian coordinate system, the Levi-Civita symbols are zero. The components of the connection and of the contorsion ($\Gamma^{\iota}_{\chi\kappa}\boldsymbol{e}_{\iota}\otimes\boldsymbol{e}^{\chi}\otimes\omega^{\kappa}$) are then equal. Equations (1) state that

$$d(\Gamma^{\iota}_{\chi\kappa}\boldsymbol{e}_{\iota}\otimes\boldsymbol{e}^{\chi}\otimes\boldsymbol{e}^{\kappa}) = 0 \qquad (2)$$

(Muraskin has his own view of this system). Notice the replacement of ω^{κ} with $\boldsymbol{e}^{\kappa}$ ($d\omega^{\kappa}$ and $d\boldsymbol{e}^{\kappa}$ are respectively connection independent and connection dependent). Equation (2) is not a Bianchi identity or an equation of structure. It is, however, "geometric enough" to be of interest for our purposes.

The initial conditions for these equations are values taken by the gamma functions at a point. They give rise to what Muraskin names as solitons, instantons, closed string particle systems, trivial solutions (like sine waves), etc. Limitations of space do not allow us to depict here a solution of particular interest, his "packet solution", reproduced in Vargas-Torr (1997, 2002). It is a multiwave packet solution without uncontrollable spreading, and living in a "vacuum" or region between the packets, where the gammas perform very close small oscillations with a band structure that evolves spontaneously into a packet, back into the vacuum, etc. This solution, and the existence at the same time of other solutions with completely different characteristics, shows the possibility of emergence of complex organizational structure from the type of equations that differential geometry provides. Muraskin's packets thus exemplify the emergence of the concept of particle and of bunches of particles as free stable solutions to field equations. If solutions of this type living in "different regions" move towards each other, the interaction of the packets (read particles) depends in the details of the interaction of the backgrounds that precede the wave packets themselves. What may appear as an insignificant difference in initial conditions may result in solutions of totally different natures. In other words, events occurring somewhere may affect a solution elsewhere through small changes in the background that "precedes" it, as if dealing with a non-local interaction.

3.2 The Emergence of Equations of Motion

An affine connection in the bundle of frames of a space-time differentiable manifold M^4 (i.e. pre-Finsler) type can be pushed to its Finsler bundle, where we shall assume that our analysis takes place independently of whether our connection is properly Finslerian or not. The base space of this bundle is spanned by the invariant forms ω^0, ω^i and ω_i^0. Its curves have significance in space-time only if they are natural liftings, i.e. if they satisfy the conditions $dx^m-u^m dt=0$, equivalently $\omega^j=0$. Three more equations relating those seven differential forms are required to determine a curve. The conditions $\omega_i^0=0$ stand out. By metric compatibility, $\omega_i^0=\omega_0^i$, and, therefore, $\omega_0^i=0$. But, in the Finsler bundle, $du=de_0=\omega_0^i e_0$. Hence, $\boldsymbol{du}=\boldsymbol{0}$; the autoparallels thus emerge as distinguished curves in the theory of Finsler bundles. In fact no other curves suggest themselves just from observation of the set of differential invariants. We shall later see what differential 1-form is involved in the equation for the extremals. The specific form of the equations for the teleparallels will depend on how we deal with the torsion of the space, giving rise either to Euler-Lagrange equations where the contribution of the torsion is buried in a fictitious metric, or to equations where that contribution is explicit and differentiated (from) but unified to the contribution of the metric.

4. Emergence of Physical Theories from Geometry or Kähler Theory

The emergence of physical concepts and theories will be considered in Finsler bundles first, rather than from the structure equations of demiurgism in the KK-type space canonically associated with Finslerian TP.

4.1 The Emergence of Mechanics

Suppose that, for some physical problem, the first component, Ω^0, of the space-time torsion is a total differential, dA. The time-like component of the first equation of structure then becomes:

$$d(\omega^0 - A)-\omega^j \wedge\omega_i^0=0. \qquad (3)$$

Naming ω^0-A as ω'^0, we have

$d\omega'^0 - \omega^i \wedge \omega_i^{\ 0} = 0.$ (4)

In order to later apply the natural lifting conditions, we write ω'^0 as $ldt+A_m(dx^m-u^m dt)$, where l and A_m are determined by the metric of the space. Consider for example the "square root" $\omega^0=\gamma(dt-udx)$ and $\omega^1=\gamma(dx-udt)$ of the metric dt^2-dx^2, where γ is as in special relativity. We now write $\gamma(dt-udx)$ in terms of dt and $dt-udx$ to obtain $\omega^0=\gamma^{-1}dt - u\gamma(dx-udt)$, which is an example of $\omega^0=ldt+A_m(dx^m-u^m dt)$. The left hand side of eq. (4) becomes $l_{,m}dx^m \wedge dt + l_{.m}du^m \wedge dt + dA_m \wedge \sigma^m - A_m\, du^m \wedge dt - \omega^p \wedge \omega_0^{\ p}$, where σ^m denotes $dx^m-u^m dt$, where $l_{,m}$ and $l_{.m}$ represent partial derivatives of l with respect to x^m and u^m, and where we have used that $\omega_p^{\ 0}$ equals $\omega_0^{\ p}$ by metric compatibility. Since the ω^p are linear combinations $A^p{}_m\sigma^m$ of σ^m, eq. (4) can be written as:

$(dA_m - l_{,m}dt + \omega_p^{\ 0}A^p{}_m) \wedge \sigma^m + (A_m - l_{.m})dt \wedge du^m = 0.$ (5)

This implies $A_m=l_{.m}$ and

$dl_{.m} - l_{,m}dt + \omega_p^{\ 0}A^p{}_m = C_{mi}\sigma^i, \qquad C_{mi}=C_{im}.$ (6)

We now proceed to obtain teleparallel natural liftings. Equation (6) becomes

$dl_{.m} - l_{,m}dt = 0.$ (7)

On curves, all differential forms are multiples of just one. We can divide symbolically by dt. The Euler-Lagrange equations thus emerge. Notice that our coordinates are totally arbitrary and the x^m's are, therefore, the q^m's. The Lagrangian thus emerges (up to constants) as a geometric concept, namely the time component of the square root of the "renormalized metric" modulo the natural lifting condition. The momentum, $l_{,m}$, has emerged simultaneously. Furthermore, under this condition, ds and ω^0 $(=ldt)$ are equal (to be replaced by the renormalized ds' and ω'^0 if we absorbed the torsion as indicated above). Since the Euler-Lagrange equations constitute the solution of a well-known extremal problem, equations (7) become the equations of the geodesics in the fictitious torsionless space-time. These extremals are the autoparallels of the original space-time with torsion from which the fictitious space-time was obtained.

We shall now obtain the integral invariant that defines classical mechanics. ω^0 can now be rewritten successively as

$ldt+l_{.m}(dq^m-u^m dt) = l_{.m}\, dq^m - dt[l_{.m}(d\,q^m/\,dt) - l].$ (8)

The Hamiltonian, $l_{.m}(d\,q^m/dt) - l$, has now emerged. With notation that reflects this emergence, we have:

$\omega'^0 = p_m\, dq^m - Hdt,$ (9)

and, therefore,

$d\omega'^0 = dp_m \wedge dq^m - dH \wedge dt,$ (10)

which shows that the integral invariants of mechanics derive from the differential invariants of geometry. If the full structure of Finslerian TP were involved, the absorption of the torsion into the metric would not been appropriate.

4.2 The Emergence of Electrodynamics: Part 1.

We now deal with the emergence of electrodynamics from geometry. The argument starts as before with the equation of motion, except that we do not absorb the torsion into $d\omega^0$. In the Ω^0 equation,

$\Omega^0 = d\omega^0 - \omega^r \wedge \omega_0^{\ r},$ (11)

we choose the symbols for the coefficients of the most general form of the zeroth component of the torsion as

$$\Omega^0 = - F_{\nu\lambda}(x^\mu, u^m)\, \sigma^\nu \wedge \sigma^\lambda + S_{\nu r}(x^\mu, u^m)\, \sigma^\nu \wedge du^r, \qquad (12)$$

where we further name F_{0i} as CE_i and $F_{jk}=-CB_i$ (i,j,k being any cyclic permutation of $1,2,3$). The right hand side of eq. (11) is now given by the left hand side of eq. (5), except that l now pertains to the true ω^0 of the space-time. We drop the S terms of the torsion (the equation of motion derived from the field equations might coincide with the autoparallels only in as limited range of distances thus excluding the strong interaction). The same argument as before now yields

$$dl_{.i}/dt \; - l_{,i} + C(E_i + B_k u^j - B_j u^k) = 0. \qquad (13)$$

The equation of motion of the previous subsection now contains the Lorentz force term. It is then clear that the R^0 part of the Finslerian torsion with S terms set equal to zero has to be identified, up to a constant, with the electromagnetic field. The factor C is to be viewed as a particle dependent if the geometry is to fit the physics. This is so since different charges see different effective torsions, as the particles are manifestations of the torsion of space-time where they are located. Second, the Ω^i's of the Finslerian formulation do not enter the equations of motion. Hence, do not need special torsions to obtain electrodynamics; any torsion will do provided that we represent it in sections of the Finsler bundle.

Consider next the first Bianchi identity. For simplicity, we consider it in the Finsler arena but without S terms. One gets:

$$R^\varphi{}_{\kappa\lambda;\eta} + R^\varphi{}_{\lambda\eta;\kappa} + R^\varphi{}_{\eta\kappa;\lambda} + R^\varphi{}_{\iota\lambda} R^\iota{}_{\eta\kappa} + R^\varphi{}_{\iota\eta} R^\iota{}_{\kappa\lambda} + R^\varphi{}_{\iota\kappa} R^\iota{}_{\lambda\eta} = 0. \qquad (14)$$

If we drop the quadratic terms (weak field approximation) and set $R^i{}_{\kappa\lambda}$ equal to zero, we obtain the homogeneous pair of Maxwell's equations for $\varphi = 0$, a universal proportionality constant remaining undefined. Lorentz invariance is not a problem since the inertial frames have simply been refibrated over the bundle of directions (as a differentiable manifold rather than as a bundle itself). Since $R^i{}_{\kappa\lambda}$ is to be associated with the $SO(3)$ symmetry implicit in the Finslerian refibration, it is tentatively identified with the weak interaction. The emergence of the inhomogeneous pair is a problem of a different nature and will later be dealt with.

4.3 The Emergence of General Relativity: Part 1.

Consider now the second equation of structure. Regardless of whether the connection is Finslerian or not, the statement that the affine curvature is zero can be written as

$$d\alpha_\mu{}^\nu - \alpha_\mu{}^\lambda \wedge \alpha_\lambda{}^\nu = - \beta_\mu{}^\lambda \wedge \beta_\lambda{}^\nu - (d\beta_\mu{}^\nu - \omega_\mu{}^\lambda \wedge \beta_\lambda{}^\nu - \beta_\mu{}^\lambda \wedge \omega_\lambda{}^\nu), \qquad (15)$$

where β is the contorsion. Its components are linear combinations of the components of the torsion. The "Einstein contraction" of the left hand side yields the Einstein tensor. Since β is assumed to comprise all non-gravitational interactions, the energy-momentum tensor of electrodynamics has to be pulled from the same contraction of the right hand side. This is a cumbersome process even if we restrict ourselves to the "00" component (Vargas-Torr, 1999). It is thus preferable to consider the vanishing of the affine curvature in the KK space, which we shall do later. The obtaining of a suitable electromagnetic energy-momentum distribution will constitute further evidence for the emergence of electrodynamics, in addition to the emergence of gravitation.

4.4 The Emergence of Dirac's Theory

Like classical mechanics, quantum mechanics (QM) is a phenomenological metatheory; it provides the essential framework to deal with different problems (more often than not, in microphysics). But the emergence of QM from our highly specialized Kähler equation comes accompanied by the emergence of the non-gravitational interactions themselves, directly from our new first equation of structure, to be introduced in the next section. In contrast, the input a in Kähler's original equation, $\partial\psi = a \vee \psi$ (when a is scalar-valued, $\vee$ simply means the Clifford product of scalar-valued differential forms), may represent arbitrary quantum mechanical systems, similarly to the representation of different classical systems by different Lagrangians.

As an intermediate step in the eventual emergence of Dirac's theory from demiurgism, we demonstrate the emergence of the Dirac theory from the Kähler theory using the example of the hydrogen atom (Kähler, 1961, 1962). Highlights of the 1961 treatment will now be summarized.

Let the signature be (-,+,+,+). We define the constant differentials

$$\varepsilon^{\pm} = \frac{1 \mp idt}{2}, \qquad \tau^{\pm} = \frac{1 \pm idx^1 \vee dx^2}{2}. \tag{17}$$

Suppose that the input differential form is scalar-valued, as is the case for the hydrogen atom. One can then show that the wave function can be written as

$$\psi = {}^{+}\psi^{+} \vee \tau^{+} \vee \varepsilon^{+} + {}^{+}\psi^{-} \vee \tau^{-} \vee \varepsilon^{+} + {}^{-}\psi^{+} \vee \tau^{+} \vee \varepsilon^{-} + {}^{-}\psi^{-} \vee \tau^{-} \vee \varepsilon^{-}, \tag{18}$$

where each of the four factors ${}^{\pm}\psi^{*}$ are differential forms which depend on $d\rho$ and dz, but not on dt and $d\phi$. They are uniquely defined by this expression, and are obtained through a process outlined by Kähler and valid for treating any ψ. One can show that each of the four terms in (18) is a solution of the same Kähler equation as ψ itself. Suppose now that a particular problem has cylindrical and time translation symmetries. Each of the solutions of the KD equation for given eigenvalues (m, E) of the $(-i\partial/\partial\phi,\ i\hbar\partial/\partial t)$ operators can be written in the form

$$e^{im\phi-(i/\hbar)Et}\ {}^{\pm}p^{*} \vee \tau^{*} \vee \varepsilon^{\pm}, \tag{19}$$

where each of the four ${}^{\pm}p^{*}$ is a function of the ρ and z coordinates and their differentials only. They satisfy the equation that results from substituting (19) in the Kähler equation $\partial\psi = a \vee \psi$. The four factors $e^{im\phi-(i/\hbar)Et}\ {}^{\pm}p^{*}$ are solutions of the Dirac equation for the same problem. For the hydrogen atom and up to universal constant factors, a is simply $\mu+(e/r)$, where μ is mass. In other cases, one will have to choose the input differential form for the Kähler equation in a way that parallels the choice of input for the same physical system when solved with the Dirac equation (standard techniques for solving can again be used). It is important to be aware of the fact that, when there are no symmetries, all five terms in eq. (18) are equivalent to each other and they live in a larger space than the solutions of the Dirac equation (sixteen instead of four complex components). With symmetries present, ψ becomes the sum of four independent solutions with four complex components each.

The Kähler equation lends itself easily to showing the emergence of the energy and angular momentum operators as Lie operators transforming one solution into another. A conservation law of probability is automatically build into KD equations for a differential form bilinear in the solution of a KK equation and of its conjugate. Antiparticles come automatically with positive energy, which makes a theory of holes unnecessary (it was deemed to be necessary before the advent of quantum field theory). Finally, the solution of the Kähler equation for the hydrogen atom is just a relatively simple extension of the obtaining of the strict harmonic differentials.

4.5 The Emergence of the Strong Interaction.

The presence of the strong interaction in the Kähler formalism is related to the aforementioned difference in number of components in the general case (meaning without symmetries) of the solutions of the Dirac and Kähler equations, the latter being considered in this section only for scalar-valued input differential form. This difference has to be put in the context of Schmeikal's (2002) representation of the generators (λ_1, ...λ_8) of *SU(3)* and the strangeness operators as Clifford numbers. The commutators are represented by antisymmetrized Clifford products of corresponding Clifford quantities in that representation. Schmeikal has further found a set of primitive idempotents related among themselves like the $\tau^{\pm}\nu\varepsilon^{*}$'s are, and such that, when the Clifford representations of λ_3, λ_8 and strangeness act on them, one gets the eigenvalues for up, down and strange quarks in the case of three out of those four idempotents, and zeroes for the fourth one.

It is possible to change the representation of *SU(3)* so that the four primitive idempotents are, for signature (-,+,+,+) precisely the primitive idempotents $\tau^{\pm}\nu\varepsilon^{*}$. Furthermore, it is possible to give an interpretation to why hadrons appear to be constituted in the way they do in high energy scattering experiments of leptons (Vargas-Torr, 2005a). From a demiurgic perspective, the reason is simply that the quantum mechanical equation of nature is not the Dirac equation, but the Kähler equation. The quarks are simply extremely good imitations of Dirac particles arising in high energy scattering experiments by particles which are solutions without symmetry of Kähler equations. The symmetry appears as an approximation in the scattering process, but only at very high energy. Confinement of quarks is an artifact resulting from trying to explain those processes in terms of the Dirac equation, when the more sophisticated Kähler equation should be used. An artifact does not cease to be an artifact just because it has structure. There is rich structure in approximating a solution of a quasi-symmetric Kähler equation with solutions of Dirac equations. Of course, one can always stretch the concept of reality to accommodate the wrongly interpreted experimental situation. It is more sensible, though, to formulate scattering theory consistently with the Kähler equation, rather than Dirac theory. That is part of the program of demiurgic TP.

5. Emergence from Demiurgism

The Einstein and Dirac equations emerge rather directly from corresponding and complementary curvature and torsion equations of demiurgism. Maxwell's equations emerge more indirectly than quantum mechanics from the same torsion equations. As in sections 4.1 and 4.2, we again have two different courses of action from the same starting point. But we have taken only minor steps in direct emergence from demiurgism. A first step consists in showing that the true nature of Maxwell's equations is not what is usually thought to be. This is so for two reasons, as we shall show in subsection 5.1.

In demiurgism, electromagnetic energy emerges at the same time as the Einstein equation, as reported in subsection 5.1. This should not be surprising. Maxwell's theory does not account for a fact pointed out by Cartan (1924, 2^{nd} paper in series on affine connections, Oeuvres Complètes) and ignored when using the tensor calculus that, whereas Maxwell's equations concern scalar-valued differential forms, energy-momentum equations (electrodynamic in particular) concern vector-valued differential forms. From a practical perspective, the theory of affine connections is theory of vector-valued quantities. Notice that the homogeneous pair of Maxwell equations was obtained from the first Bianchi identity of demiurgism. This identity should be shown to emerge from demiurgism. The treatment is as yet incomplete and, in any case, is too involved for consideration here.

5.1 Part II of Emergence of Electrodynamics and Gravitation

Cartan (1924, ibid) argued, and the present authors fully concur with him, that the integral and point form of Maxwell's equations are not equivalent, and that the first one is the right one. Kähler equations, and the Kähler equation of demiurgism in particular, are point equations. That makes for an unexpected difference. Let us now deal with an unexpected similarity. The torsion equation in demiurgism involves only the torsion field, i.e. the one that supersedes the electromagnetic field. Maxwell's equations involve, in addition to F, the current 3-form, j. Careful analysis shows, however, that current, or charge for that matter, is a practical rather than fundamental concept in Maxwell's electrodynamics. Better said, it may well be a very fundamental concept in a more developed physical paradigm, but that status is not justified by the present state of development of the same. For further clarification, let us remark that we deal with electrodynamics without knowing how the concept of charge applies at extremely short distances. We conjecture that the practical rather than fundamental nature of Maxwell's electrodynamics is the reason for the need for renormalization.

When we consider all sources explicitly, the Maxwell system is written as

$$\int \underline{\partial} F = \int j^*, \qquad (20)$$

where the asterisk stands for Hodge dual. We use the Kähler operator $\underline{\partial}$ (Vargas-Torr, 2005e). For our purposes, we need only consider static electric fields. Maxwell's homogeneous pair is contained in the exterior part of eq. (20), which then becomes

$$\int \Delta\varphi = -\int \rho \,. \qquad (21)$$

Let us integrate this equation for a charge that we do not know whether it is a point charge (equivalently, a divergent field) or whether it is simply localized over a very small volume (still finite fields). The Laplace equation is satisfied between two concentric spheres centered at the charge and enclosing it. We use Green's second identity with functions φ and $1/r$. One of the two volume integrals becomes zero because $\Delta(1/r)=0$. The other one becomes $\int(\rho/r)dv$ over the volume between the spheres. The two surface integrals become four, two for each sphere. When the external sphere is sent to infinity, the two surface integrals over it go to zero under appropriate conditions. One of the surface integrals over the small sphere (of radius ε) becomes $4\pi\varepsilon$ times the average value over the surface of the negative of the normal derivative of φ. If and only if φ is assumed to be finite, the latter integral goes to zero in the limit of ε going to zero. The other surface integral over the small sphere becomes 4π times the average value $\underline{\varphi}$ of φ over it, hence 4π times the value of φ at the center of the charge in the limit. If the charge is a point charge (the potential then being divergent), we let ε approach zero. The volume integral is zero, but the first surface integral is not. The second identity becomes an equation not involving the charge density, just the potential and its (normal) derivative. In this regard, it is actually like Kähler equations.

The fact that the theory of distributions deals rigorously with divergent charges does not change the fact that we do not know what happens at each and every point, but only at a distance from the elementary charges. That theory simply legitimizes the integration of the equation with point charges, regardless of whether elementary charges are of that type or not. In spite of this lack of knowledge, we still solve the equations as if it did not matter what are elementary charges like. Maxwell's equations are about averages. Equations dealing with integral are more sensible to deal with averages. The integrand can be wrong about the details, and the integral could still be right.

In the KK space, where the short range interactions are excluded ab initio, the Finslerian torsion for the electromagnetic interaction $\boldsymbol{\Omega}_{em}=\Omega^0 \boldsymbol{e}_0=-CF\boldsymbol{e}_0=-CF\boldsymbol{u}$ becomes $\aleph_{em}=-CF\boldsymbol{u}$. In this space, one also obtains (Vargas-Torr, 2005b) the equation of motion with Lorentz force when one computes the autoparallels in the KK space with this torsion (There are additional terms of a different nature, apparently related to radiation reaction, a problem which may thus admit a more elegant treatment than present ones).

Working with the reformulated first equation of structure

$$\underline{\partial}\aleph = \boldsymbol{u} \vee d\wp(\vee, \vee)\aleph \tag{22}$$

for the torsion $\aleph$ in the KK space canonically associated with demiurgic TP is very complicated. For instance, there are more terms in $\underline{\partial}(F\boldsymbol{u})$ than those resulting from application of the Leibnitz rule. We shall use a simplified expression for our illustration. Suppose that appropriate reductions made the equation (22) become, up to constants,

$$\partial F = A \vee F, \tag{23}$$

where A is the electromagnetic potential. In order to recover the homogeneous pair of Maxwell's equations, the 3-form part of the $A \vee F$ product would then have to be zero. The requirement is trivially satisfied since, in electrostatics, A is proportional to dr, and F is proportional to $dr \wedge dt$. If a KD equation becomes the Maxwell system, an additional conservation law emerges from it. In the rest frame of each individual charge, the Maxwell system expresses that the Laplace equation is satisfied all over, except inside the balls bounded by the tiny spheres referred to above. Denote the differential 3-form $A \vee F$ as j^*. We use $a \vee u=j^*$ instead of $A \vee F$ to emphasize from this point on that the argument does not depend on the specifics of the factors. We then have

$$j = (a \vee u)^* = (\underline{\partial} u)^* = z \vee (\underline{\partial} u), \tag{24}$$

z being the unit pseudo-scalar in the algebra of differential forms. Since z is a constant differential, we have:

$\partial j = \partial(z \vee (\partial u)) = z \vee (\partial\partial u)$. (25)

The operator $\partial\partial$ is the d'Alambertian $\Box$ (the Laplacian Δ in 3-space) if the affine curvature is zero, as we have assumed. Outside the tiny balls, u (respectively Δu) is zero. We thus have

$\partial j = z \vee \Box u = 0$. (26)

The conservation of charge is thus tied to the existence of solutions of equation (22) such that $\boldsymbol{u} \vee d\wp(\vee, \vee)d(d\wp)$ is zero, or very close to being zero, outside some very loosely defined tiny balls centered at each charge.

The strict limitations of using the Finslerian formalism (or perhaps just the rules to work with it given the entanglement of the different interactions) are not yet clear. It is thus interesting to consider the emergence of GR also in the KK space. One again obtains a geometrized version of Einstein's equations

$\boldsymbol{G} + \boldsymbol{T} = d\boldsymbol{\lambda}$, (27)

when one uses $\aleph_{em}$=$-CF\boldsymbol{u}$. Interestingly, the Einstein tensor $\boldsymbol{G}$ and the standard electromagnetic energy-momentum tensors emerge as bivector-valued differential forms (Vargas-Torr, 2005b), like in the publications by Cartan (1923 and 1924, papers on the theory of affine connections, Oeuvres Complètes) when he deals with a KK space in disguise There is an interesting discrepancy by a factor of ½ in one of the two terms that constitute $\boldsymbol{T}$ in terms of the $F_{\mu\nu}$. This is not a source of concern at all. Thanks to the fact that the standard dynamics of particles has been reproduced, one could reach in principle the standard expression of energy-momentum (i.e. without this discrepant factor) in an inductive way, like in many presentations of electrodynamics. Hence, rather than a problem, we might have here the potential key to the relation of interaction energy and self-energy. Furthermore, $d\lambda$ is a complementary energy momentum tensor, also electrodynamic, which has the property that its integral over all of space is 0, since it is an exact differential. Like any such terms, it has gravitational consequences, but which are systematically ignored by books which resort to them to modify energy-momentum tensors. Finally, $\boldsymbol{G}$ appears to emerge as the gravitational energy-momentum tensor, probably up to some constant. To conclude, it can hardly be said that we have proved reductionism of Maxwell's electrodynamics from the KD equation of demiurgism (the reduction from classical geometry is better documented). It is fair to say, however, that we have started a sophisticated program with incalculable potential.

5.2 The Emergence of the Standard Quantum Formalism

The final goal is emergence of physics from demiurgism. Emergence of physics from geometry or from the Kähler equation is an intermediate step, to be followed by emergence of geometry from demiurgism where one cannot yet achieve that final goal directly. .

We proceed with first steps in relating equation (22) with $\aleph_{em}$=$-F\boldsymbol{u}$ to the first Bianchi identity, which now constitutes part of the new vision of the first equation of structure. We first dispose of an issue pertaining to non-scalar-valued input differential forms. The Kähler derivative of a differential form ($\aleph$) does not change its valuedness, but its product with a non-scalar-valued differential form ($\boldsymbol{u} \vee d\wp$) does. This causes inhomogeneous valuedness of the wave function, unlike that of the torsion. This problem disappears in eq. (28) with $\aleph_{em}= -Fu$ since the trivector part of the right hand side vanishes due to the double factor u.

Our reductionist problem is now reduced to showing how the first equation of structure of the KK space, $\underline{\partial}\aleph = \hat{a} \vee \aleph$, with $\hat{a}$ equal to $u \vee d\wp$, reduces to specific Kähler equations in different cases, like for the hydrogen atom. The solving of problems such as this has not yet been undertaken. The feasibility of solving them, however, can be foretold from the form of the input differential form $u \vee d\wp$ in the first equation of structure of the KK space. Recall that $d\wp$ is the potential of the torsion $\aleph$ and that, in the electromagnetic case, we have $\aleph_{em}=-CFu$. The mass term μ in $\mu+eA$ would be associated with the term $ud\tau$ in $d\wp$. It is worth pointing out that the position of the unit imaginary in Kähler is not the same as in the Dirac, which provides perspective on the fact that there is no unit imaginary in the Kähler equation that constitutes the first equation of structure in the KK space. Stationary cases would correspond to absence of radiation, associated in this formalism with constant u. Since the square of u is -1, this vector will apparently play the role of the unit imaginary.

At present, the emergence of the weak interaction is the most tenuous of all. As shown in subsections 4.1 and 4.2, the effect of a Finslerian torsion on the equations of the autoparallels is given exclusively by its temporal component. It is not clear at this point whether, in the reformulation of the electromagnetic torsion pertaining to the KK formalism, the group $O(3)$ acting among the spatial components of that torsion is absent (and has to emerge or be introduced somehow) or remains in the spatial components of space-time. The first option would appear as the more likely one, since the KK space is defined by $(\omega^{\mu}, \omega_0^{i})$ only. Since the ω_i^{j} are the (left) invariant forms of the rotation group, the original set $(\omega^{\mu}, \omega_0^{i}, \omega_i^{j})$ of invariants may be expected to give rise to a product structure of the KK space by the group $O(3)$ or $SO(3)$. On the other hand, the justification for the second option would be that the rotational degree of freedom remains in the spatial part of the torsion; it is only the latter's temporal part that has migrated to the fifth dimension in changing from the Finslerian to the KK versions of the theory. Regardless of what version is the appropriate one, an $SU(2)$ symmetry will be associated with the original ω_i^{j}. The group $SU(2)$ acts on the wave function when $SO(3)$ acts on the other factors in equations such as Dirac's and Kähler's. This has to do with the form of rotations in Clifford algebra and the position of the wave function as the extreme right hand side factor on both sides of those equations. In due time, we hope to get our cues from the physics as to how to incorporate the weak interaction if we fail to see how mathematical structure speaks of this issue.

6. Anticipation: Integrability and Initial Conditions

Anticipatory systems are defined as systems for which the present behavior is based on past and/or present events but also on future events built from these past, present and future events (Dubois, 2000). In demiurgism all systems are emergent, and the theory itself is nothing but the program in the making of showing emergence to ever greater degree of sophistication. The issue emerges of whether one can formulate a concept of anticipation that will apply, even in loose form, to the basic equations themselves of demiurgism. We shall only make observations about integration of our differential system, which may help those who could speak more authoritatively on this issue.

Differential systems raise issues of integrability and of initial conditions. Let us start with the second of these two issues. Anticipation does not have the same character as in the physics, since the latter is emergent and its equations have parameters. These implicitly define final states and, together with initial conditions, define the solution to specific problems (Dubois, 2000). There are no parameters in demiurgism. Initial conditions is all one has.

However, the state of the future is still present in the evolution of some physical system, i.e. a subsystem of the world. Indeed, suppose we launch initial conditions at one point. Somebody else launches initial conditions somewhere else. As the solutions launched from each of the two points affect further and further points, they eventually either meet or clash. How do we make them compatible unless we already know the solution itself that we wish to obtain using those initial conditions? One might argue that nature guarantees their compatibility, if we read properly the initial conditions at each of the two points. But this presumes that nature behaves in a way that is not guaranteed and that we proceed to explain.

Consider GR. The initial conditions for the Einstein system (barring simplifications when there are symmetries, which amounts to anticipating in part the solution) consist in specifying the metric at all points of a space-like hypersurface. After we obtain the metric by integration, we know the full metric curvature and not just the Einstein tensor. The extra information is contained in the boundary conditions. If the system to be integrated were to specify the full curvature, initial conditions at a point would suffice.

The system of equations of the torsion sector in demiurgism is more like the system of equations of electrodynamics (with added complexities, one of them being that one has to solve for the metric at the same time as for the connection). That system specifies the exterior and interior *derivatives of the torsion field*, not like the Einstein system which specifies (a contraction of) *the curvature field itself*. Furthermore, because we are not dealing with a contraction, the initial condition concerns a space-time point in demiurgism. But every point is a source of solutions and different solutions will not match, virtually anywhere. Such is the case with Maxwell's electrodynamics, where one broadcasts from different points (sources). Since solutions in electrodynamics can be superimposed (and, correspondingly, syntonized), no compatibility issue arises. In demiurgism, however, there is not linearity, and every point may have to be considered in principle as source for launching initial conditions. This is an infinitely more dense set of sources than in electrodynamics, where the sources are systems not points. It is impossible to solve the problem until one knows the solution everywhere at one point in time, like in GR. It then appears that we have clashing rather than meeting of solutions.

The validity of what has been said above will certainly be impacted (and in different ways for different statements) by the first issue of whether the system is integrable or not. Non integrability does not totally mean that the system cannot be integrated. Let us explain. Consider a differential 1-form which is not exact. This is to say that it is not the exterior derivative of a function, i.e. it does not admit a potential function. This does not mean that we cannot integrate it between any two points, like the differential forms for work and heat. We can, but the result will depend on curve chosen for the integration. There is the same type of basic idea in our foregoing considerations about the non matching of the solutions obtained by launching initial conditions from two different points. We suspect that the general theory of integrability of exterior systems (every differential system can be given the exterior form) is not sufficiently advanced for one to be able to pronounce itself clearly on this particular problem at this point. It is not unreasonable to infer that, like in electrodynamics, there will be a stochastic background, but more chaotic. A minor change in the background of solutions that Muraskin named packet solution may result in chaotic looking behavior (Muraskin, 1995, pp. 125-6) due to the influence of some other comparable structure. This adds complexity to an already unfathomable space of solutions.

7. Concluding Remarks.

In the span of just two papers, we have presented a comprehensive picture of demiurgic TP. At the very least, it shows that pure thought allows one to make physics emerge from something more fundamental, unless we redefine physics to include it. The main usefulness of the more fundamental equations does not lie in that one can solve its equations. One cannot in general, except perhaps for "robust structures", say leptons, protons and photons; and also for short lived particles at the level of characterizing them by a set of eigenvalues of certain operators that emerge from the theory. Concerning physics, the usefulness of demiurgic TP additional to solving equations lies in the possibility of theoretical emergence of physical theories and concomitant physical concepts. What was shown in previous sections constitutes the first baby steps. In the wide sense of the term physics, this is not the end of physics. It is the beginning.

It has been claimed ab initio by some that, because of the anticipation issue, we cannot be just physics and (as usually put) chemistry. Dubois work' is an antidote against that view. But even if physics were not capable ab initio of "explaining" the behavior of thinking organisms, this might be a failure of present day physics to be the starting point in the reductionist chain. As physical systems and physical laws emerge from demiurgism, so may do in principle systems endowed with greater levels of complexity. If physics is taken as the first step in the ladder of natural sciences, one risks the possibility of excluding the type of reductionism that may require the coexistence for the living system of indirect reductionist elements, through physics and chemistry, with direct reduction elements, directly from demiurgism.

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