Objection to False Claims
Used against Evans' Field Theory

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These remarks cannot undo eventual formal errors. However, one should not argue with false claims, that let appear Evans' theory, called ECE, [1] in a false light. This article refers to Hehl's "An assessment of Evans' unified field theory" [2,3]. Let us quote from [2][1]:

Electrodynamics has nothing to do with the geometry of spacetime

In gravity the experimentally well established equality of inertial and gravitational mass $m_{\mathrm{in}} = m_{\mathrm{gr}}$ is a fundamental feature. It is the basis of Einstein's equivalence principle and of a *geometric* interpretation of gravity in the framework of general relativity. The *universality* of this feature is decisive. Since there is no physical object without energy-momentum, the equivalence principle applies equally well to all of them, without any known exception.

Is there a similar physical effect known in electromagnetism? No, not to my knowledge. Rather, the decisive features of electromagnetism are electric charge and magnetic flux conservation (yielding the Maxwell equations [38][2]). And these conservation laws have nothing to do with spacetime symmetries, whereas energy-momentum, the source

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[1]Quotations have been copied from file AssessI06.tex, fwh.
[2]Item of Hehl's references

in Einstein's gravitational theory, is related, via Noether's theorem, to *translations* in spacetime. In the Maxwell-Dirac theory (Maxwell's theory with a Dirac electron as source), electric charge conservation emerges due to the $U(1)$ phase (gauge) invariance of the theory, that is, due to an *internal* symmetry (unrelated to external, i.e., spacetime symmetries). Moreover, charge conservation is universally valid. However, it has nothing to say about electrically and magnetically *neutral* matter, as, e.g., the neutrinos $\nu_{\mathrm{e}}, \nu_{\mu}, \nu_{\tau}$, the photon γ, the gauge boson Z, the neutral pion π^0, etc.

Evans provides *no new insight* into this question. His only argument is that any ansatz (like his $\mathcal{A}^{\alpha} = a_0 \vartheta^{\alpha}$) must be permitted and only experiments can decide on its validity. However, Evans' ansatz $\mathcal{A}^{\alpha} = a_0 \vartheta^{\alpha}$ *presupposes* that electromagnetism, like the coframe ϑ^{α}, is a universal phenomenon, which it isn't, since neutral matter is exempt from it. The lack of universality of electromagnetism makes its geometrization a futile undertaking.

This argument is sufficient for me to exclude Evans' theory right from the beginning. However, some people, like Evans himself, don't find it so convincing.

This is no matter of conviction, it is matter of fact. First, it is fact that already the electrovacuum involves pure RIEMANNian geometry. One can immediately see it from (normalized) equations approvedly valid for the electrovacuum

$$R_{ik} = \frac{1}{4} \, g_{ik} F_{ab} F^{ab} - F_{ia} F_k{}^a \qquad , \qquad (1)$$

$$F_{ij,k} + F_{jk,i} + F_{ki,j} = 0 \qquad , \qquad (2)$$

$$F^{ia}{}_{;a} = 0 \qquad . \qquad (3)$$

It is already derived in [4] and quoted in [5]. An English-language article focussed to the derivation can be found in [6]. Also, it is shown in [7] that the electromagnetic field tensor is a curve parameter of the world-lines, like the curvature vector (see EISENHART [8])

$$k^i = \frac{\mathrm{d}x^a}{\mathrm{d}s} \, (\frac{\mathrm{d}x^i}{\mathrm{d}s})_{;a} = \frac{\mathrm{d}^2 x^i}{\mathrm{d}s^2} + \{ {}_a{}^i{}_b \} \, \frac{\mathrm{d}x^a}{\mathrm{d}s} \frac{\mathrm{d}x^b}{\mathrm{d}s} \qquad , \qquad (4)$$

that contains both acceleration and gravitation.

By this, the lack of an electromagnetic counterpart to the equivalence principle does not give reasons for HEHL's claim. The curvature vector is the most simple interpretation of the equivalence principle. Electromagnetism is indeed a universal phenomenon, as EVANS "presupposes".

HEHL mentions gauge theories. Are these relevant at all ? With equ. (2), one can represent the field tensor by an electromagnetic vector potential

$$F_{ik} = A_{i,k} - A_{k,i} \qquad . \tag{5}$$

The six independent components of the field tensor are reduced to four components of the vector potential. That is useful to solve equations (1) to (3). Nevertheless, *the vector potential is only an auxiliary quantity.* It is physically irrelevant, also for more practical reasons:

One may take the voltage as difference of two electric potential values. But that is a crutch. The voltage is physically the fixed integral of the electric field strength from one measuring point to the other measuring point. It is analogous with the magnetic vector potential. Quite a few take the AHARONOV-BOHM effect as evidence for the physical relevance of vector potential and gauge. BRUHN [9] has demonstrated that the behaviour of the test electrons is exclusively decided by the magnetic flux.

If EVANS postulates the electromagnetic vector potential as a gauge-invariant non-RIEMANNian quantity, he does nothing worse than mainstream. EVANS claims the unification with the assumption that ECE shares all predictions from all approved theories.

How to interprete sources, i.e. charges, currents, masses, momenta ?

The one way, the Geometric theory of fields, is based on the facts that the electrovacuum is purely RIEMANNian geometrical, and that mass, spin, charge, magnetic momentum are integration constants from equ. (1,3,5). This way is supported by results from numerical simulations according to these tensor equations [10].

EVANS chose the other way defining the sources as non-RIEMANNian quantities, but nevertheless based on geometry. Criticizing this step means

criticizing CARTAN. HEHL has to remark:

> Cartan did *not* develop a corresponding electromagnetic theory. In fact, in the same papers [14], he linked, within a consistent theoretical framework, torsion to the spin of matter. He laid the groundwork to what we call nowadays the EC-theory of gravity [1,35,68]. This excludes the mentioned identification of a piece of the torsion with the electromagnetic potential.

> Later Eyraud [29] and Infeld [45] and, more recently, Horie [44] tried to link torsion to the electromagnetic field. But these attempts did lead to nowhere. For more details, one may consult Tonnelat [66] and Goenner [31].

May be, EVANS' attempts lead to more ?

But it is definitively false to link the torsion to the spin of matter directly. May be that EVANS has been confused by this false step.

Spin of matter is defined from rotating mass (dependent on radius) already in classical mechanics. With it, mass *and* spin go into General relativity (GR).[3] HEHL tells (see first quotation): "... the source in Einstein's gravitational theory, is related, via Noether's theorem, to *translations* in spacetime." - Who is right now, NOETHER or CARTAN ?

Just the last paragraphs demonstrate, as problematical the interpretation of sources is. The solution cannot consist in a statement like "This argument is sufficient for me to exclude Evans' theory right from the beginning". Only a consistent alternative provides a clean solution. This alternative can only consist in renouncing sources.

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[3]See [4] how to calculate it.

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