1)

APPENDIX 12

THE FOUR FUNDAMENTAL LAWS OF ELECTRODYNAMICS IN THE UNIFIED FIELD THEORY: VECTOR NOTATION

The Inhomogeneous Laws

These are obtained from:

$$\partial_\mu F^{a\mu\nu} = \mu_0 c J^{a\nu} \qquad -(1)$$

where:

$$J^{a\nu} = -\frac{A^{(0)}}{\mu_0}\left(q^b_\mu \tilde{R}^a{}_b{}^{\mu\nu} + \omega^a_{\mu b}\tilde{T}^{b\mu\nu}\right) \qquad -(2)$$

Coulomb Law ($\nu = 0$, $\mu = 1, 2, 3$)

The charge density is:

$$J^{a0} = -\frac{A^{(0)}}{\mu_0}\left(q^b_1 \tilde{R}^0{}_b{}^{10} + q^b_2 \tilde{R}^0{}_b{}^{20} + q^b_3 \tilde{R}^0{}_b{}^{30} + \omega^0_{1b}\tilde{T}^{b10} + \omega^0_{2b}\tilde{T}^{b20} + \omega^0_{3b}\tilde{T}^{b30}\right) \qquad -(3)$$

so

$$\boxed{\underline{\nabla} \cdot \underline{E}^a = \frac{\rho^a}{\epsilon_0} = \mu_0 c J^{a0}} \qquad -(4)$$

It is seen that charge density originates in the geometry of spacetime. Therefore if gravitation changes spacetime it has an effect on the charge density. This is a direct result of differential geometry.

2) Ampère Maxwell Law ($\nu = 1, 2, 3$)

For $\nu = 1$, $\mu = 0, 2, 3$

$$J_x^a = J^{a1} = -\frac{A^{(0)}}{\mu_0}\left(q_0^b \tilde{R}^a{}_b{}^{01} + q_2^b \tilde{R}^a{}_b{}^{21} + q_3^b \tilde{R}^a{}_b{}^{31} + \omega^a{}_{0b}\tilde{T}^{b01} + \omega^a{}_{2b}\tilde{T}^{b21} + \omega^a{}_{3b}\tilde{T}^{b31}\right) \quad -(5)$$

For $\nu = 2$, $\mu = 0, 1, 3$

$$J_y^a = J^{a2} = -\frac{A^{(0)}}{\mu_0}\left(q_0^b \tilde{R}^a{}_b{}^{02} + q_1^b \tilde{R}^a{}_b{}^{12} + q_3^b \tilde{R}^a{}_b{}^{32} + \omega^a{}_{0b}\tilde{T}^{b02} + \omega^a{}_{1b}\tilde{T}^{b12} + \omega^a{}_{3b}\tilde{T}^{b32}\right) \quad -(6)$$

For $= 3$, $\mu = 0, 1, 2$

$$J_z^a = J^{a3} = -\frac{A^{(0)}}{\mu_0}\left(q_0^b \tilde{R}^a{}_b{}^{03} + q_1^b \tilde{R}^a{}_b{}^{13} + q_2^b \tilde{R}^a{}_b{}^{23} + \omega^a{}_{0b}\tilde{T}^{b03} + \omega^a{}_{1b}\tilde{T}^{b13} + \omega^a{}_{2b}\tilde{T}^{b23}\right) \quad -(7)$$

Thus:

$$\boxed{\underline{\nabla} \times \underline{B}^a = \frac{1}{c^2}\frac{\partial \underline{E}^a}{\partial t} + \mu_0 \underline{J}^a} \quad -(8)$$

in which the scalar elements of current are given in eqns. (5) to (7).

i)

The Gauss Law of Magnetism

For all practical purposes:

$$\boxed{\underline{\nabla} \cdot \underline{B}^{a} = 0} \qquad -(9)$$

The Faraday Law of Induction

For all practical purposes:

$$\boxed{\underline{\nabla} \times \underline{E}^{a} + \frac{\partial \underline{B}^{a}}{\partial t} = \underline{0}} \qquad -(10)$$

If we take into consideration the very tiny homogeneous current then:

$$j^{a\mu} = -\frac{A^{(0)}}{\mu_0}\left(q V_{\mu}^{b} R^{a}{}_{b}{}^{\mu\nu} + \omega^{a}{}_{\mu b} T^{b\mu\nu}\right) \qquad -(11)$$

$$\sim 0$$

and very tiny terms appear on the right hand sides of eqns. (9) and (10).