CHAPTER SIX

ANTI SYMMETRY

The concept of anti symmetry pervades ECE theory, and manifests itself in several important ways. The theory is based on differential forms that are anti symmetric {1 - 11} by definition, notably the torsion form. This is a vector valued two form of differential geometry, and in another language is an anti symmetric tensor with an upper a index signalling the fact that electromagnetism in ECE theory has a fundamentally different geometry that is more complete than that of the Maxwell Heaviside theory. As explained in chapter one, the first and second Cartan Maurer structure equations define the anti symmetric torsion form and the anti symmetric curvature form, a tensor valued two form of differential geometry. In a way, the entire ECE theory is anti symmetric from the basics of geometry.

The fundamentally important achievement of Cartan geometry is to reduce everything to two fundamental objects, the torsion and curvature, which are defined in terms of the tetrad and the spin connection in a very simple way. The great elegance of the Cartan geometry is that it reduces very complicated vector and tensor equations to simple form equations. However this mathematical elegance can only be achieved at the expense of abstraction, as is always the case in mathematics. However abstract a mathematical theory, it must always reduce to well known but less elegant mathematics. If it does not, or is not comprehensible, it is either self inconsistent or effectively useless in natural philosophy. The less elegant vector format of the Cartan structure equations has proven to be the most useful in the foregoing chapters, but the structure equations show that everything is anti symmetric.

The reason for this is that the structure equations, when translated into tensorial language, are defined by the commutator of covariant derivatives. It is important to note that the structure equations are precisely the same fundamental definitions of geometry in all notations: differential form, tensor and vector. As explained already in this book the commutator is anti symmetric by definition. It is loosely referred to as a round trip in a mathematical space of any dimension. This round trip, or return journey, defines the two structure equations of Cartan and Maurer in an elegant way and shows that the two structure equations are not independent, they are always linked by the commutator. This very fundamental property of mathematics can be looked upon, loosely writing, as a reason for the existence of the Cartan identity and the Evans identity of differential geometry. So the commutator is the "most fundamental" object in geometry. It was unknown to pioneers such as Riemann, Christoffel, Ricci, Levi-Civita and Bianchi, otherwise they would have inferred torsion, (which they obviously did not), and would have realized that the Christoffel connection is anti symmetric from the most fundamental type of reasoning in mathematics. This realization is the key to the anti symmetry laws of ECE theory developed in this chapter. They are powerful laws that refute the Maxwell Heaviside (MH) theory immediately, showing that the MH theory is lacking in information and is self insufficent and inconsistent. This is a major advance in electromagnetism that was fully realized in UFT 130 ff. on www.aias.us . It is not clear whether Cartan and Maurer inferred the commutator, it may be present in their work, but it is not made clear. The commutator is present in Lie algebra however, and is a fundamental concept there. To chemists its most well known manifestation is the commutator of Pauli matrices which gives another Pauli matrix, defining the SU(2) basis used by Dirac.

The famous role of Albert Einstein in all this was to propose that non Euclidean geometry is needed for the theory of gravitation. He finally decided in a paper published in late 1915 to use the second Bianchi identity known to him. Naturally this was the second Bianchi identity without torsion, torsion was unknown in 1915. The UFT paper 88 published about six or seven years ago has been influential in showing that the second Bianchi identity as used by Einstein is incorrect, so the Einsteinian era is over and we are entering into a post

Einsteinian era of thought. One cannot make a howler in mathematics, however well intentioned, and expect to get away with it for a century - unless of course one is Einstein, who cannot be wrong. This is very familiar - human nature as distinct from nature, and human nature is almost always wrong. So people are still busy proving the precision of the Einstein theory knowing full well that it collapsed completely almost sixty years ago when the velocity curve of a whirlpool galaxy was discovered experimentally. They are dogmatists because they ignore nature, they are not Baconian scientists.

In historical fact, which is always brushed aside by dogmatists, Einstein did not get away with it at all, he was criticised severely by Schwarzschild in December 1915 in a letter which is now online and easily googled up, placed there by A. A. Vankov as discussed already in this book. Vankov has pointed out many more errors in the 1915 paper of Einstein, but UFT 88 destroyed his theory completely and replaced it with the correct second Bianchi identity. UFT88 has been studied several thousand times in about six years without any objection. So one would not like to be a dogmatist any more. If Bianchi had had the commutator at his disposal he would have inferred torsion, being the clear minded mathematician that he was. All the details of the calculation are given in UFT 99, again a heavily studied paper, again without a single objection. After Schwarzschild's untimely demise in 1916 there was a free for all, the main critic was gone. However, Bauer and Schroedinger noted independently in 1918 that something was drastically wrong with the Einstein field equation. They were brushed aside by human nature, and the world was told that Eddington had proven general relativity. The world did not know about torsion, or in fact anything about general relativity. Eddington did not have anywhere approaching the precision to prove anything. Almost a century later people are still trying to prove that light bending is twice the Newtonian value, and their experiments are still being criticised. The critics are still being brushed aside. This chant of "twice the Newtonian value" is reminiscent of Golding's

"Lord of the Flies". It is a ritual like any other. The data may or may not be precise but do not prove a mathematical howler. They can be investigated however with the post Einsteinian ECE theory and we can do our best to make sense of them. That is Baconian science.

Cartan inferred his elegant geometry in the early twenties, in the middle of the golden era of physics when profound discoveries had become commonplace. The only thing known about geometry at this time, when Einstein suddenly became famous, was that the curvature is anti symmetric in its last two indices. To the general public this meant absolutely nothing, but the same general public regarded Einstein as an Idol of the Cave. This is a metaphor, no disrespect to Einstein, who must have been intensely irritated by his new found fame, especially as he was being harassed by a bee - Elie Cartan - more irritating than any fly. Cartan had written to Einstein in the most respectful terms pointing out that Einstein's geometry had half of it missing. It contained curvature but no torsion, two wheels on the wagon, which was listing badly and about to sink. There ensued a correspondence known only to a tiny group of scholars. It was always a polite correspondence which made Einstein fully aware of torsion but the latter was not incorporated into the theory of general relativity.

There is little purpose in going in to the details of this correspondence because it was carried out at a time when the action of the commutator on a vector was not clear. The relevant contemporary equation was given in chapter one and is recounted here for ease of reference:

$$[D_\mu, D_\nu] V^\rho = R^\rho{}_{\mu\nu\sigma} V^\sigma - T^\lambda{}_{\mu\nu} D_\lambda V^\rho \quad -(1)$$

Here $T^\lambda{}_{\mu\nu}$ is the torsion in tensor format {1 - 11} and $R^\rho{}_{\mu\nu\sigma}$ is the curvature in tensor format. This equation is the essence of anti symmetry in ECE theory. The commutator acts on a vector V^ρ in any dimension in any mathematical space. It is made up of the covariant derivatives defined by Christoffel in the eighteen sixties:

$$D_\mu V^\nu = \partial_\mu V^\nu + \Gamma^\nu_{\mu\lambda} V^\lambda \quad -(2)$$

using the Christoffel connection $\Gamma^\nu_{\mu\lambda}$. It is the geometrical connection that makes the space different from that of Euclid, two thousand plus years ago. The commutator formalism is valid in n dimensions, while Euclid thought in three dimensions, without a geometrical connection.

The first thing to notice is that the commutator always produces the torsion and curvature at the same time. It makes no sense to throw away the torsion. This arbitrary procedure is equivalent to throwing away one of the Cartan structure equations. No expert in differential geometry would do that, only dogmatic physicists. Unfortunately, the curvature was known before Eq. (1) was known. The early pioneers of geometry had guessed and got it wrong, they had guessed that geometry could be described by curvature and nothing else. This guess is entirely excusable, it is how knowledge works, but it is entirely inexcusable to go on ignoring torsion once it is known. This is exactly what happened in twentieth century relativity. The latter fell flat on its face when the velocity curve of a whirlpool galaxy was discovered in about 1958.

The second thing to notice is that when the connection is made zero, or removed, the commutator of ordinary derivatives is zero:

$$[\partial_\mu, \partial_\nu] V^\rho = 0 \quad -(3)$$

and this is a fundamental property of a space without a geometrical connection. In three dimensions such a space is that of Euclid. It has no torsion and no curvature. Notice that the curvature and torsion both vanish. It is not possible for one to exist and the other not to exist. It is becoming clear that the commutator is an elegant object of thought, it produces non Euclidean geometry and shows that this type of geometry is always described by only two types of tensor, the torsion and curvature, and that both always coexist. They both vanish in Euclidean geometry and more generally in an n dimensional space with no connection.

The most important thing to notice is that a commutator of any kind is always anti symmetric. In the case of covariant derivatives it is defined from the most fundamental principles of geometry as:

$$[D_\mu, D_\nu] V^\rho = D_\mu (D_\nu V^\rho) - D_\nu (D_\mu V^\rho) \quad -(4)$$

so interchanging mu and nu produces the opposite sign. This is what is meant by anti symmetry. Any object with subscripts mu and nu changes sign under the action of the commutator. So it is entirely obvious and long accepted that torsion and curvature are anti symmetric:

$$T^\lambda{}_{\mu\nu} = - T^\lambda{}_{\nu\mu}, \quad -(5)$$

$$R^\rho{}_{\mu\nu\sigma} = - R^\rho{}_{\mu\sigma\nu} \quad -(6)$$

If these tensors were not anti symmetric, the commutator method could not be used, and the Cartan Maurer structure equations would not valid. In the ninety years since they were proposed, they have never been refuted logically.

The torsion tensor has been defined for ninety years by:

$$T^\lambda{}_{\mu\nu} = \Gamma^\lambda{}_{\mu\nu} - \Gamma^\lambda{}_{\nu\mu} \quad -(7)$$

and is the difference of two Christoffel connections. In the second connection mu and nu are reversed. So the action of the commutator is:

$$[D_\mu, D_\nu] V^\rho = -\Gamma^\lambda_{\mu\nu} D_\lambda V^\rho + \ldots\ldots \quad -(8)$$

This equation has been written in such a way as to show that there is a one to one correspondence between the commutator indices, mu and nu, and the indices mu and nu of the connection. The commutator is antisymmetric by definition, so the connection is anti symmetric from the most fundamental principles of non Euclidean geometry:

$$\Gamma^\lambda_{\mu\nu} = -\Gamma^\lambda_{\nu\mu} \quad -(9)$$

This entirely obvious result refutes the Einsteinian general relativity immediately, so although logical to geometry it is terminally dangerous to foggy dogma or fogma. The truth is always dangerous and exciting. Argument is vulgar and often convincing.

In the development of early non Euclidean geometry the metric was inferred first by Riemann, then the connection by Christoffel, then the curvature by Ricci and Levi Civita and finally the identities known after Bianchi. This took about forty years, from the eighteen sixties to about 1902. These developments did not use the commutator, so there was no way of knowing the symmetry of the lower two indices of the connection. It could be inferred only that the connection was a matrix for each upper index λ. Clearly this pure mathematical development never considered physics, so no fact of nature was used to try to determine the symmetry of the connection. For each λ the connection is a matrix in mu and nu. A matrix in general has no symmetry, it is therefore described as asymmetric. The only thing that can be inferred logically is that the Christoffel connection is asymmetric. It is the sum of symmetric and anti symmetric components, as for any matrix. However, the commutator always produces the anti symmetric part of the connection, and at the same time produces the anti symmetric torsion and anti symmetric curvature and at the same time produces the first and second Cartan Maurer structure equations. So the entire Cartan geometry uses an anti symmetric connection and the entire Cartan geomerty is produced by the commutator. This is the essence of this chapter.

The fogma of the twentieth century ignored the commutator and asserted that Christoffel had somehow managed to prove that the connection is symmetric. If the connection is symmetric, the commutator is symmetric and vanishes. The torsion and curvature vanish, and with them the structure equations of Cartan and Maurer. So the fogma led to the darkest recesses of Plato's Cave, and we are emerging in to the light with ECE theory.

6.1. APPLICATION OF ANTI SYMMETRY TO ELECTRODYNAMICS.

produces the anti symmetric torsion and anti symmetric curvature and at the same time produces the first and second Cartan Maurer structure equations. So the entire Cartan geometry uses an anti symmetric connection and the entire Cartan geomerty is produced by the commutator. This is the essence of this chapter.

The fogma of the twentieth century ignored the commutator and asserted that Christoffel had somehow managed to prove that the connection is symmetric. If the connection is symmetric, the commutator is symmetric and vanishes. The torsion and curvature vanish, and with them the structure equations of Cartan and Maurer. So the fogma led to the darkest recesses of Plato's Cave, and we are emerging in to the light with ECE theory.

6.1. APPLICATION OF ANTI SYMMETRY TO ELECTRODYNAMICS.

On the U(1) level used in the standard model the commutator of covariant derivatives acts on the gauge field {1 - 10, 13} ϕ as follows:

$$[D_\mu, D_\nu]\phi = -ig[\partial_\mu, A_\nu]\phi \quad -(10)$$

where g is a constant and where A_ν is the four potential on the U(1) level. Now let:

$$\mu \rightarrow \nu, \quad \nu \rightarrow \mu \quad -(11)$$

then by definition:

$$[D_\mu, D_\nu]\phi = -[D_\nu, D_\mu]\phi. \quad -(12)$$

The commutator is expanded with the Leibnitz Theorem as follows:

$$\begin{aligned}[\partial_\mu, D_\nu]\phi &= \partial_\mu(A_\nu\phi) - A_\nu(\partial_\mu\phi) \\ &= (\partial_\mu A_\nu)\phi + A_\nu(\partial_\mu\phi) - A_\nu(\partial_\mu\phi) \\ &= (\partial_\mu A_\nu)\phi \end{aligned} \quad -(13)$$

Therefore:

$$[\partial_\mu, A_\nu]\phi = (\partial_\mu A_\nu)\phi \quad -(14)$$

$$[\partial_\nu, A_\mu]\phi = (\partial_\nu A_\mu)\phi \quad -(15)$$

and Eq. (12) is:

$$(\partial_\mu A_\nu)\phi = -(\partial_\nu A_\mu)\phi \quad -(16)$$

giving the antisymmetry law of ECE theory on the U(1) level in electrodynamics. It was realized in UFT 130, a heavily studied paper, that Eq. (16) profoundly changes the nature of electric and electronic engineering in all their aspects. They have been inexplicably missed since Heaviside's time in the late nineteenth century but are simple to derive. Eqs. (16) immediately show that U(1) gauge symmetry is incorrect and self inconsistent. The basic assertion of U(1) = O(2) gauge electromagnetism (flat electromagnetism) is that there are only transverse states of radiation in vacuo. This patently absurd assertion is necessitated by the early guess of Einstein that a particle moving at c must have identically zero mass. As we have seen the correct interpretation was given in July 1905 by Poincaré, that c is not the speed of light in vacuo but the constant of the Lorentz transformation.

So in flat electromagnetism the transverse vector potential is:

$$\underline{A} = \frac{A^{(0)}}{\sqrt{2}}(i\underline{i} + \underline{j})e^{i\phi} \quad -(17)$$

where the electromagnetic phase is:

$$\phi = \omega t - \kappa Z \quad -(18)$$

Here ω is the angular frequency at instant t, κ is the wave vector magnitude at position Z. Therefore:

$$\frac{\partial A_x}{\partial Z} = -ikA_x = -k\frac{A^{(0)}}{\sqrt{2}}e^{i\phi} \quad -(19)$$

$$\frac{\partial A_y}{\partial Z} = -ikA_y = -ik\frac{A^{(0)}}{\sqrt{2}}e^{i\phi} \quad -(20)$$

However the antisymmetry law (16) means that:

$$\partial A_Z / \partial X = -\partial A_x / \partial Z = -kA^{(0)} e^{i\phi}/\sqrt{2}$$

$$\partial A_Z / \partial Y = -\partial A_y / \partial Z = ikA^{(0)} e^{i\phi}/\sqrt{2} \quad -(21)$$

showing immediately that there is a longitudinal polarization A_Z by anti symmetry. It is immediately obvious that there is no Higgs boson, which rests on flat electromagnetism, the U(1) sector symmetry of the theory behind the Higgs boson. Using the de Moivre Theorem:

$$e^{i\phi} = \cos\phi + i\sin\phi \quad -(22)$$

so:

$$\frac{\partial A_Z}{\partial X} = -k\frac{A^{(0)}}{\sqrt{2}}\cos\phi \, ; \quad \frac{\partial A_Z}{\partial Y} = -k\frac{A^{(0)}}{\sqrt{2}}\sin\phi \quad -(23)$$

and

$$\left(\frac{\partial A_Z}{\partial X}\right)^2 + \left(\frac{\partial A_Z}{\partial Y}\right)^2 = \frac{k^2 A^{(0)2}}{2} . \quad -(24)$$

If cylindrical symmetry is used for the sake of simplicity it is found that:

$$A_Z = \pm \frac{1}{2} X k A^{(0)} \quad -(25)$$

and there are three senses of space like polarization. The Beltrami analysis of chapter three shows the nature of longitudinal solutions very clearly and obviously. In a sense the standard model of physics has always been a flat world fantasy. As soon as Proca developed his equations, U(1) gauge invariance collapsed. That was in 1938, and it is still being rolled out today in standard physics, but not in ECE physics.

In the obsolete flat electromagnetism, the electric field strength E is defined by the scalar and vector potentials by:

$$\underline{E} = -\underline{\nabla}\phi - \frac{\partial \underline{A}}{\partial t} \quad -(26)$$

and the magnetic flux density by:

$$\underline{B} = \underline{\nabla} \times \underline{A} \,. \quad -(27)$$

In the flat world of U(1) electromagnetism it is claimed that a static electric field is defined by:

$$\underline{E} = -\underline{\nabla}\phi \quad -(28)$$

and that for a static electric field:

$$\frac{\partial \underline{A}}{\partial t} = \underline{0} \,. \quad -(29)$$

The anti symmetry equations (16) immediately refute these assertions because:

$$\underline{\nabla}\phi = \frac{\partial \underline{A}}{\partial t} = \underline{0} \,. \quad -(30)$$

The electric field is always defined by Eq. (30) in all situations in the natural sciences and engineering.

Similarly in gravitational theory the Newtonian acceleration due to gravity is always defined in the obsolete standard physics by:

$$\underline{g} = -\underline{\nabla}\Phi \quad -(31)$$

but the anti symmetry argument shows that:

$$\underline{g} = -\underline{\nabla}\Phi = -\frac{1}{c}\frac{\partial \underline{\Phi}}{\partial t} \quad -(32)$$

where $\underline{\Phi}$ is the gravitational equivalent of the vector potential $\underline{A}$ in electromagnetism.

The anti symmetry law (16) leads to multiple difficulties for flat electromagnetism and standard physics. The law (16) can be expressed as two equations:

$$\underline{\nabla}\phi = \frac{\partial \underline{A}}{\partial t} \quad -(33)$$

and

$$\partial_i A_j = -\partial_j A_i. \quad -(34)$$

From Eqs. (27) and (33):

$$\underline{\nabla}\times\underline{E} = 0, \quad \frac{\partial \underline{B}}{\partial t} = \underline{0}, \quad -(35)$$

meaning that the magnetic field in flat electrodynamics cannot change with time, an absurdity. This is a difficulty encountered at the most basic level in the tensorial theory of electromagnetism. Apparently it was not realized by Lorentz and Poincaré because they did not infer the anti symmetry law (16). The Faraday law of induction of the flat electromagnetism is:

$$\underline{\nabla}\times\underline{E} + \frac{\partial \underline{B}}{\partial t} = \underline{0} \quad -(36)$$

so from Eq. (35):

$$\underline{\nabla}\times\underline{E} = \underline{0} \quad -(37)$$

which means that the electric field strength is also static, another absurd result of assuming a zero photon mass. A static electric field on the U(1) level is defined by:

$$\underline{A} = \underline{0} \quad -(38)$$

so it follows that:

$$\underline{B} = \underline{\nabla} \times \underline{A} = \underline{0} \quad -(39)$$

and that the magnetic flux density vanishes. From the anti symmetry equation (33) it follows that:

$$\underline{\nabla} \phi = \frac{\partial \underline{A}}{\partial t} = \underline{0} \quad -(40)$$

and so:

$$\underline{E} = -\underline{\nabla} \phi = \underline{0} . \quad -(41)$$

Anti symmetry therefore results in the complete collapse of U(1) electromagnetism, both $\underline{E}$ and $\underline{B}$ vanish as a result of anti symmetry in the flat world of U(1) electromagnetism. The ship falls off the edge of the flat dogmatic world. Anti symmetry proves straightforwardly that the notion of a massless photon is empty dogma, and that the geometry used in MH theory is woefully inadequate.

Note carefully that U(1) symmetry gauge theory itself, Eq. (10), has been used to disprove the theory simply by using the anti symmetry of the commutator, which acts on the gauge field {1 - 10, 13} as follows:

$$[D_\mu, D_\nu]\phi = [\partial_\mu - igA_\mu, \partial_\nu - igA_\nu]\phi . \quad -(42)$$

The U(1) covariant derivative is defined as:

$$D_\mu = \partial_\mu - igA_\mu \quad -(43)$$

where:

$$g = \frac{e}{\hbar} = \frac{\kappa}{A^{(0)}} \quad -(44)$$

as argued in previous chapters. The photon momentum in this theory is:

$$p = \hbar \kappa = eA^{(0)} \quad -(45)$$

a minimal prescription. In Eq. (42):

$$[\partial_\mu, \partial_\nu] = 0 \quad -(46)$$

so:

$$[D_\mu, D_\nu]\phi = -ig\left([\partial_\mu, A_\nu] - ig[A_\mu, A_\nu]\right)\phi. \quad -(47)$$

The fundamental anti symmetry:

$$[D_\mu, D_\nu]\phi = -[D_\nu, D_\mu]\phi \quad -(48)$$

means that:

$$[\partial_\mu, A_\nu]\phi = -[\partial_\nu, A_\mu]\phi \quad -(49)$$

so:

$$\partial_\mu A_\nu = -\partial_\nu A_\mu \quad -(50)$$

and we obtain Eq. (16) irrefutably. The only alternative is to abandon the commutator, but as argued already that means the abandonment of geometry itself.

The derivation of the anti symmetry law is so simple that it is almost trivially evident from the commutator method. Yet the law is so powerful that it can refute a century of dogma in a few lines, as we have just argued.

This catastrophe for the standard physics became evident a few years ago in UFT

132. By now it is long known that flat electromagnetism is empty dogma, and by implication the Higgs boson. The latter exists only because the media can be used to propagate the idea. As in Einstein's era the general public still has no idea of the meaning of commutator. This is an illustration of human nature rather than that of nature. The scene is now set for the entry of ECE theory and for the implementation of anti symmetry within ECE theory.

6.2 ANTI SYMMETRY IN ECE ELECTROMAGNETISM

In ECE electrodynamics the electromagnetic field is defined by:

$$F^a_{\mu\nu} = \partial_\mu A^a_\nu - \partial_\nu A^a_\mu + \omega^a_{\mu b} A^b_\nu - \omega^a_{\nu b} A^b_\mu \quad -(51)$$

in which the antisymmetry law is determined by the antisymmetry of the Chistoffel connection:

$$\Gamma^a_{\mu\nu} = -\Gamma^a_{\nu\mu} . \quad -(52)$$

Using the tetrad postulate the Christoffel connection becomes:

$$\Gamma^a_{\mu\nu} = \partial_\mu q^a_\mu + \omega^a_{\mu\nu} \quad -(53)$$

so anti symmetry in Cartan geometry means that:

$$\partial_\mu q^a_\nu + \omega^a_{\mu\nu} + \partial_\nu q^a_\mu + \omega^a_{\nu\mu} = 0. \quad -(54)$$

As in chapter two this equation translates into the following anti symmetry equation in electrodynamics:

$$\partial_\mu A^a_\nu + \partial_\nu A^a_\mu + A^{(0)}\left(\omega^a_{\mu\nu} + \omega^a_{\nu\mu}\right) = 0. \quad -(55)$$

This was first derived in UFT 133 and UFT 134 and is a fundamental constraint on the first

Cartan Maurer structure equation:

$$F^a_{\mu\nu} = \partial_\mu A^a_\nu - \partial_\nu A^a_\mu + A^{(0)}\left(\omega^a_{\mu\nu} - \omega^a_{\nu\mu}\right). \quad -(56)$$

This is known as the Lindstrom constraint and is discussed in more detail as follows, based on UFT 134.

For a single polarization the ECE theory of electromagnetism reduces to a format that is superficially similar to the Maxwell Heaviside equations:

$$\underline{\nabla} \cdot \underline{B} = 0 \quad -(57)$$

$$\underline{\nabla} \times \underline{E} + \partial \underline{B} / \partial t = \underline{0} \quad -(58)$$

$$\underline{\nabla} \cdot \underline{E} = \rho / \epsilon_0 \quad -(59)$$

$$\underline{\nabla} \times \underline{B} - \frac{1}{c^2} \frac{\partial \underline{E}}{\partial t} = \mu_0 \underline{J}, \quad -(60)$$

but the relation between the fields and the potentials are as follows:

$$\underline{E} = -\underline{\nabla} \phi - \frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} + \underline{\omega} \phi, \quad -(61)$$

$$\underline{B} = \underline{\nabla} \times \underline{A} - \underline{\omega} \times \underline{A}. \quad -(62)$$

The electric component of the anti symmetry equation for a single polarization is:

$$\underline{\nabla} \phi - \frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} - \underline{\omega} \phi = \underline{0} \quad -(63)$$

and the magnetic anti symmetry relation restricted by the Lindstrom constraint is:

$$\underline{\nabla} \times \underline{A} = -\underline{\omega} \times \underline{A} \quad -(64)$$

If we apply the anti symmetry equations (63) and (64) to the field intensities $\underline{E}$ and $\underline{B}$ we see two independent definitions of $\underline{E}$ and a single definition of $\underline{B}$:

$$\underline{E} = -2 \frac{\partial \underline{A}}{\partial t} - 2\omega_0 \underline{A} \quad -(65)$$

or

$$\underline{E} = -2\underline{\nabla}\phi + 2\underline{\omega}\phi \quad -(66)$$

and

$$\underline{B} = 2\underline{\nabla} \times \underline{A} \, . \quad -(67)$$

So $\underline{B}$ is obviously compatible with the Gauss Law:

$$\underline{\nabla} \cdot \underline{B} = 0 \, . \quad -(68)$$

Applying the two alternative equations (65) and (66) for $\underline{E}$, and (67) for $\underline{B}$, to Faraday's Law, Eq. (58) gives for both cases:

$$\underline{\nabla} \times \left(\phi \underline{\omega} + \frac{\partial \underline{A}}{\partial t} \right) = \underline{0} \quad -(69)$$

and

$$\underline{\nabla} \times \left(\omega_0 \underline{A} \right) = \underline{0} \, . \quad -(70)$$

Take the curl of Eq. (63) and apply Eq. (70) to obtain Eq. (69), meaning that Eq. (69) contains no new information that is not already given by the electric component of the anti symmetry equations. Using the anti symmetry relations the following equations can be obtained as in UFT 134:

$$\underline{\nabla} \times (\underline{\omega}\phi) - \frac{\partial}{\partial t}(\underline{\omega} \times \underline{A}) = \underline{0} \quad -(71)$$

$$-\nabla^2 \phi + \underline{\nabla} \cdot (\underline{\omega}\phi) = \rho / (2\epsilon_0) \quad -(72)$$

$$-\underline{\nabla} \times (\underline{\omega} \times \underline{A}) - \frac{1}{c^2}\frac{\partial}{\partial t}(\underline{\nabla}\phi - \underline{\omega}\phi) = \mu_0 \underline{J}/2 \, . \quad -(73)$$

Eq. (72) gives a resonant form of the Coulomb law which can be used to produce resonant energy from spacetime as described in the next chapter. Eqs. (62) to (65) give a set of seven equations in seven unknows as described in UFT 134. However the Coulomb and Ampère Maxwell laws are not independent. This can be shown for example by taking the divergence of Eq. (73):

$$\frac{1}{c^2}\frac{\partial}{\partial t}\left(-\nabla^2\phi + \underline{\nabla}\cdot(\underline{\omega}\,\phi)\right) = \frac{1}{2}\mu_0\,\underline{\nabla}\cdot\underline{J} \quad -(74)$$

and integrating with respect to time to give:

$$-\nabla^2\phi + \underline{\nabla}\cdot(\underline{\omega}\,\phi) = \rho/2\epsilon_0 \quad -(75)$$

with:

$$\rho = \int \underline{\nabla}\cdot\underline{J}\,dt. \quad -(76)$$

Starting with Eqs. (65) and (67), Faraday's law becomes:

$$\underline{\nabla}\times\left(-2\frac{\partial\underline{A}}{\partial t} - 2\omega_0\underline{A}\right) + 2\frac{\partial}{\partial t}\left(\underline{\nabla}\times\underline{A}\right) = \underline{0} \quad -(77)$$

which can be simplified to:

$$\underline{\nabla}\times\left(\omega_0\underline{A}\right) = \underline{0} \quad -(78)$$

and is identical with Eq. (70). The Coulomb and Ampère Maxwell laws take the forrm:

$$\underline{\nabla}\cdot\frac{\partial\underline{A}}{\partial t} + \underline{\nabla}\cdot\left(\omega_0\underline{A}\right) = \rho/(2\epsilon_0) \quad -(79)$$

$$\underline{\nabla}\times\underline{\nabla}\times\underline{A} + \frac{1}{c^2}\frac{\partial^2\underline{A}}{\partial t^2} + \frac{1}{c^2}\frac{\partial}{\partial t}\left(\omega_0\underline{A}\right) = \frac{1}{2}\mu_0\underline{J}. \quad -(80)$$

Eq (79) is compatible with Eq. (78) and shows that $\omega_0\underline{A}$ represents a pure source field. Eqs. (79) and (80) represent four equations for four variables . These equations are independent if the charge and current density are chosen to be unrelated. Eq. (80) is a wave equation in three dimensions with transverse and longitudinal solutions that go beyond MH electrodynamics. Eq. (79) is a non linear diffusion equation, the non linearity being caused by the spin connection, and indicating that there is a flow of potential present in addition to MH theory. This can be considered to represent interaction with the surrounding vacuum or spacetime - the source of energy in resonance effects.

It is possible to derive a third version of the equation set using Eq. (70):

$$\omega_0 \underline{A} = -\frac{\partial}{\partial t}(\underline{\nabla}\phi). \quad -(81)$$

Substituting Eq. (66) and (68) into Eq. (59) and (60) gives:

$$\underline{\nabla}\cdot\frac{\partial \underline{A}}{\partial t} + \underline{\nabla}\cdot(\omega_0 \underline{A}) = -\rho/(2\epsilon_0) \quad -(82)$$

$$\underline{\nabla}\times\underline{\nabla}\times\underline{A} + \frac{1}{c^2}\frac{\partial^2 \underline{A}}{\partial t^2} + \frac{1}{c^2}\frac{\partial}{\partial t}(\omega_0 \underline{A}) = \frac{1}{2}\mu_0 \underline{J} \quad -(83)$$

and using the vector identity:

$$\underline{\nabla}\times\underline{\nabla}\times\underline{A} = \underline{\nabla}(\underline{\nabla}\cdot\underline{A}) - \nabla^2\underline{A} \quad -(84)$$

time integrating Eq. (82) and substituting the expression for $\underline{\nabla}\cdot\underline{A}$ into Eq. (83) gives:

$$\left(-\nabla^2 + \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right)\left(\underline{A} + \int \omega_0 \underline{A}\, dt\right) = \frac{1}{2}\mu_0 \underline{J} + \frac{1}{2}\int \frac{\underline{\nabla}\rho}{\epsilon_0}\, dt. \quad -(85)$$

Using Eq. (81) this can be written more elegantly as:

$$\left(-\nabla^2 + \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right)(\underline{A} - \underline{\nabla}\phi) = \frac{1}{2}\mu_0 \underline{J} + \frac{1}{2\epsilon_0}\int \underline{\nabla}\rho\, dt. \quad -(86)$$

By using Eq. (65):

$$\int \underline{E}\, dt = -2\underline{A} - 2\int \omega_0 \underline{A}\, dt = -2\underline{A} + 2\underline{\nabla}\phi \quad -(87)$$

which appears in Eq. (86). Alternatively Eq. (86) is according to Eq. (66):

$$\int \underline{E}\, dt = -2\int \underline{\nabla}\phi\, dt + 2\int \phi\, \underline{\omega}\, dt \quad -(88)$$

Substituting this alternative form of Eq. (88) into Eq. (87) we obtain:

$$\left(-\nabla^2 + \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right)\left(\int \underline{\nabla}\phi\, dt - \int \phi\, \underline{\omega}\, dt\right) = \frac{1}{2}\mu_0 \underline{J} + \frac{1}{2\epsilon_0}\int \underline{\nabla}\rho\, dt \quad -(89)$$

and after taking the time derivative:

$$\left(-\nabla^2 + \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right)\left(\underline{\nabla}\phi - \underline{\omega}\phi\right) = \frac{1}{2}\mu_0 \frac{\partial \underline{J}}{\partial t} + \frac{1}{2\epsilon_0}\underline{\nabla}\rho. \quad -(90)$$

In total, Eqs. (81), (86) and (90) represent nine equations in nine unknowns:

$$\omega_0 \underline{A} = -\frac{\partial}{\partial t}(\underline{\nabla}\phi)$$

$$\left(-\nabla^2 + \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right)\left(\underline{A} - \underline{\nabla}\phi\right) = \frac{1}{2}\mu_0 \underline{J} + \frac{1}{2\epsilon_0}\int \underline{\nabla}\rho\, dt \quad -(91)$$

$$\left(-\nabla^2 + \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right)\left(\underline{\nabla}\phi - \underline{\omega}\phi\right) = \frac{1}{2}\mu_0 \frac{\partial \underline{J}}{\partial t} + \frac{1}{2\epsilon_0}\underline{\nabla}\rho \quad -(92)$$

The equations are entirely independent and represent a balanced set.

Singularities occur in the solutions, giving plenty of opportunity for resonance effects and obtaining energy from spacetime. For example if the cross product is taken of the electric portion of the anti symmetry equation (63) with A :

$$\underline{\nabla}\phi \times \underline{A} - \frac{\partial \underline{A}}{\partial t} \times \underline{A} - \omega_0 \underline{A} \times \underline{A} - \phi\, \underline{\omega} \times \underline{A} = 0 \quad -(93)$$

Assuming that the time derivative of A is parallel to A:

$$\underline{\nabla}\phi \times \underline{A} = \phi\, \underline{\omega} \times \underline{A} \quad -(94)$$

and Eq. (64) can be used to remove :

$$\underline{\nabla} \times \underline{A} = -\frac{1}{\phi}\underline{\nabla}\phi \times \underline{A}. \quad -(95)$$

Singularities occur whenever ϕ is zero and $\underline{\nabla}\phi$ and $\underline{A}$ are not. Combined with the driven resonances in Eqs. (91) and (92) a rich supply of non linear solutions becomes available.

It is seen that the ECE anti symmetry equations are the only equations of electrodynamics that are self consistent and are preferred over the MH equations.

The Lindstrom magnetic constraint combined with a particular solution of the electric constraint reduces the second model described above to MH theory. Anti symmetry means that it is not possible to reduce ECE theory to MH theory simply by removing the spin connection, because that procedure produces:

$$\underline{E} = -\frac{\partial \underline{A}}{\partial t} - \underline{\nabla} \phi \qquad - (96)$$

$$\underline{B} = \underline{\nabla} \times \underline{A} \qquad - (97)$$

As shown already in this chapter these relations when used with anti symmetry generally invalidate MH theory, a major discovery of the evolution of ECE theory. However, applying the following particular solutions of the anti symmetry equations:

$$\underline{\omega}\, \phi = -\partial \underline{A} / \partial t \qquad - (98)$$

$$\omega_0 \underline{A} = \underline{\nabla} \phi \qquad - (99)$$

$$\underline{\omega} \times \underline{A} = -\underline{\nabla} \times \underline{A} \qquad - (100)$$

the electric and magnetic fields of the ECE theory become:

$$\underline{E} = -2 \frac{\partial \underline{A}}{\partial t} - 2 \underline{\nabla} \phi \qquad - (101)$$

$$\underline{B} = 2 \underline{\nabla} \times \underline{A} . \qquad - (102)$$

The standard MH structure is:

$$\underline{B} = \underline{\nabla} \times \underline{a} \qquad - (103)$$

and comapring Eqs. (102) and (103):

$$\underline{a} = 2 \underline{A} \qquad - (104)$$

Substitutng Eq. (103) into the Faraday Law:

$$\underline{\nabla} \times \underline{E} + \frac{\partial \underline{B}}{\partial t} = \underline{0} \quad -(105)$$

gives:

$$\underline{\nabla} \times \underline{E} = -\underline{\nabla} \times \frac{\partial \underline{a}}{\partial t} \quad -(106)$$

which has:

$$\underline{E} = -\frac{\partial \underline{a}}{\partial t} - \underline{\nabla} \phi_1 \quad -(107)$$

as the only solution. Comparing Eqs. (101) and (107) gives;

$$\phi_1 = 2\phi \quad -(108)$$

which show that the theory designated II in the engineering model on www.aias.us reduces to the MH theory given the restrictions: (98) to (100).

(

Note carefully that this reduction is achieved by:

$$\underline{B} = \underline{\nabla} \times \underline{a} = \underline{\nabla} \times \underline{A} - \underline{\omega} \times \underline{A} = 2\underline{\nabla} \times \underline{A} \quad -(109)$$

and not by discarding the spin connection. So the MH format achieved in this way is still a theory of general relativity, making unification with gravitation possible.

and not by discarding the spin connection. So the MH format achieved in this way is still a theory of general relativity, making unification with gravitation possible.

6. 3 DERIVATION OF THE EQUIVALENCE PRINCIPLE FROM ANTI SYMMETRY AND OTHER APPLICATIONS.

The equivalence of inertial and gravitational mass is known as the weak equivalence principle and has been tested experimentally with great precision. In this section the equivalence principle is derived from anti symmetry. It has been shown independently [1 - 10] by Moses , Reed and Evans that any vector field in three dimensions may be expressed as the sum of three vectors:

$$\underline{V} = \underline{V}^{(1)} + \underline{V}^{(2)} + \underline{V}^{(3)} \quad -(110).$$

in the complex circular basis defined earlier in this book. Helmholtz showed in the nineteenth century that any vector field can be written as the sum of two vectors:

$$\underline{V} = \underline{V}_s + \underline{V}_\ell \quad -(111)$$

where:

$$\underline{\nabla} \cdot \underline{V}_s = 0, \quad -(112)$$

$$\underline{\nabla} \times \underline{V}_\ell = \underline{0}. \quad -(113)$$

The use of the complex circular basis extends the Helmholtz equation as follows:

$$\underline{V}_s = \underline{V}^{(1)} + \underline{V}^{(2)} \quad -(114)$$

$$\underline{V}_\ell = \underline{V}^{(3)}. \quad -(115)$$

The most fundamental components are therefore components of $\underline{V}^{(1)}, \underline{V}^{(2)}, \underline{V}^{(3)}$.

Examples of these fundamental components are:

and so on. In the first papers on ECE theory these components were identified as the objects known as tetrads in Cartan geometry. Such an identification had also been made indirectly by Reed. In Cartan's original definition of the tetrad the a index is the upper index of a four dimensional Minkowski spacetime at point P to a four dimensional manifold indexed . Each of the three dimensional vectors defined in Eq. (110) is the space like component of the following four dimensional vectors:

$$V_\mu^{(i)} = \left(V_0^{(i)}, -\underline{V}^{(i)} \right) \quad -(116)$$

$$i = 1, 2, 3.$$

The complete four dimensional vector is the sum of these three vectors:

$$V_\mu = V_\mu^{(1)} + V_\mu^{(2)} + V_\mu^{(3)}. \quad -(117)$$

So there exist three time like components and the complete time like component is their sum:

$$V_0 = V_0^{(1)} + V_0^{(2)} + V_0^{(3)}. \quad -(118)$$

In four dimensions the a index is:

$$a = (0), (1), (2), (3) \quad -(119)$$

so in general there also exists the component $V_0^{(0)}$. These fundamental elements may always be expressed as tetrad elements and defined as a 4 x 4 matrix as follows:

$$X^a = V_\mu^a X^\mu. \quad -(120)$$

It follows that any four dimensional vector can be defined as a scalar valued quantity multiplied by a Cartan tetrad:

$$V_\mu^a = V q_\mu^a. \quad -(121)$$

Therefore Cartan's differential geometry may be applied to any four dimensional vector. Normally it is applied to the tetrad and the first Cartan structure equation defines the Crtan torsion from the tetrad. The latter is the fundamental building block because it consists of fundamental components of the complete vector field. The Heaviside Gibbs vector analysis restricts consideration to $\underline{V}$ only, but the tetrad analysis realizes that $\underline{V}$ has an internal structure.

In four dimensions therefore define the fundamental vectors:

$$V^{(0)}_{\mu} = \left(V^{(0)}_{0}, \underline{0} \right) \qquad - (122)$$

$$V^{(i)}_{\mu} = \left(V^{(i)}_{0}, -\underline{V}^{(i)} \right), i = 1, 2, 3 \qquad - (123)$$

Eq. (122) means that the space like components of $V^{(0)}_{\mu}$ are zero by definition because the superscript (0) is time like by definition. There are no space like components of a time like property. On the other hand a vector such as $V^{(1)}_{\mu}$ is a four vector, so $V^{(0)}_{0}$ in general is its non-zero time like component. In general the Cartan tetrad is defined by:

$$X^{a} = q^{a}_{\mu} X^{\mu} \qquad - (124)$$

where X denotes any vector field. Therefore Cartan geometry extends the Heaviside Gibbs analysis and this finding can be applied systematically to physics, notably dynamics. The Heaviside Gibbs analysis was restricted to three dimensional space with no connection, i.e. a Euclidean space. Using Cartan's differential geometry the analysis can be extended to any space of any dimension by use of the Cartan spin connection. Using this procedure all the equations of physics can be derived automatically within a unified framework, thus producing the first successful unified field theory.

Now apply this method to the concept of velocity in dynamics. The velocity tetrad is:

$$v^a_\mu = v\, q^a_\mu \quad -(125)$$

where v is the scalar magnitude of velocity, i.e. the speed. The gravitational potential is defined as:

$$\Phi^a_\mu = c\, v^a_\mu = \Phi\, q^a_\mu . \quad -(126)$$

In analogy the electromagnetic potential is also defined in terms of the tetrad in ECE theory:

$$A^a_\mu = A^{(0)}\, q^a_\mu \quad -(127)$$

The electromagnetic field is defined in terms of the Cartan torsion:

$$F^a_{\mu\nu} = A^{(0)}\, T^a_{\mu\nu} \quad -(128)$$

and also the gravitational field:

$$g^a_{\mu\nu} = \Phi\, T^a_{\mu\nu} . \quad -(129)$$

The acceleration due to gravity in ECE theory is therefore part of the torsion, so in general the acceleration in electrodynamics is also part of the torsion, defined conveniently as:

$$a^a_{\mu\nu} = c\, v\, T^a_{\mu\nu} . \quad -(130)$$

In vector notation Eq. (129) splits in to two equations:

$$\underline{a}^a = -\frac{\partial \underline{v}^a}{\partial t} - c\,\underline{\nabla} v^a_0 - c\,\omega^a_{0b}\,\underline{v}^b + c\, v^b_0\, \underline{\omega}^a_b \quad -(131)$$

and

$$\underline{\Omega}^a = \underline{\nabla} \times \underline{v}^a - \underline{\omega}^a{}_b \times \underline{v}^b . \quad -(132)$$

The spin connection is defined as:

$$\omega^a_{\mu b} = \left(\omega^a{}_{0b}, -\underline{\omega}^a{}_b\right). \quad -(133)$$

In tensor notation the relation between acceleration and velocity in generally covariant dynamics is:

$$a^a_{\mu\nu} = c\left(\partial_\mu V^a_\nu - \partial_\nu V^a_\mu\right) + v\left(\omega^a_{\mu\nu} - \omega^a_{\nu\mu}\right). \quad -(134)$$

Sp Eqs. (131) and (132) may be simplified to:

$$\underline{a}^a = -\frac{\partial \underline{v}^a}{\partial t} + \underline{\nabla}\,\underline{\Phi}^a + c v\,\underline{\omega}^a_{orb} \quad -(135)$$

and:

$$\underline{\Omega}^a = \underline{\nabla} \times \underline{v}^a + v\,\underline{\omega}^a_{spin} \quad -(136)$$

where:

$$\underline{\omega}_{orb} = \left(\omega^a_{01} - \omega^a_{10}\right)\underline{i} + \left(\omega^a_{02} - \omega^a_{20}\right)\underline{j} + \left(\omega^a_{03} - \omega^a_{30}\right)\underline{k} \quad -(137)$$

and

$$\underline{\omega}_{spin} = \left(\omega^a_{32} - \omega^a_{23}\right)\underline{i} + \left(\omega^a_{13} - \omega^a_{31}\right)\underline{j} + \left(\omega^a_{21} - \omega^a_{12}\right)\underline{k} \quad -(138)$$

and where:

$$v\,\underline{\omega}^a_{orb} = -\omega^a{}_{0b}\,\underline{v}^b + v^b_0\,\underline{\omega}^a{}_b \quad -(139)$$

and

$$v\,\underline{\omega}^a_{spin} = -\underline{\omega}^a{}_b \times \underline{v}^b \quad -(140)$$

Equations (139) and (140) are Coriolis type accelerations due to orbital and spin torsion. Eq. (135) shows that acceleration is due to the rate of change of velocity and also the gradient of the potential. If the inertial frame of Newtonian dynamics is defined as flat space time then in the inertial frame:

$$\underline{a}^a = -\frac{\partial \underline{v}^a}{\partial t} - \underline{\nabla} \Phi^a \quad - (141)$$

The equivalence principle assumes that:

$$-\frac{\partial \underline{v}^a}{\partial t} = -\underline{\nabla} \Phi^a \quad - (142)$$

which is the direct result of the ECE anti symmetry law:

$$\partial_\mu v_\nu^a = -\partial_\nu v_\mu^a \quad - (143)$$

when

$$\mu = 0, \; \nu = 1 \quad - (144)$$

Q. E. D.

Force is defined by mass multiplied by acceleration, so

$$\underline{F}^a = -m \frac{\partial \underline{v}^a}{\partial t} = -m \underline{\nabla} \Phi^a \quad - (145)$$

which is a generalization of the weak equivalence principle assumed by Newton but not proven by him. ECE theory shows that the equivalence principle has a geometrical origin.