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:

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

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:

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

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.