Essay 11: GEOMETRY AND CONSERVATION OF LINEAR MOMENTUM

The most profound concepts of physics are obtained from geometry in a simple way. This is the essence of the philosophy of relativity. Simplicity of concept ought to be at the root of all scientific thought, and in modern physics this idea is known as Ockham=s Razor after the mediaeval friar William of Ockham, condemned as a heretic in England and France for claiming outrageously that thought must be original, plain and ungoverned. This idea of simplicity is sometimes expressed as AEntia non sunt multiplicanda praeter necessitatem@. This means AEntities are not multiplied more than is necessary@, or Akeep it simple@. Debye expressed this as Acomplexity is lack of understanding@, or ALook here, it is so simple@. The Pythagoras Theorem of geometry is one example of simplicity and profundity, and this is a characteristic of geometry. The Athenians knew this when they designed the Parthenon, still the ideal of beauty after two thousand five hundred years. The northern European peoples knew it in their triskeles and intricate designs, all based on a well studied geometry and on an understanding as profound as anything we have today. What ought to happen in physics is that the simpler of two theories is preferred, the simplest possible understanding of nature is sought for.

. This is why a unified theory of nature is the most profound theory of nature. A unified theory uses the least number of postulates, and is based on one rigorously tested framework. As an example of these ideas take the idea of linear momentum and its conservation in nature. The way that this is understood now is that the total momentum of a well defined system is conserved. The total momentum does not change. In order for this to be true the system must be defined carefully. Sometimes it is known as Aconservative@. This has nothing to do with the tory party, it means that the system is conserved. Newton=s most original contribution to dynamics was his third law, which is usually stated as action and reaction are equal and opposite. Stated in this way it is an obscure law unless action and reaction are defined. The action in that law is not the modern definition of action, which has the units of angular momentum or energy multiplied by time, the units of the Planck constant. Gradually, the third law became the conservation of total momentum. If two particles collide, their total momentum before the collision is the same as their total momentum after the collision. In modern physics this is an example of a conservation theorem. Total energy is also conserved, and in special relativity the total energy-momentum is conserved. Hamilton extended these ideas further to find that the sum of the kinetic and potential energies is conserved. This sum became known as the hamiltonian. In general relativity, the hamiltonian is conserved and the hamiltonian is expressed directly in terms of geometry expressed as the metric.

This history shows how ideas in natural philosophy evolve from generation to generation over hundreds of years. The ideas never remain static. The linear momentum in classical dynamics is the mass multiplied by the linear velocity. This concept is so familiar that it is difficult now to imagine how long it took to evolve. If two particles collide, the quantity that is conserved is the sum of the two momenta. The momentum of one particle is not conserved when it collides with another. For more than two hundred years (1665 to 1905) this definition of momentum remained unchanged. In 1905 it had to be changed because special relativity was found to violate conservation of momentum if the latter were defined by mass multiplied by velocity, (i.e. by mv). The choice in 1905 was to abandon special relativity or change the definition of momentum. The second choice led to the definition of momentum as gamma m v, where gamma was a factor discovered earlier by Lorentz. The relativistic definition of momentum p became gamma m v. By simple algebra it was found that this definition led to an expression for total relativistic energy E as the sum of the relativistic kinetic energy T and the rest energy E0. The latter is the only equation of physics known to the general public, E0 = m c squared. Its origin in relativistic momentum is however almost unknown, even to professional physicists. In the world of chemistry and engineering, relativistic momentum itself is almost unknown.

With the availability now of ECE unified field theory the concept of relativistic momentum is found in a few lines of algebra from geometry. The powerful differential geometry of Cartan can be expressed symbolically in a very simple way, and its most fundamental theorem can be expressed as a wave equation. This equation shows that spacetime can be expressed in terms of waves. The wave equation contains a factor labelled R that reveals the origin and meaning of mass. In a limit, R becomes proportional to m, the mass as known to Newton. The ECE wave equation reduces to quantum mechanics known in the twentieth century, and that type of mechanics reduces to the Einstein energy equation cited already. That energy equation is simply the relativistic momentum itself. In the limit when particles move slowly, the relativistic momentum becomes the classical momentum, which is Newton=s action of his third law.

In UFT 158 to 163, the ideas of de Broglie were found to collapse if properly tested. That means that there is a property of nature that is not described by de Broglie. The geometry of ECE theory tells us that that property is R, because R is derived from the most fundamental property of differential geometry. In the absence of ECE theory one would be tempted to throw away quantum theory or special relativity. That would be a mistake because in some ways both work precisely. They fall apart only if conservation of momentum is properly considered. This in turn shows that conservation of momentum is at once simple and profound, more profound than quantum mechanics and special relativity. That is why the relativistic momentum emerged in 1905, it is an expression of the conservation of momentum in spacetime rather than Newton=s space and time considered as independent. The twentieth century physics collapsed because it had forgotten the principle of conservation of momentum, and forgotten its roots in the Ockham Razor. Twentieth century physics became a morasse of complexity built on clay feet. It can be rebuilt more solidly on geometry.