The Case for an Active Æther, Inertia as an External Force.

1. Introduction.

This paper is written to try to persuade people of the existence of an æther capable of inflicting forces on matter, indeed an æther which is responsible for many of the forces known to man. The setting for this exercise is the simple gyroscope, that children's toy which exhibits such remarkable balancing properties. It is shown that a precessing gyroscope disobeys Newton's Law of action and reaction, it creates an action torque but the reaction is missing. A simple explanation for this phenomenon is that inertial forces on a body are *external* forces, that acceleration of matter through space causes a reaction with the æther which manifests itself as this external force. Because this *external* property is not accepted by conventional science, it is not taught, so at an early age we are all brainwashed into the Newton view of inertia, and once brainwashed it is difficult to accept something different. A physicist skilled in electromagnetic theory should have no difficulty in accepting at least the *possibility* that inertia forces are external to a body, since he will be familiar with motion-induced external forces exerted on particles carrying an electric charge. Indeed, certain of these electromagnetic forces are proportional to the acceleration of the particle, hence they are inertia-like, leading to early texts referring to the phenomenon as *electrostatic mass*. This electromagnetic inertia is proportional to the charge, and the reader is asked to accept that a similar æther interaction creates inertia proportional to the mass. This alternative view is recommended to the reader because it opens the door to an æther theory which brings together electromagnetic, gravitational and quantum theory.

2. The Balancing Gyroscope.

Most people are familiar with the gyroscope balanced on a small pillar shown in Figure 1.

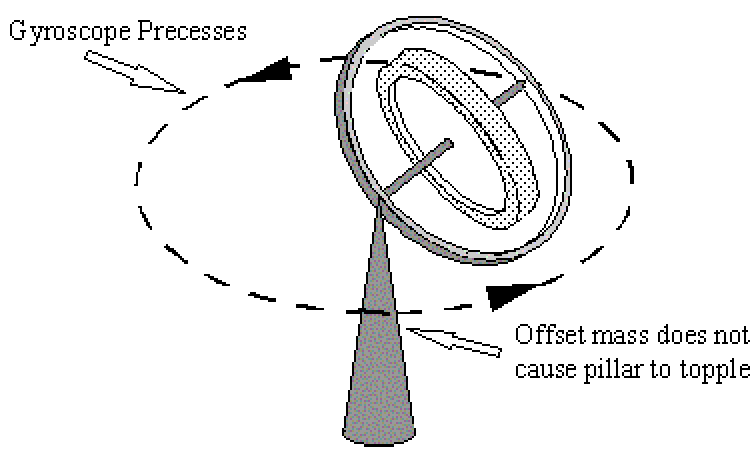

Figure 1. Gyroscope on a Pillar.

Although the heavy mass of the spinning wheel is significantly off-centre with regard to the pillar, it does not fall off, moreover the pillar does not fall over. It is as if there is an invisible force holding the gyroscope against gravity. Even more remarkable is a gyroscope balancing on a tight-rope, as shown in Figure 2.

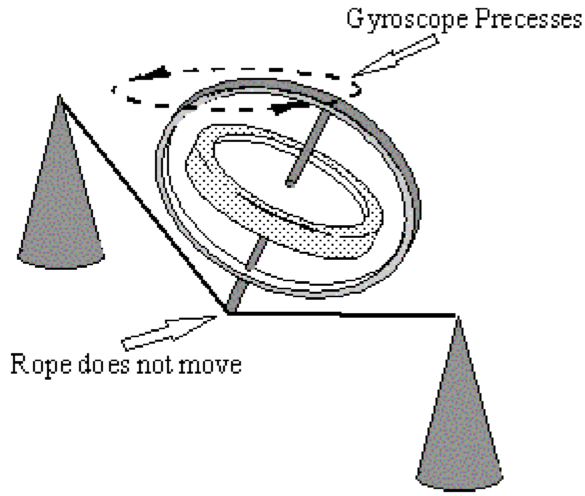

Figure 2. Gyroscope on a Tight-Rope.

The late Professor Eric Laithwaite showed this experiment on TV in his infamous lecture at the Royal Society. Not only does the gyroscope not fall off, there is no perceptible movement of the rope even when the gyroscope mass is widely "off balance" (this led Prof. Laithwaite to erroneously claim there was a missing centrifugal force). Of course the conventional explanation is that the precessing gyroscope develops a torque: this torque is the invisible force. Figure 3 shows how the heavy mass acting downwards on one end of a radius arm, and the pillar reaction acting upwards on the other end, forms a gravitational-induced torque which is countered by the gyroscopic torque.

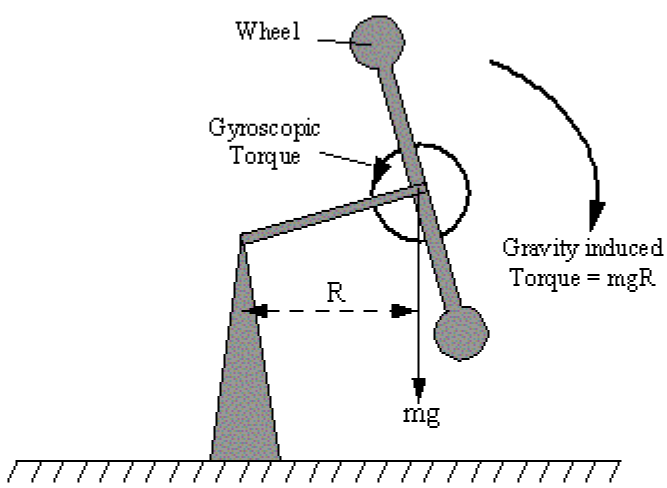

Figure 3. Torque Diagram.

The effect of the gyroscopic torque is to transfer the "mass-centre" from the heavy wheel to the pillar, the weight really does act on the centre line of the pillar (one can explore where the mass acts by placing a roller under the base of the pillar to find the balancing point). It is this transfer of the weight to an effective centre of gravity in the pillar that explains the balancing act, the non-movement of the tight-rope in Figure 2. Laithwaite demonstrated the possibility of using this transfer feature for the movement of mass without reaction. He hung a heavy weight onto a precessing gyroscope whereupon the precession rate immediately increased (to balance the increased torque). He removed the heavy weight after it had travelled through 180º, where the precession rate reverted to its original value. *The weight was thus moved across a precession diameter, with no reaction in the support structure (the pillar or tight-rope).* Surprisingly no-one has since made use of this significant feature.

Calculation of the gyroscopic torque is very simple, involving the product of the angular momentum of the spinning wheel and the precession angular velocity. Unfortunately this simple formula does not truly indicate where the forces are applied, one tends to think only of a shaft torque. In fact the torque is really a couple whose two equal and opposite forces appear in the spinning wheel, and since this is intentionally designed to have most of its mass concentrated at the rim, that is where the forces occur. When a wheel is spinning its outer mass is responsible for centrifugal forces which remain within the plane of the wheel, putting stress on the "spokes". The presence of an additional precessing motion produces other force components known as Coreolis forces, and these do not act in the plane of the wheel, the force vectors point out into space. These forces are smoothly distributed around the rim, Figure 4 showing these Coreolis force vectors at selected points where the length of the arrow indicates the strength. The forces are maximum at the top and bottom of the wheel (but in opposite directions), reducing to zero at each half way point.

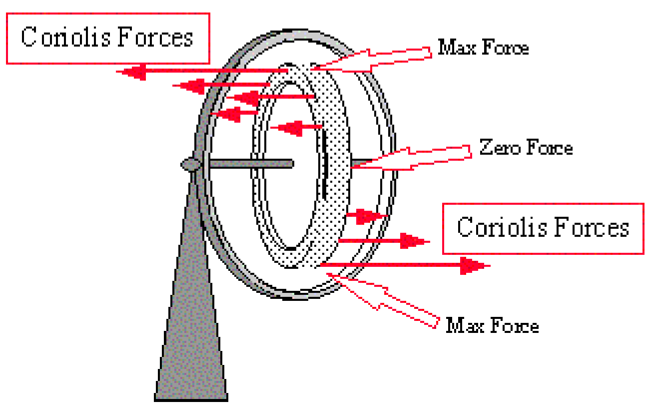

Figure 4. Showing Coreolis Forces.

It is quite educational to construct a static simulation of these Coreolis forces. Here the wheel does not spin (imagine the bearings glued solid), and the forces are provided by tensioned springs. Figure 5 shows such a simulation where the gyroscope, on its pillar, is positioned inside a frame to which the outer ends of the springs are connected.

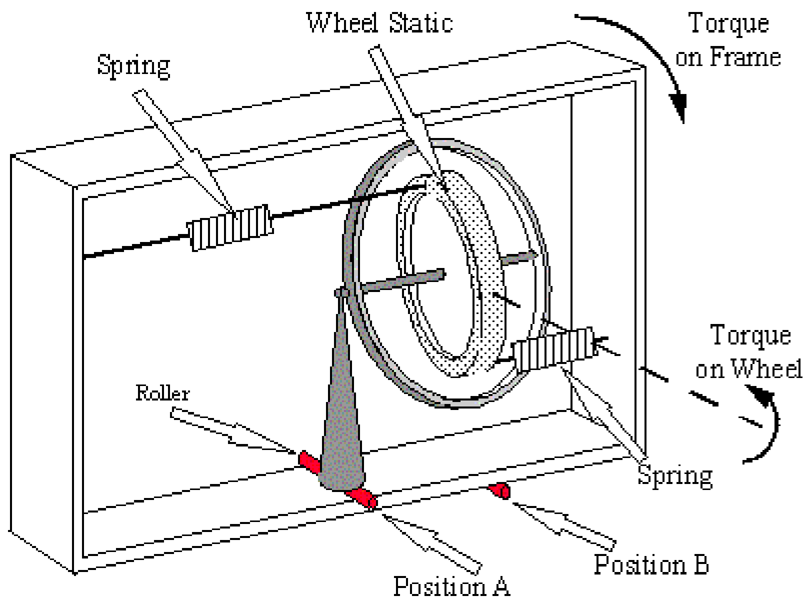

Figure 5. Static Simulation.

The transferred mass centre acting down the pillar can be found by placing a roller under the base of the pillar, where the balance point will be found to be at the centre of the base, position A, which we have deliberately placed at the centre of the frame. If we now take the roller *outside* the frame, the balance point is found to have moved to a new position B. At first sight this seems incredible, how can the balance point move from A to B simply by taking the measurement from inside to outside of the frame? The answer is found in the *reaction torque* in the frame. The tensioned springs apply exactly the same magnitude of couple (torque) to the frame as to the wheel, but in opposite direction. This reaction torque transfers the mass centre from A to the off-centre position B, which of course is where it must be because the whole system is simply an asymmetric assemblage of static masses.

We now pose the question, *where, in the real gyroscopic experiment, is the reaction torque?* Or put another way, *where is the reference frame for the gyroscopic torque?* This question has been asked before with regard to the inertial frame of gyroscopes when used as navigational instruments. To the best of our knowledge the inertial frame is not the Earth, is not even our planetary system, but is in the fixed stars. There is some connection between inertia of matter and the distant parts of the universe. Some philosophers (notably Mach) have claimed that distant matter is responsible for inertia, and this has become known as Mach's Principle.

What is clear from the static simulation, the tensioned springs *apply* a force to the wheel. From the point of view of the wheel, the forces are *externally applied. There is no way the forces can be simulated from within the wheel, because there is then no connection to the reaction frame.* If the only way to simulate Coriolis forces, which are simply one manifestation of mass inertia, is by external application, that surely indicates inertia itself is an external force? The force vectors shown in Figure 4 point out into space, why oh why does conventional science not recognise these as external forces?

3. A Revision to Newton's Laws.

If we accept inertia to be external in nature, then we must revise Newton's Laws. Our first new law must quantify the *external* force $F_{external}$ applied by the æther to a mass when it is accelerating through space. This force opposes the acceleration, so taking m as the mass and $\mathbf{a}$ as the acceleration we obtain

$$F_{external} = -m\mathbf{a} \qquad (1)$$

Note that this has the opposite sign to Newton's. We now introduce a second law which states that the sum of all the forces on a body will be zero, Nature will always produce the acceleration necessary to fulfil this.

$$\sum F = 0 \qquad (2)$$

This equation is the equivalent of Newton's Law of action and reaction, and is simply an elegant way of presenting this mathematically. In combination with equation (1), for a simple system of a single mass receiving a single *applied* force, this leads to the force which must be applied in order to create the acceleration as

$$F_{applied} = +m\mathbf{a} \qquad (3)$$

Thus we arrive at Newton's first Law, but from a different viewpoint to Newton.

The above re-interpretation of Newton's Laws has much to commend it. If we swing a weight around on a piece of string, the string becomes taut, it is in tension. Our text books tell us that such a string in tension must have equal and opposite forces acting on each end, we even give these two forces separate names, centrifugal and centripedal. One is the applied force $F_{applied}$, and its source is readily identified, but the text books fight shy of identifying the real source of the other force, merely quoting the Newtonian view of "matter resisting change from uniform motion".

Another feature still found in mechanics texts is the concept of a "fictional" force. This is defined as force acting at right angles to the motion, hence the force does no work. Both centrifugal and Coreolis forces are therefore classified as "fictional", hardly the right term for something which is so obviously real! There is often to be found in children's playgrounds a piece of equipment best described as a self-powered carousel. This consists of turntable, usually hexagonal or octagonal in shape, mounted on a central pivot, with running-boards on which children can stand and grab-handles for them to hold. Children very quickly learn a technique which gets passed on from generation to generation, whereby as many as possible get onto the carousel holding their bodies outward at maximum radius. A few of the stronger ones push the carousel up to speed before themselves jumping on, then, at a signal from the ring-leader, all the children pull themselves inward. The result is quite exhilarating!! The carousel rotation gets up to speeds well beyond the design limit, usually resulting in bodies being thrown off and the intervention of the playground Keeper! For those sceptics who still hold Newton's view of inertia, this experiment is highly commended. Not only do you feel the centrifugal force on your body acting radially outward, you do considerable work against this force when pulling yourself towards the centre. In so doing you can then feel the Coriolis force acting tangentially on your body, trying to accelerate the angular motion of the carousel. Fictional forces? Humbug!! External forces? Certainly!, you can *feel* them.

5. An Inertial Pump.

Here is another attempt to justify the external nature of inertia by comparison with known electromagnetic effects. The description is of a pump which relies on the inertial properties of the liquid, but the design is evolved in stages. First we have a simple pump which uses back and forth reciprocating motion as shown in Figure 6.

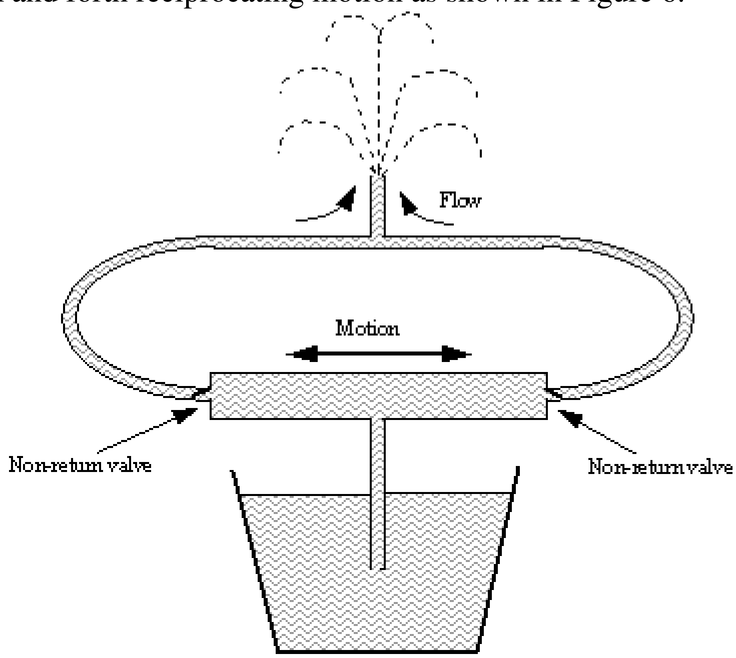

Figure 6. Inertial Pump, Linear Reciprocating Motion.

The pump essentially consists of a cylinder with outlets at each end each enclosing a non-return valve. Back and forth motion causes liquid flow due entirely to the inertia of the liquid. The next evolution is to turn the linear motion into circular motion, as shown in Figure 7.

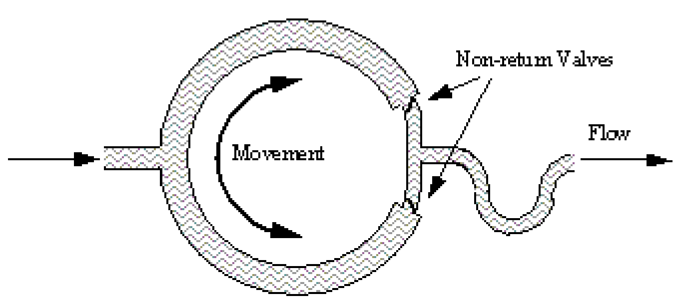

Figure 7.   Inertial Pump, Angular Reciprocating Motion.

Here the cylinder is bent into a circular loop, the pump operating on the same principle as before except that the linear motion has been turned into circumferential motion. Now we reach the final design where we eliminate the reciprocation, Figure 8.

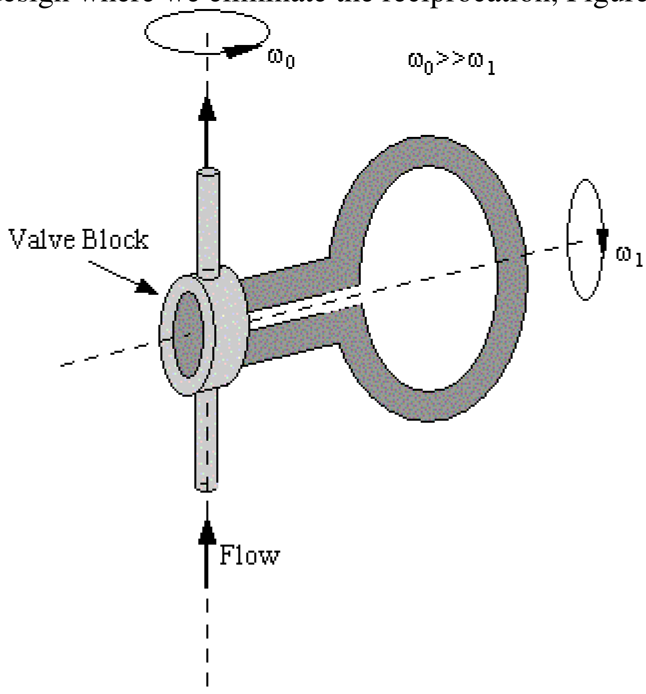

Figure 8. Inertial Pump.

Figure 8 shows the loop placed in a high spin environment ω_0, spinning around the vertical axis. The loop is also caused to rotate (by mechanism not shown) at lower angular velocity ω_1 about a horizontal axis. Thus the liquid within the loop suffers a reversal of spin direction once every half cycle of frequency ω_1. The pressure pulses so caused are rectified, not by non-return valves as in the previous cases, but by a slide valve arrangement fixed to the horizontal axis. This valve block acts exactly like a commutator in an electric generator, indeed the similarity between this liquid pump and the electrical generator ("charge pump") shown in Figure 9 is remarkable.

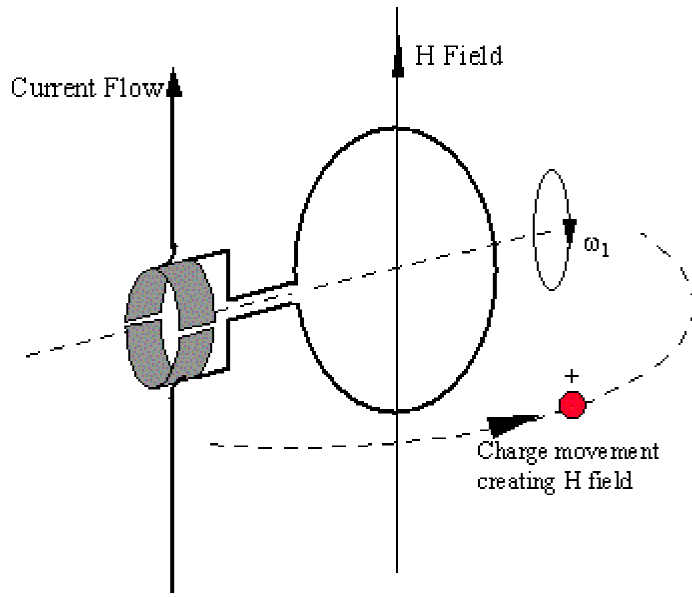

Figure 9. Electric Generator.

The comparison gets even closer when one considers relative motions, in the one case the relative motion between a mass particle in the liquid in the moving loop and the mass particles of distant matter, and in the other case the relative motion between a charged particle in the moving coil and the charge particles responsible for the magnetic field. *The relative motions are identical in form. Surely this indicates that similar actions are at work?* The similarity between mass behaviour in a spin environment and electric charge behaviour in a magnetic field has previously been noted by Sciama. *Why can't modern science now accept the obvious, inertia is NOT an internal property of mass?*

6. Conclusion.

Hopefully readers of this paper, even sceptics, will have the feeling that Newton didn't quite get things right. The next step is to examine the æther in more detail to see how it can be responsible for inertia, and indeed responsible for mass itself. That will be the topic for the next paper in this series.