Cyclones and the Coriolis Force

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***Abstract*. The Coriolis force will be shown to be a real transverse centrifugal force that arises naturally in conjunction with the conservation of angular momentum.**

Centrifugal Force

I. Centrifugal force is the inverse cube law repulsive force which is induced by transverse motion relative to any point in space, and which acts at right angles to the transverse motion that induces it. Since an inverse cube law force field arises in connection with an electric dipole, it follows that an electric dipole must exist at every point in space. Centrifugal force must therefore be a property of space that exists in conjunction with the law of conservation of angular momentum, because the inverse cube law relationship in centrifugal force is dependent on the conservation of angular momentum. It will be considered that space is densely packed with rotating electron-positron dipoles that are aligned solenoidally in a double helix fashion such that their rotation axes trace out magnetic lines of force [1]. Each electron-positron dipole consists of an electron in mutual circular orbit with a positron. An electron is a sink for the aethereal medium which fills all space. This aether is of unknown substance and it is dynamic, compressible, and stretchable. An unknown cause pulls the aether into electrons and the ensuing tension in the aether causes a force of attraction. A positron is an aether source and an unknown cause pushes aether out of the positrons, hence causing a repulsion pressure. Rotational stress in the aether constitutes vorticity which in turn widens the positron sources and tightens the electron sinks. Hence angular acceleration of an electron-positron dipole will induce aether pressure. Aether pressure is otherwise known as positive charge, and centrifugal force is positive charge that has been induced by angular acceleration of electron-positron dipoles. This angular acceleration can be caused by transverse motion of an object through the electron-positron sea. The electron-positron sea, which is a rigid solid, will be called the electric

sea. Centrifugal force takes on the mathematical form m$\mathbf{v}\times\boldsymbol{\omega}$ where $\boldsymbol{\omega}$ refers to the angular velocity, the vorticity, or the circulation.

Compound Centrifugal Force

II. The etymology of centrifugal force tells us that it is an outward fleeing force and we always expect centrifugal force to be a radial force. In a planetary orbit, gravity entrains an extended region of electric sea with it in its orbital motion. This extended region of electric sea is called the gravitosphere and it is the transverse shear stress in the electric sea at the boundary of the gravitosphere that induces the outward radial centrifugal pressure from the electron-positron dipoles in the electric sea. However, this shear stress does not only act on the side of the planet that is nearest to the focus of the orbit. There will also be shear stress on the upper and lower sides of the planet in the axial direction. This will give rise to a mutually cancelling axial centrifugal pressure above and below the planet. On the windward side of the planet's motion in the transverse direction, the electron-positron dipoles of the gravitosphere will become compressed, whereas on the leeward side they will become rarefied. This will lead to an aether vorticity gradient in the electron-positron dipoles in the transverse direction across the gravitosphere. If the planet's motion is compounded with a radial component as is the case in non-circular orbits, there will also be centrifugal pressure induced on both the windward side and the leeward side in the transverse direction. This compound transverse centrifugal pressure will cancel mathematically, but the aether vorticity gradient will result in the windward centrifugal force and the leeward centrifugal force having different physical effects. According to whether the radial motion is inwards or outwards, one of these compound centrifugal forces will be such as to change the direction of the motion, whereas the other will change the speed. (A similar situation arises when an electric current is generated in a wire that moves in a magnetic field [2])

In the case of the planetary orbit, an inward radial motion of the planet will be deflected at right angles into the transverse direction by the windward compound centrifugal force, while the leeward compound centrifugal force will cause an angular acceleration. The windward and the leeward compound centrifugal forces can therefore be individually observed due to their different physical natures, but they cancel each other mathematically

and this leads to the conservation of angular momentum (Kepler's law of areal velocity). When the compound centrifugal force acts to change the direction of a radially moving object, it bears some features in common with the radial centrifugal force, but it also differs in some important respects. In the radial centrifugal force, the transverse speed and the angular speed are totally related to each other. With the compound centrifugal force that causes a change in direction, the radial speed and the angular speed are independent of each other. The electric sea through which the planet's gravitosphere moves is a rigid solid, and so the radial motion that induces the compound centrifugal force is equivalent to motion through a large rigid vortex as opposed to motion through a fluid vortex. The rigidity has the effect of doubling the circulation in relation to the electron-positron dipoles, and so the compound centrifugal force that causes a change in direction takes on the mathematical form $2m\mathbf{v}\times\boldsymbol{\omega}$ where $\boldsymbol{\omega}$ is the angular velocity (or circulation) of the planet. This kind of vortex motion also occurs in meteorological cyclones, and when a rotating object expands or contracts along its radial length. Consider the case of a man who is sitting on a rotating chair with his arms stretched outright. When he brings his arms in, the rate of rotation will increase. As his arms are being brought in, a transverse compound centrifugal force acts to deflect the inward radial motion into the transverse direction and an equal and opposite transverse compound centrifugal force will simultaneously cause an angular acceleration.

Gaspard-Gustave Coriolis

III. In the first half of the 19th century, the French scientist Gaspard-Gustave Coriolis [3] while studying the forces that act in water-wheels, considered a rotating frame of reference and the supplementary forces that we would expect to find in such a frame. He divided these forces into two categories. The first category was the induced forces that oppose the applied forces which are needed to drag an object in the rotating frame. If the object were stationary in the rotating frame, the outward radial centrifugal force would be the only force to consider, providing that the rate of rotation were to remain constant. However, if there were to be any constrained radial motion in the rotating frame of reference, such as in the case of a marble that is constrained to roll along a radial groove in a rotating turntable, then two equal and opposite transverse centrifugal forces would also be induced. One

of these transverse forces would be the compound centrifugal force that has the effect of angularly accelerating or angularly decelerating the marble and hence the turntable. The other induced transverse force would be the compound centrifugal force that changes the direction of the marble. It seems however that in relation to his first category of supplementary forces, Coriolis did not consider the transverse compound centrifugal force that changes the direction of a radially moving object.

The second category of supplementary forces which Coriolis looked at was based on the mathematical transformation equations. Coriolis identified a term $2m\mathbf{v}\times\boldsymbol{\omega}$ which looked like the centrifugal force multiplied by the factor of 2, and he used the name 'compound centrifugal force' for this effect. This compound centrifugal force is nowadays referred to as the Coriolis force in his honour. Coriolis therefore detached the Coriolis force from its physical reality in relation to the conservation of angular momentum in constrained rotating radial motion. He failed to note the restriction on the direction of the Coriolis force which is inherent in the derivation of the transformation equations. The Coriolis force is a transverse effect, whereas Coriolis himself allowed it to swing around in any direction like a weather cock on a pole, according to the direction of the velocity which is inducing it.

The Inertial Effect

IV. The inertial effect in the atmosphere due to the Earth's rotation can be split into the east-west deflection and the north-south deflection. In the case of the east-west deflection, the north-south moving elements of atmosphere are simply following their inertial path. Partial Coriolis force is involved to the limited extent to which the atmosphere as a whole constrains moving elements of itself to the north-south direction. In the case of the north-south deflection, we are witnessing a slackening or tightening up of the radial centrifugal force on the moving elements of the atmosphere in the east-west direction. This leads to a kind of Archimedes' principle in the atmosphere. These collective inertial effects cause the direction of rotation of a cyclone to be determined by the direction of rotation of the Earth, and the Coriolis force will then preserve that direction in connection with the conservation of angular momentum. The Coriolis force in meteorology is therefore a lot more complicated than is commonly believed. It is a real effect which exists in connection with the conservation of angular momentum, and in

meteorology it is also partially connected with the inertial effect of the Earth's rotation. If the Coriolis force were not real, we wouldn't be able to observe cyclonic activity from outer space since it should then only be an illusion that would be observable from a rotating frame of reference. The Coriolis force will in fact be involved in all vortex phenomena including the water that swirls out through a kitchen sink, but the inertial effect which determines the initial direction of rotation in the large meteorological cyclones will not be strong enough to have any noticeable effect on the kitchen sink scale. In the special case of tornadoes, the cyclonic effect of the Earth's rotation would not be strong enough to have any effect in isolation, but the tornadoes form in a region of larger cyclonic activity in which the direction of the angular momentum has already been set by the inertial effect. The Coriolis force in connection with conservation of angular momentum will then ensure that the direction of angular momentum in the surrounding cyclonic activity is transmitted to the tornadoes. The mistake in modern established thinking lies in believing that the Coriolis force is exclusively linked to the inertial effect, whereas in actual fact it is exclusively linked to conservation of angular momentum.

The Foucault pendulum is another situation that involves partial Coriolis force. At the poles, there is no Coriolis force involved in a Foucault pendulum. An artificial circular motion relative to the surface of the Earth is superimposed on the pendulum's actual motion. At other latitudes, the situation becomes a lot more complicated. The inertial effect will exist. But the pendulum bob does not have total freedom of motion. The motion is constrained by its attachment to the pivot, and this has the effect of cancelling some of the inertial effect.

References

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