The General Convective Force

(A General Survey of the Coriolis force and the Centrifugal force)

Frederick David Tombe,
Belfast, Northern Ireland, United Kingdom,
Formerly a Physics Teacher at
College of Technology Belfast, and
Royal Belfast Academical Institution,
sirius184@hotmail.com
20th May 2008, Philippine Islands
(14th August 2008 Amendment)

Abstract. A combined expression for Coriolis force and centrifugal force of the form vXω can be obtained by differentiating a velocity vector with respect to time. It will be discussed how the Coriolis force arises when v and ω are independent of each other, and how the centrifugal force is an outward radial effect which occurs when v and ω are directly related to each other.

The Picoscopic Scale

I. If we consider a velocity vector without reference to any particular system of coordinates and then differentiate it with respect to time, the resulting acceleration has a component at right angles to the direction of motion given by the expression **v**X**ω** where **v** refers to velocity and where **ω** refers to the angular velocity. This expression could refer to either a centrifugal force or a Coriolis force and the **ω** term could refer to the vorticity of the aether. We see this expression in the well known Lorentz force law in electromagnetism and it has been discussed in 'Centrifugal Force in the Electric Circuit' at,

http://www.wbabin.net/science/tombe42.pdf

how it can either refer, on the picoscopic scale, to a fine-grain Coriolis force or a fine-grain centrifugal force in the electron-positron sea, depending on the circumstances. When the **v** term and the **ω** term are directly related, we will have a centrifugal force giving rise to magnetic

repulsion, whereas when the two terms are independent of each other, we will have a Coriolis force giving rise to electromagnetic induction.

The Large Scale

II. Kepler's law of areal velocity tells us that all the aether vorticity has been absorbed by the electron-positron sea and that its effects have been devolved to the topic of magnetism. As such, in order to obtain a Coriolis force on the large scale without involving the magnetic field, we need to have a situation in which a motion is constrained to rotate [1]. One such example would be that of a marble rolling along a radial pipe fixed on a rotating turntable. The Coriolis force induced on the marble would be a tangential effect described by the expression $2m\mathbf{v}X\boldsymbol{\omega}$. The reason for the additional factor of 2 is because in this situation, space effectively behaves like a rigid solid, rotating as a whole body, and as such, the vorticity is equal to twice the angular velocity. This induced Coriolis force will oppose the rotation that is causing it (Lenz's law). A torque will therefore need to be externally applied in order to cancel or override the induced Coriolis force.

Cyclones

III. An object which attempts to move radially in a rotating frame of reference will experience a tangential deflection superimposed upon its motion unless the radial motion is constrained. This superimposition effect should not be confused with Coriolis force. Coriolis force does not affect the magnitude of a velocity.

An interesting example occurs in meteorology. When an element of air moves into the centre of a cyclone in a north-south direction, the surrounding atmosphere that co-rotates with the Earth's rotation will attempt to constrain this element of air to the north-south path. But since the bonding is weak, the applied torque will be insufficient and so the element of air will deflect to the east or to the west. The torque supplied by the surrounding atmosphere will however cause a spiral effect in the cyclone which can be viewed as a real effect from outer space.

Had there been absolutely no restraining effect at all on the moving element of air, the element would have carried on in its inertial path which would have been viewed from space as a straight line motion.

The deflection associated with east-west air currents in a cyclone can at least in part be attributed to a slackening or a tightening up of the centrifugal force as compared to the centrifugal force acting on the surrounding atmosphere.

Another interesting example involving negative effects is that of the Foucault pendulum. The swinging bob is constrained in its motion by its physical connection to the fulcrum which is co-rotating with the Earth. This constraint works in conjunction with the superimposed artificial tangential deflection.

Only at the poles is the swinging bob totally unrestrained, and as such the precession effect at the poles is a pure artifact. The Coriolis force would not appear to be involved in the Foucault pendulum at any latitude.

Action and Reaction

IV. On the large scale, a radially outward centrifugal force occurs between any two objects that possess a mutual tangential speed. This fact is denied in modern science, but even a straight line motion as measured from a fixed origin will possess an outward centrifugal acceleration along the radial line connecting the particle with the origin. The physical action that causes centrifugal force is actually a knock on effect from what is going on at the fine-grain level between the electron-positron dipoles of the electric sea, and it will be discussed in 'The Cause of Centrifugal Force' at,

http://www.wbabin.net/science/tombe43.pdf

In a planetary orbit, the radially inward centripetal force is supplied by gravity and as such it is totally independent of the outward centrifugal force. However, in simple everyday cases of circular motion, the centripetal force is a reaction to the outward centrifugal force in the same way as normal reaction is a reaction to weight. The object undergoing circular motion experiences a centrifugal force which gives it a centrifugal weight. In the case of an object on the inside wall of a rotating cylinder, the outward centrifugal weight of the object will induce the wall

to exert a reactive inward centripetal force on the object. In the case of an object being swung around in a circle on the end of a string or a spring, the outward centrifugal weight of the object induces a reactive inward centripetal tension in the string or the spring.

The Gyroscope

VI. In a toppling pivoted spinning gyroscope we can observe the induced Coriolis force. The moving elements on the gyroscope rim move through the aether as the gyroscope topples under gravity. This means that parts of the rim are effectively moving in rotating aether. This generates a Coriolis torque on the falling gyroscope that causes it to precess sideways and then upwards.

References

[1] The Coriolis force actually does occur in a Keplerian orbit, but it reverses its direction cyclically, and it is always cancelled out by an equal and opposite angular force resulting in ongoing zero tangential force. In the absence of vorticity, there is no ongoing net induced Coriolis force that is not cancelled by an equal and opposite angular force.