

# **Turbulence, Vorticity and the Coriolis 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  
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**Abstract. There is a common misunderstanding that the Coriolis force is something that is necessarily tied up with the Earth's rotation. It is true that the direction of rotation of large scale vortex phenomena in the atmosphere and the oceans is determined by the Earth's rotation. But Coriolis force is a real force which is visible in all vortex phenomena from large scale cyclones to small whirlpools in a disturbed fish tank, and it is visible from any frame of reference.**

**This article examines the distinction between the real hydrodynamical Coriolis force on the one hand, and the effect which causes the cyclonic behaviour in the larger vortices in the atmosphere and the oceans on the other hand. The latter effect is commonly mistaken for Coriolis force itself.**

## **Conservation of Angular Momentum**

**I. Bernoulli's Principle is essentially a statement of the principle of conservation of energy in a fluid. In conservative systems it is generally considered that only irrotational forces are involved. This however is not quite true. It is true that there will be no net tangential force involved in a conservative system. But conservation of angular momentum still allows for the separate physical existence of Coriolis force and angular force, providing that they cancel each other out numerically.**

The interplay of Coriolis force and angular force can be observed in any vortex motion and indeed in any non-circular Keplerian orbit. A radial motion will arise as a result of a sink, a source, a region of low pressure, or a region of high pressure. Let's consider the case of an inward radial motion towards a sink. As the element of fluid moves radially inwards, the angular force will increase in the tangential direction giving rise to an increase in the magnitude of the angular acceleration. Meanwhile, the radial direction itself will be rotating. The sideways deflection of the radial motion in the opposite direction to the angular force constitutes the Coriolis force. The Coriolis force and the angular force will cancel numerically, hence giving rise to conservation of angular momentum. But they will each be observed physically. Hence in any vortex motion, whether it is in the turbulence in the air behind the wing of a jet that is taking off, or on the surface of a lake that is disturbed by an oar, there will be a Coriolis force acting which will be rooted in the inter-molecular bonds of the fluid. This in turn points to the vortex nature of atoms as was suggested by Lord Kelvin.

## **The Cyclonic Effect**

**II.** The cyclonic effect refers to situations in which the direction of rotation of a vortex is determined by the rotation of the Earth, and hence by which hemisphere the effect is taking place in.

In a large scale vortex phenomenon such as a cyclone, when an element of air moves, it will have inertia. When moving in a north-south direction, this inertia will deflect the element in an east-west direction relative to the surface of the Earth, due to the Earth's rotation. This effect is often confused for Coriolis force itself, but it is not even negative Coriolis force. The larger body of the atmosphere surrounding this moving element will be co-rotating with the Earth's rotation, and so there will be a mutual interference. A partial Coriolis force will be applied on the moving element by the larger body of atmosphere. Throughout the cyclone as a whole, elements of air will be moving radially inwards from all directions. Elements that begin moving in the east-west direction will experience a slackening or tightening up of centrifugal force. This will give rise to a kind of rotational Archimedes' principle, and as such these elements will be deflected into the north-south direction. As in the case of the elements that had initially been moving in the north-south direction, these elements will interfere with the larger co-rotating body of atmosphere. The net result of this interference all the way around the cyclone will be to

produce an angular momentum and hence a vortex. Conservation of angular momentum will then result in a continually increasing Coriolis force on all the radial motion in the cyclone. This will be counterbalanced by a continually increasing angular force. In an anti-cyclone these two effects will be continually decreasing with the outward radial motion.

In the case of smaller vortex phenomena such as tornadoes or the water swirling out of the kitchen sink, the cyclonic effect will not be strong enough to overcome any existing angular momentum. However, in the case of the tornado, there will nearly always be a cyclonic angular momentum already in existence in the body of atmosphere that it forms in.

### **Conclusion**

**III.** The denial of real hydrodynamical Coriolis force in modern physics, along with the denial of the rigid electron-positron sea of molecular vortices, has resulted in the denial of real hydrodynamical Coriolis force being applied to that rigid electron-positron sea, where it then becomes involved in electromagnetism, as well as in misunderstood rotating rigid body motions such as are observed in rattlebacks and gyroscopes. See ‘The Cause of Coriolis Force’ at,

<http://www.wbabin.net/science/tombe55.pdf>