The Coriolis Force and the Rattleback

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Abstract. **The rattleback (Celtic Stone) is the most mysterious phenomenon in classical mechanics. It reverses its angular momentum by inducing a Coriolis pressure from the dense background sea of rotating electron-positron dipoles which is the medium for the propagation of light. [1]**

Magnets and Rattlebacks

I. Magnets and rattlebacks share in common the fact that they involve a mutual alignment of the spin moments of their constituent atoms and molecules. They differ however in that rattlebacks involve a rotation on the large scale in order to bring this alignment about. In magnetic materials, the induced spin alignment results in a linear force, whereas in rattlebacks, the induced spin alignment results in a reversal torque which opposes the initial rotation. Another important difference is that rattlebacks are generally made of materials which are not as dense as magnetic materials. **[2]**

Gravity and Friction

II. Gravity acts vertically downwards and so the reversal torque in a rattleback cannot be sourced in gravity. Sliding friction is involved in that it dissipates the entire motion, but sliding friction by its nature is not something that could cause a reversal torque. Static friction is necessary in order to enable the rocking stage of the rattleback's cycle. Without static friction, a rattleback will not work. However, static friction by its nature is not something that could actually go as far as to cause a reversal torque.

Forging a Torque by Mathematical Manipulation

III. It has been customary in the past to resort to mathematical manipulations in order to try and explain the rattleback mystery. A few pages of difficult mathematics will not however produce the reversal torque. We need to first of all physically identify the reversal torque before we can involve it in any mathematical calculations.

The Asymmetrical Factor

IV. One-directional rattlebacks are generally elongated with two arms. Each arm will have its own centre of mass. When the rattleback rotates, the centrifugal force will act through the centre of mass of each arm. If the centrifugal force is directed out of the plane of rotation, then the rotation axis is asymmetrical, and an axial precession occurs. Asymmetry is also a key factor in the two-directional rattleback.

Ampère's Circuital Law

V. The reversal torque in a rattleback, by its very nature, clearly exhibits the hallmarks of an axial Coriolis force. We are watching a rotating object having its axis of rotation rotated and its angular momentum being reversed. As in the case of a gyroscope, we are dealing with an extrapolation of Ampère's Circuital Law in which the constituent atoms and molecules mutually align due to a circular electric current which is caused by the background sea of rotating electron-positron dipoles permeating between the atoms and molecules. We therefore have a compound motion involving spinning objects that are undergoing a linear motion in the electron-positron sea. This will induce compound centrifugal pressure between the molecules and the electron-positron wind, but due to the rigid nature of the rattleback or gyroscope material, this pressure will not be free to manifest itself unless it is liberated by additional factors. In the case of the gyroscope, we need to introduce a forced precession in order to liberate this compound centrifugal pressure, which is known as the *Coriolis force*. In the case of the rattleback, when it is rotated on an asymmetrical axis, the equatorial planes of the spinning constituent molecules will be set at an angle out of the equatorial plane of the large scale spin, and as such the Coriolis force acting on the molecules will cause the large scale equatorial plane to precess.

The One-Directional Rattleback

VI. A one-directional rattleback may actually rotate on a symmetrical axis, in which case it is the rocking motion which is the determining factor. Consider a one-directional rattleback, symmetrical in shape apart from pointers that are attached to the end of each arm, such that they can be adjusted to any angle in the plane of rotation. During the rotation, the centrifugal force will always be in the plane of rotation. However, providing that the rotation is not too fast, the instability will inevitably result in a random rocking motion on top of the rotation. If the pointers are set perpendicular to their respective arms but pointing in opposite directions to each other, the rocking motion will induce a Coriolis torque. This Coriolis torque will cause the rocking axis to precess in sympathy with the pointers, if it is not already precessing in that direction.

The Two-Directional Rattleback

VII. Two-directional rattlebacks are rounder than one-directional rattlebacks yet they still exhibit a distinct asymmetry in shape. In these cases, it is the compound motion as between the rotation and the rocking motion which is acted on by the reversal torque. Hence the rattleback is forced to reverse its angular momentum irrespective of the initial direction of rotation.

References

[1] Tombe, F.D., "The Double Helix Theory of the Magnetic Field" (2006)
http://www.wbabin.net/science/tombe.pdf

[2] Tombe, F.D., "The Coriolis Force in Maxwell's Equations" (2010)
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