

On the Cause or Causes of Inertia

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This article sets out two possible causes of inertia. The first is that a sub-atomic substance - aether - restricts the movement of atoms and atomic matter. The second is that vibrations within atoms restrict the movement of atoms and atomic matter.

1. Introduction

What is inertia? In their treatise, *Principles of Mechanics and Dynamics*, William Thomson (Lord Kelvin) and Peter Guthrie Tait define inertia: [1]

"Matter has an innate power of resisting external influences, so that everybody, as far as it can, remains at rest, or moves uniformly in a straight line.

"This, the Inertia of matter, is proportional to the quantity of matter in the body. And it follows that some cause is requisite to disturb a body's uniformity of motion, or to change its direction from the natural rectilinear path."

The question of the cause of inertia has perplexed scientists for many centuries. Much work has been done to determine the cause, but to this day no specific cause has yet been generally accepted by the scientific community.

This article suggests two separate causes of inertia.

The first is based upon the proposition of the existence of aether, a sub-atomic substance that permeates the universe. This approach assumes that aether is a material substance that is subject to Newton's Laws of Motion. Thus, when aether interacts with material objects, it restrains their movement.

The second proposal contemplates that vibrations in the structure of atoms restrain the movement of atoms and atomic matter.

These two approaches fundamentally differ. One involves the interaction of aether with atomic matter, whereas the other is an intrinsic property of matter, namely vibrations.

Amitabha Ghosh poses this question: [2]

"...is the inertia of an object an intrinsic property of matter (irrespective of the presence of other matter in the universe) or is it nothing but the manifestation of the interaction of the moving object with the other matter present in the rest of the universe?"

Which concept is preferable? Or, might the cause of inertia be a combination of them both?

2. The Aether Approach

The aether approach is based upon the propositions that aether is a material substance, that it pervades the universe, that it is sub-atomic in size, and is subject to Newton's Laws of Motion.

The aether cause-of-inertia proposal is essentially derived from the author's cause-of-gravity concept that is set out in two articles: *The Cause of Gravity: A Concept*; [3] and *Flowing Aether: A Concept*. [4]

The cause-of-gravity concept is briefly as follows: Cosmic bodies expel aether cells into space where they condense into groups of aether cells that flow back into cosmic bodies. The expulsion and inflow are cyclic and continuous. The inflow is caused by a pressure difference between aether in cosmic bodies (lower pressure) and aether in space (higher pressure). The lower pressure in cosmic bodies is caused by the expulsion of aether cells. The process is like that of a household vacuum cleaner. It expels air and this reduces the air pressure in the machine below the ambient air pressure, thus causing air to flow into the machine. The one-way force of gravity is the result of the emitted aether cells being extremely small, tending to pass on through atomic matter, whereas the returning groups of aether cells are larger, tending to collide with atomic matter and push it toward cosmic bodies.

Both the gravity and the cause-of-inertia concepts are built upon the proposition that aether interacts with atomic matter in accord with Newton's Laws of Motion. Based on this assumption it is argued that aether that surrounds and interacts with atomic matter restrains its movement. Put another way, the presence of surrounding aether tends to keep matter in place, and force is required to overcome this restraint.

In effect, this proposal is akin to Mach's Principle which ties all movement in the universe to everything that exists in the universe. As stated by Ghosh:[5]

"'Mach's Principle' ...proposes that the inertia of an object to acceleration is due to the resistance generated by its interaction with the matter present in the rest of the universe."

However, for all practical purposes it is not necessary to look to the whole universe to comprehend the essence of the present cause-of-inertia proposal. The contribution of far-away aether to

close-at-hand inertia must be miniscule. It is the direct interaction of atomic matter with adjacent aether that the present concept of inertia is aimed at.

In summary, the aether proposal is that aether is a material substance and, like any other material substance, is subject to Newton's Laws of Motion. Applying Newton's laws to aether offers an explanation for aether having a restraining effect upon atomic matter.

It is noted that two recent published articles advocate the interaction of aether and atomic matter as the cause of inertia. [6,7]

3. The Vibrations Approach

It is an undisputed fact that atoms vibrate. The proposal here is that the vibrations of atoms cause atoms and atomic matter to resist movement.

It is well known that rotating or spinning objects, such as fly-wheels and gyros, resist being moved off their planes of rotation. This observation is equally applicable to pendulums that oscillate back and forth. A good example is the Foucault pendulum. It maintains its plane of oscillation while the Earth rotates beneath it. It stands to reason that vibrating objects must have the same property. As stated by Eric Laithwaite: [8] "... an oscillating mass has all the properties of a wheel and mathematically may be so represented." In all these situations, there are back and forth oscillations of matter, each having its own plane of oscillation. This common factor ties planes of oscillation to the observed resistance to movement.

The centre of a body's inertia depends upon the movements and the masses of each individual part of the body. As stated by Thomson and Tait: [9, 10]

"The kinetic energy of any system is equal to the sum of the kinetic energies of a mass equal to the sum of the masses of the system, moving with a velocity equal to that of its centre of inertia, and of the motions of the separate parts relatively to the centre of inertia."

And:

the products of the masses of all the particles each into the square of its distance from the axis."

The argument here is that when a force moves an object, the movement changes the planes of vibration of virtually all the atoms that comprise the object. It stands to reason that the collective vibrations of the object's atoms provide the object with a measure of resistance to movement. This resistance is innate to atomic matter.

The above-cited Thomson and Tait treatise deals extensively with the physics of gyrostats. [13] The treatise examines the movements of frameworks that have gyrostats attached to them. The results show that the gyrostats have inertial effects on the

frameworks. For those interested in further exploring the inertia proposal, you will find that the treatise is a treasure trove of information.

The inertia proposal is restricted to vibrations. Many scientists view atoms as containing spin, rotation and/or vortices. These phenomena involve reciprocal movements that provide resistance to changes of their planes of oscillations, just like vibrations. In view of this, why not extend this proposal to spin, rotation and vortices?

The answer lies in the necessity of atoms having structure. While vibrations are part and parcel of solid structures, spin, rotation and vortices are the antithesis of structure. Visualize matter in its solid state. In order to form solid structures, atoms must be firmly attached to each other. The idea of atoms being made up of spinning or rotating or swirling parts, runs counter to the property of stability of structures. In regard to atoms in their gaseous and liquid states, they need structure. The liquid and gaseous state atoms are in constant motion and collide with each other. They need structure to withstand these collisions. In addition, no matter what state atoms are in -- solid, fluid or gaseous -- they need the stability of structure to enable them to contain their immense energy. This is not to say that atoms cannot be structured so as to enable them to hold particles that spin, rotate or form vortices. However, in order to accommodate and contain these phenomena, elaborate structures would be needed. On the present state of knowledge of atoms, that prospect does not appear likely. Accordingly, the cause-of-inertia proposal is restricted to vibrations.

4. Conclusion

This article presents two separate versions of inertia. Each suggests a means of resistance that a force must overcome to cause movement. The author has not, as yet, found a convincing rationale that falsifies and therefore eliminates either of the two concepts.

It is suggested that the cause of inertia may be a combination of interaction of matter with surrounding aether and the innate property of matter, namely vibrations.

Might one be preferable as being more powerful than the other? Assuming that vibrations in atoms are an aspect of electromagnetism and a means of storage of the immense energy that atoms are known to possess, and that the pushing force of aether is likely small compared to these electromagnetic forces, it is suggested that vibrations in atoms are probably the dominant cause of inertia.

References

- [1] W. Thomson (Lord Kelvin) and P.G. Tait, *Principles of Mechanics and Dynamics, Part One*, (Constable and Company, Limited, London, 1962), pp. 222-223, para. 216.
- [2] A. Ghosh, *Mach's Principle and the Origin of Inertia*, edited by M Sachs and A.R. Roy, (C. Roy Keys, Inc., Montreal, 2003), p. 13.

- 3] D.W. Shaw, *Phys. Essays*, 25, 66 (2012).
- 4] D.W. Shaw, *Phys. Essays*, 26, 523 (2013).
- 5] Ref. 2.
- 6] G. Boersma, *Phys. Essays* 27, 259 (2014).
- 7] M. Sato and H. Sato, *Phys. Essays*, 28, 95 (2015).
- [8] E. Laithwaite, *An Inventor in the Garden of Eden*, (Cambridge University Press, Cambridge, UK, 1994), p. 243.
- [9] Ref. 1, at p. 259, para. 280.
- [10] Ref. 1, at pp. 259-260, para. 281.
- [11] Ref. 1, chapter 2, pp. 219-439, paras. 205-368.