

Letter to Editor

Greatest Discovery in Newtonian Mechanics

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Newton wanted to reconsider his laws of motion when he was in mid-sixties. This fact has remained almost unknown even though it has been reported by Anthony French in a letter in Am. J. Phys. 1984 [1]. The title of that letter is “Did Newton forget his own laws of motion?” It remained in my mind because I was aware of the report of John Warren in Physics Education, UK, 1971 [2].

That report shows even engineering students have two contrasting ideas about the circular motion, one Newtonian idea learnt formally in earlier school and other pre-Newtonian idea learnt through daily experiences since childhood. Here, I have to note that even Einstein used to say that a child learns half of physics by the age 03, as per an article of Roger Osborne in The Physics Teacher, 1984 [3]. Let me explain how Newton’s introspection and Warren’s report support each other and automatically proving Warren’s report as the greatest discovery in Newtonian mechanics.

Statement of Newton’s First Law of Motion

A steady body remains steady OR a body in uniform motion continues to be in the state of uniform motion, unless it is acted upon by an unbalanced force. But the question is How to set a steady body in motion? In other words, how to make an artificial motion? Newton could explain the reason behind Kepler’s third law of planetary motion because planetary motion is a natural motion. But our daily experience includes many artificial motions as well, for example shifting a box from one place to other. I think Newton realized the need of explaining artificial motion, when he was in mid-sixties, and therefore felt the need of having a principle for putting bodies in motion – like driving a car on road. Hence the title of my talk: “Did Newton really forget his own laws of motion?” [4].

Warren’s Investigation

His problem is based on the uniform circular motion of a car with constant speed and air resistance is neglected. Students were asked to show the resultant force acting on the car with an arrow. Observations reported by him are given below.

1. Nearly 50% students of engineering ignored centripetal force and considered the forward force of engine as the resultant force.
2. About 40% students gave inclusive answers.
3. Only about 10% students gave the expected answer that is centripetal force.

Why Warren’s Observation is the Greatest Discovery Mechanics

Our conventional entrance examinations include questions based, frequently, on natural motion of planets. Hence students tend to prefer the expected answer in order to have sufficient marks for getting admission in engineering. But the issue of artificial motion does remain latently in students’ minds, exactly like in Newton’s mind in mid-sixties. If a teacher continues to be unhappy with “forward” force of engine, then engineering students will question the need of engine in car. I this point first in Physics Education, UK 1984 [5].

Another reason for the greatness of Warren’s observation is the fact that all planets of our solar system are orbiting the Sun in one and the same direction. That feature prevented us from thinking of what would be the direction of resultant force if the motion is in reverse direction? This why I have called our solar system as a troubling one [6]. But artificial motion can be anti-clockwise or clockwise and hence half of Warren’s students chose forward force of engine and ignored centripetal. This is also a reason why Josie left physics after studying for one year and joined biology [7].

In short, John Warren unknowingly showed the similarity between engineering students’ thinking and Newton’s exceptional introspection and so I consider his report as the greatest discovery in Newtonian mechanics. Sadly, he passed away on 02 December 2016, at age 93, and so I am dedicating this letter to his memory.

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