Marinov vs. Newton's Third Law

As far as I know, nobody has ever gone into a laboratory and observed a violation of Newton's third law (equality, opposite-ness, and collinearity of action-reaction forces). For this reason, Marinov's report [GED **9**, 36 (1998)] of such observations was of sufficient interest to me to motivate some attempts at repetition. Unfortunately, his account was entirely qualitative, giving no indication of the strengths of currents or magnets he used. The only information is in his Fig 1, which shows two horizontal, oppositely-oriented cylindrical bar magnets, one above and one below a horizontal conducting rod. This balanced assembly is suspended by a string so that it is free to turn in the horizontal plane. The conducting rod is part of a DC circuit with "copper wires leading to a battery attached to its ends."

Presumably the copper wires were very flexible, or he used very high currents. This did not appeal to me as a definitive way to go about doing the experiment, since lead effects could always be blamed for whatever might be observed. (It's the same with dowsing experiments: as long as the dowsing rod is connected to a human being, the performance of either can always be attributed to the other.) So the first thing I tried was mercury contacts. I made an assembly resembling Marinov's picture with 5/16-inch diameter Alnico bar magnets, each 20.3 cm long, of field strength measuring about 3700 gauss (by a transverse Hall effect Gaussmeter probe inserted between two of them). These were epoxied to a central brass rod of 3/16-inch diameter and 27.7 cm length. Suspension was by a 15-cm length of 20-lb test fishing line monofilament. Attached to the ends of the brass rod were 1/8-inch diameter tungsten rods about 3-cm long. These dipped into mercury cups formed from plastic caps of 4.5 cm diameter. Similar fixed tungsten electrodes dipped into the far sides of the mercury pools contained in these caps. To avoid chemical actions, only inert tungsten touched the mercury.

I should record that the tungsten rods had roughly hand-polished surfaces, and that the mercury was introduced into the cups with an eyedropper, which brought the surface up gradually, while the suspended assembly with its attached electrodes was in position. The result was that the electrodes slightly dimpled the surface without being "wetted" by the mercury. This turned out to be quite important, since it induced what may be termed a "skating" mode of contact of the electrodes with the mercury, similar to that of a water spider on water. This contrasted with a "wetted" mode, later induced by lowering the assembly less gently into the mercury. Between these two modes (which exploit surface tension in entirely different ways) there were orders of magnitude of difference in sensitivity to small forces applied to the assembly. In the skating mode, a small push caused the suspended assembly to "coast" - that is, to continue any imparted motion. But in the wetted mode, the surface tension of the mercury (seven times that of water) acted along and was proportional to the length of a "waterline." This "grabbed" the electrode and prevented all coasting motions. The tendency to wetting of the electrode seems to be enhanced by surface contamination of the mercury, so for maximum sensitivity it is important to keep the mercury as clean as possible. Both skating and wetted modes were found to be equally effective in passing electrical current.

With the assembly in the skating mode, it was observed that currents as small as 3 ampères (DC) turned on for only 3 seconds sufficed to cause an immediate turning of the assembly in the direction claimed by Marinov. Greater currents seemed to induce more vigorous turning. Reversal of the current direction reversed the sense of turning. Although the mercury surface in the cups was curved slightly in the radial direction, the electrodes would "climb the hill" as readily as "coast down it" - so gravity effects were judged to be inconsequential. This all supported exactly what Marinov said. Later, after the mercury had wetted the electrodes (and the mercury surface had become contaminated through a misguided attempt to "lubricate" the electrodes with vaseline), no visible turning, or other motion, could be induced with currents up to 42 amps for 3 seconds. At this point it appeared that Newton's third law was indeed violated.

To settle this matter, another experiment was undertaken in which the suspended assembly was entirely unconnected to anything else in the environment, apart from ambient air. A 6-volt lantern battery as well as a mercury tilt switch and a radio-controlled actuator for this switch (improvised from a Toys 'R' Us radio-controlled toy) were all attached to the suspension, along with a laser diode pointer that cast a red spot on the wall to enable small motions of the assembly to be observed. The purpose of the radio control was to eliminate initial velocity transients when the battery was turned on by mechanical action. A power resistor was included that limited current to about 4 ampères.

Unfortunately the radio control was not too successful, as the battery turn-on impulse induced a visible jarring that activated rocking degrees of freedom, soon translated into azimuthal motions. However, in every case it was observed that when current flowed the assembly initially turned in the sense predicted by Marinov. Then the turning ceased and the assembly swung back in the opposite direction ... but while DC continued to flow, it seemed never fully to recover its initial equilibrium position. At this point it looked as if Newton was definitely on the canvas and down for the count.

Then the bubble burst. I removed the magnets and tried it with no magnets on the assembly. The turning reproduced identically to what I had observed with the magnets present. I then jumped to the conclusion that some asymmetry of the wiring, acted on by the earth's magnetic field, was probably responsible for the observed turning effects. I should be interested if some observer living in the southern hemisphere might observe turnings in the opposite sense from those reported by Marinov. Meanwhile I have dropped my investigations in favor of other activities. As far as I am concerned Newton remains correct about his third law, to which magnetic forces offer no proven exception.

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I wish to thank Dr. J. D. Kooistra for steering me toward "Toys 'R' Us", an unsuspected resource. Possibly what I found about "skating" of electrodes may prove useful.

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