Magnet Symmetry and Newton's Third Law

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As teachers of classical mechanics at the introductory level for some time, we had always lacked a simple demonstration of Newton's third law. Sure, allowing a balloon to fly around demonstrates the principle, but due to the randomness of the flight, the observation is not very convincing. Many teachers, after hearing about, or seeing demonstrations at meetings, have taken to using a CO_2 fire extinguisher to propel themselves backwards while sitting on a cart. This works reasonably well, but the action-reaction pair does not stay around long enough to be viewed as such.

While contemplating the problem students have in believing that a ball in free fall attracts the earth as much as the earth attracts the ball, one of us (RC) picked up a pair of equal-mass horseshoe magnets.[1] When such magnets are placed on an overhead projector, you can project their shadows so that even a large class can see them. When these magnets are held together with both like poles touching (Fig. 1), they each desire the other to be gone. Upon being released, they slide away from each other for a relatively small distance on the slick glass surface of the projector. As shown in Fig. 2, beautifully symmetric patterns appear in the final state.

The ball-earth model can be obtained by reversing the procedure, i.e., having the magnets attract each other. If you use magnets with different masses, you can demonstrate approximately the motion of a freely falling ball. ♦

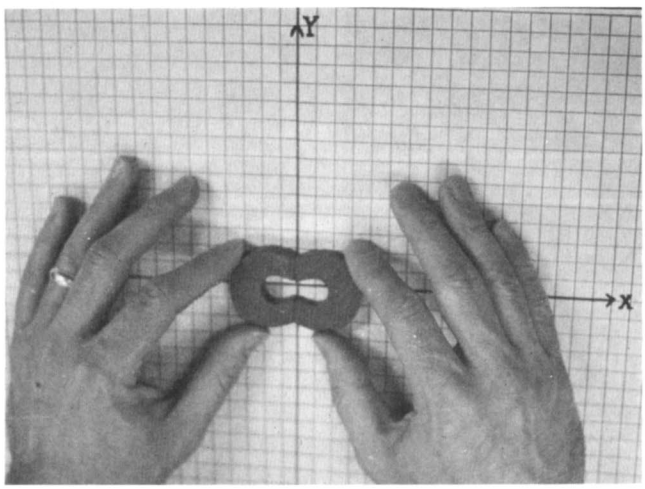

Fig. 1. Initial positioning of the magnets.

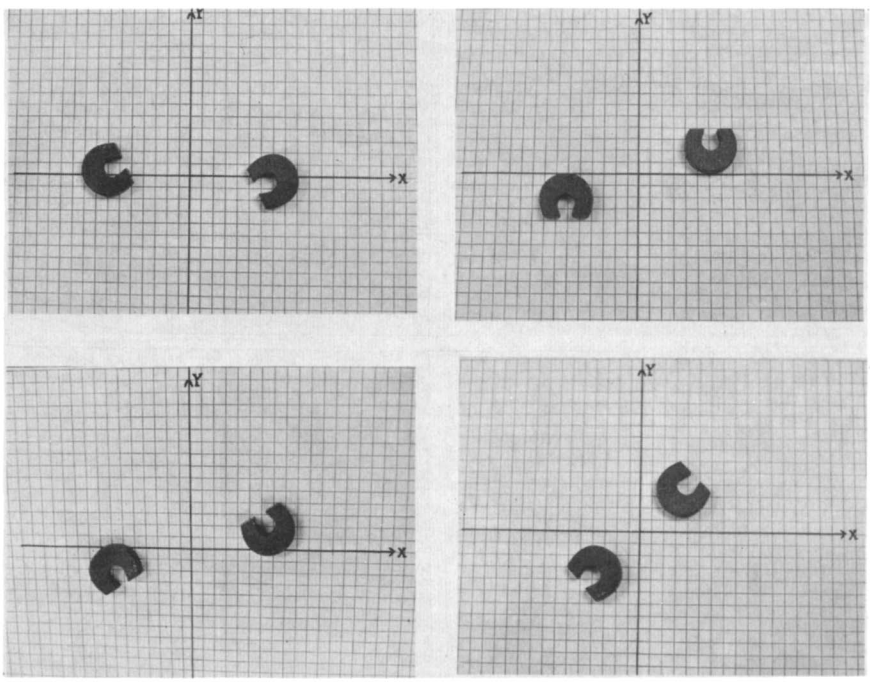

Fig. 2. Four possible final states of the magnets.

Reference

1. CENCO, Alnico 1 Horseshoe Magnet #78326-02 at $6.50 each.