Group Image 1

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When capturing this photograph I was working in conjuncture with two other students in the course Christopher Svedman and Peter Mitrano. We were experimenting with various fluid behaviors at a boundary region between two liquids of differing viscosity. The set up of the experiment was a layer of corn syrup beneath a layer of water inside of a rectangular glass flower vase (see diagram in appendix for details). The fluid behavior actually show was not expected but produced a stunning phenomenon that was hard to image. In this image a drop of fountain pen ink was dropped carefully just above the surface of the water, while sinking it contacted the boundary layer between the corn syrup and the water, and astonishingly actually created a Worthington Jet off of the corn syrup.

The set up for this image was fairly rudimentary and could be easily reproduced. The experiment took place in a small clear glass flower vase with dimensions of approximately 10.8 cmx7.0 cmx15.25 cm. The corn syrup layer with a depth of approximately 4-5 cm was poured in slowly first to ensure no air or water bubbles formed within it. Next, a layer of water was added of similar thickness on top of the corn syrup. The ink was placed on the water surface using a fountain pen ink adapter which is similar to a syringe but is operated by a screw driven plunger and with an opening approximately 3mm across. The drop was placed by touching the open end of the adapter on to the water surface rather than dropping it reduces the initial velocity of the ink. The ink used was a black permanent fountain pen ink made by Parker Brand Quink. The only negative properties of this image are that phenomenon is not in focus. This is due to the rapid nature and uncertain location of the phenomenon. Despite this draw back the creation of a Worthington Jet underwater is a stunning one.

The physical phenomenon of a Worthington Jet is usually created by a drop of fluid falling through the air onto the still surface of another fluid. The kinetic energy of the falling drop depresses the surface. Then the surface tension of the fluid surface begins to rapidly correct for the depression and while doing so builds up sufficient momentum to both create an upwards jet of fluid, and in some cases even allow for a secondary drop to be ejected upwards from the top of the jet. What makes this image unique is the fact that it occurred completely under water by the interaction between the falling ink and the corn syrup boundary, and that the fluid both present in the crown and the jet was purely the ink, as the corn syrup has too high a viscosity of create this phenomenon at the length scales involved. The physics that this reveals is immensely interesting, and it is worth noting that a search of the literature turned up no other work done on the formations of Worthington Jets within fluids.

To image this phenomenon two light halogen light sources were placed just above the water surface to shine the maximum amount of light onto the falling ink. The camera was mounted on top of a tripod to help reduce any motion blur due to motion of the camera. Behind the tank a white sheet of cotton was used to form a uniform background and to reflect back as much light as was possible back into the fluid. Below is a table containing the pertinent photographic information for this image.

Exposure: 1/80s

f-stop: 5.6

ISO: 400

Focal Length: 55mm

Image Stabilizer: On

Flash: Did not fire

Distance to Object: ~0.5m

Camera: Canon EOS Rebel Xsi

Lens: Canon 55-200mm f/3.5 – 5.6 IS

Appendix: Apparatus:

Below is a diagram of the tank with the Worthington Jet forming inside of it: