Non-coalescence of jets

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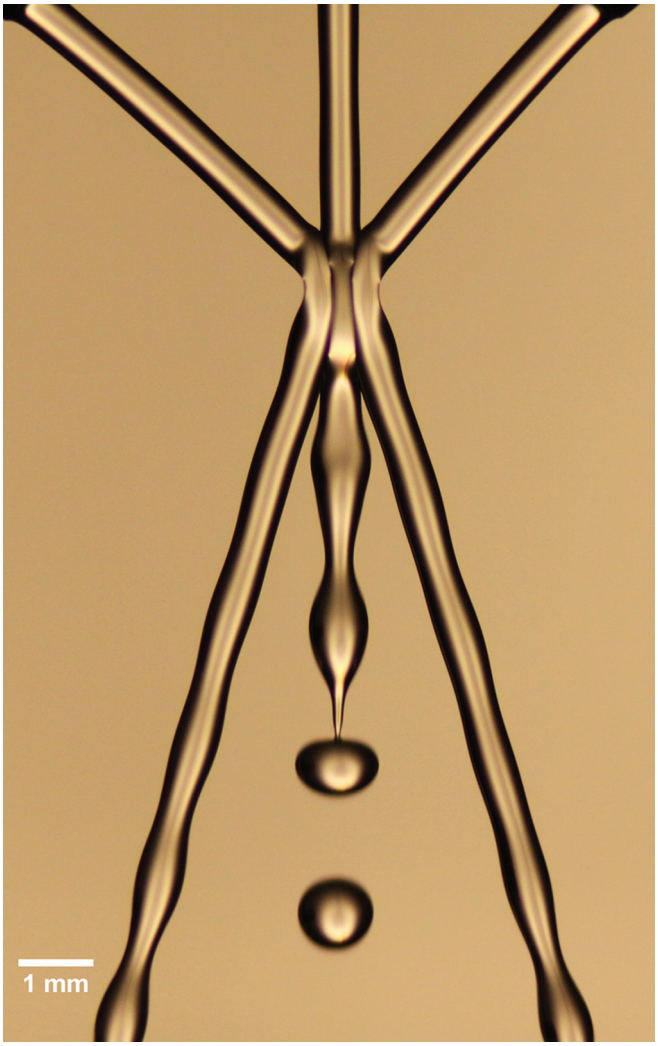

FIG. 1. (Color) Two side jets bouncing off the middle jet.

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The phenomenon of non-coalescence between fluid jets was first reported by Lord Rayleigh, more than a century ago.[1] Rayleigh described the observation in words without any experimental data or pictures. To the best of our knowledge, this curious phenomenon received no attention from the scientific community since then. We present the first experimental demonstration of the non-coalescence of two and three jets of the same fluid, and of non-coalescence between a jet and droplets of the same fluid.

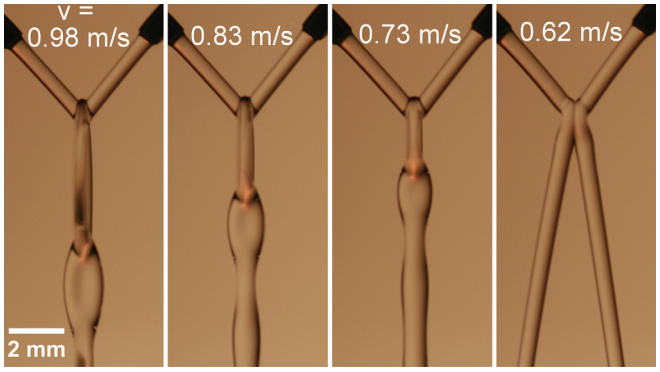

FIG. 2. (Color) Transition from coalescence to non-coalescence of two colliding jets.

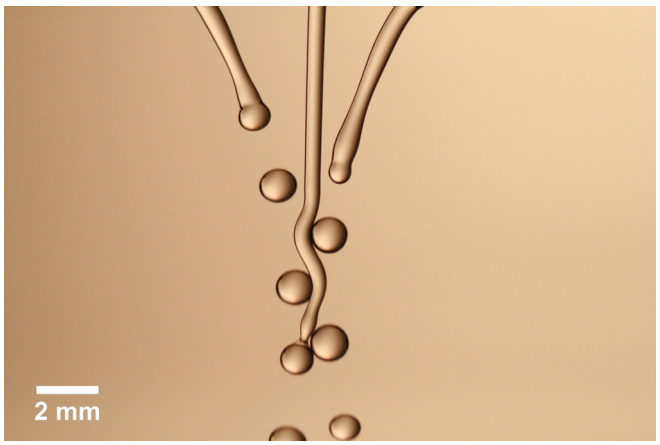

FIG. 3. (Color) Series of drops from two sides colliding with the jet without merging.

Figure 1 shows two jets of silicone oil (viscosity 10 cSt at 25 °C) with diameter 500 μm, impinging obliquely onto a vertical jet of the same fluid and diameter.

Instead of coalescing, the jets from the sides rebound off the middle jet due to lubrication by a thin film of air separating the jets. The layer of air is continuously replenished by the motion of the jets, resulting in indefinitely sustained non-coalescence between the jets. As the jet velocity (v) increases, the air film is drained and the two jets coalesce. Figure 2 shows the transition from coalescence to non-coalescence between two jets when the experiment is carried out below a critical jet velocity.

We also observed non-coalescence between a jet and drops of the same fluid, an example of which is shown in Figure 3. The drops plunged into the jet from two sides without coalescing into it, bending it at two locations.

[1]L. Rayleigh, "Investigations in capillarity," Philos. Mag. **48**, 321 (1899).

