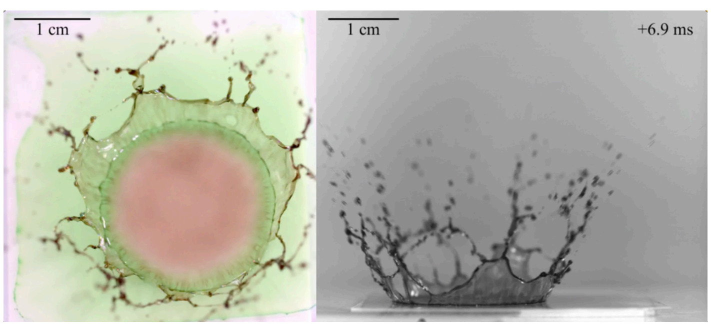
Drops Wear Different "Crowns"

A study of drops falling on a thin liquid film finds that splash behavior depends on film thickness—a result that could impact our understanding of stalagmite formation.

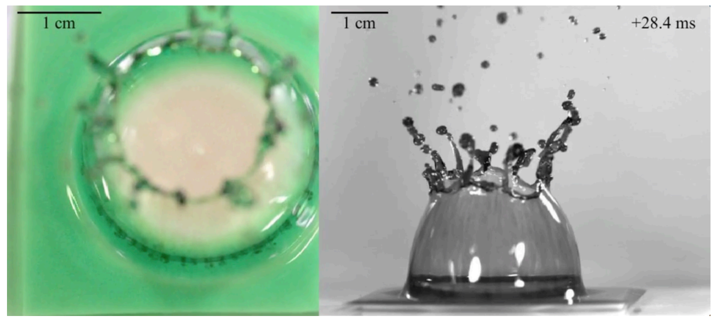
By **David Ehrenstein**

Stalagmites grow upward from a cave floor as mineral-rich water drips down from the ceiling, delivering ions that form calcite. To better understand how the critical ions are distributed and mixed, researchers used a lab experiment to study falling drops impacting a thin film of water. High-speed video revealed a variety of splash "crowns" around the impact point, whose shape depended on both the thickness of the water film and on the relative influence of surface tension. The results could lead to improved models of stalagmite growth and may also apply to other situations, such as raindrops striking agricultural crops, where pathogens could potentially be spread through the splashes.

To track the mixing during a drop splash, Justine Parmentier and her colleagues from the University of Liège in Belgium added dyes to the drop liquid and to the film liquid. They found that for thin films—less than 100 µm in thickness—the drop created a rapid splash, with a small crown that broke up into tiny droplets. Following the splash, the team found that the drop liquid was concentrated in a small spot around the impact point.



When struck by a falling water drop, the thinnest water films—less than 100 µm deep—barely form the "crown" structure before it breaks up into tiny secondary drops.
Credit: J. Parmentier *et al.* [1]



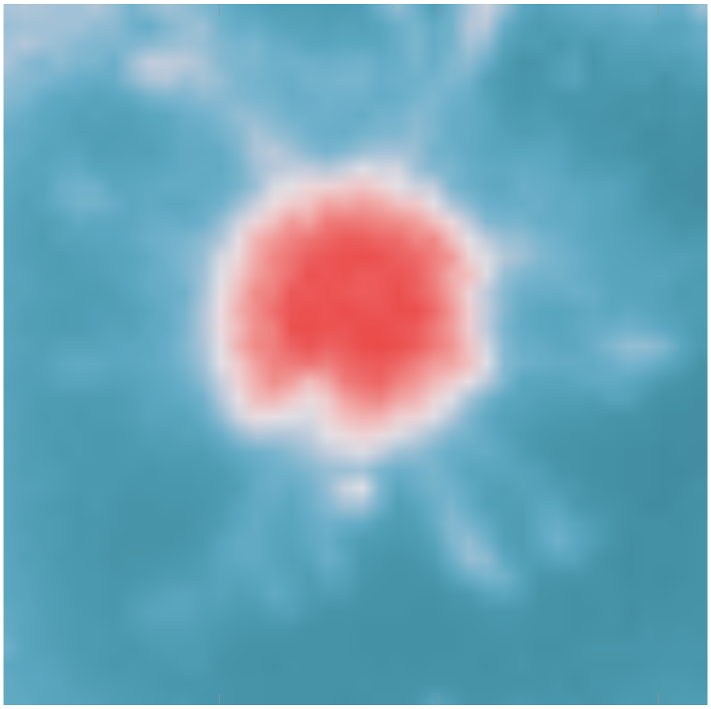
For films over 100 µm and with inertial forces dominating over surface tension, the crown forms and eventually collapses in on itself.
Credit: J. Parmentier *et al.* [1]

By contrast, drops striking thicker films formed longer-lived crowns that rose several centimeters before collapsing in on themselves. This behavior led to a high level of random mixing between the drop and the film. The researchers say that since the amount of mixing depends on the film thickness, the variability of this thickness must be accounted for in future models of stalagmite growth.

David Ehrenstein is a Senior Editor for ***Physics Magazine***.

REFERENCES

1. J. Parmentier *et al.*, "Drop impact on thin film: Mixing, thickness variations, and ejections," Phys. Rev. Fluids 8, 053603 (2023).



Hit the spot. This processed image of the impact point shows the red dye from the drop about 1 second after striking a 103-µm-thick water film.
Credit: J. Parmentier *et al.* [1]