Freezing of Supercooled Water Droplets due to Collision

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Little work has been done on the initiation of freezing by the collision of two supercooled water drops. Hobbs (1965), the first to call attention to the importance of this matter, postulated that supercooled droplets in natural fogs may freeze spontaneously on collision. Alkezweeny (1968) suspended two drops 1 mm in diameter on thermocouples in a cold chamber. After supercooling, the drops were brought in contact. The results showed that the contact enhanced the probability of freezing, a probability which increased as the supercooling approached the natural freezing temperature of the individual drops, −18°C. Furthermore, on the average, 2–3 ice splinters were produced during the freezing.

During the cloud seeding project conducted by Meteorology Research, Inc. (MRI) in the summer of 1968 in Flagstaff, Ariz., an Aztec aircraft carrying an MRI Continuous Particle Collector (MacCready and Todd, 1964) made many consecutive penetrations through several isolated cumulus clouds. The Continuous Particle Collector (CPC) replicates both ice crystals and water droplets. Their irregular shapes and dark edges differentiate ice crystals from water droplets. Further-

Fig. 1. Droplets of 200 and 140 μm frozen on contact.
more, frozen droplets with diameters ≥ 50 μm can easily be differentiated from water droplets of the same size because the latter splash on collision.

Figs. 1 and 2 were taken from the CPC record from a natural cloud on 27 June 1968 under the following conditions: penetration level, 20,800 ft; temperature, −10°C; cloud top height, 22,500 ft (visually estimated); cloud top temperature, −13°C (estimated). Fig. 1 shows two droplets of 120 and 60 μm in diameter frozen in contact, and Fig. 2 shows droplets of 200 and 140 μm also frozen in contact.

This observation suggests that the collision of two supercooled water drops might lead to freezing. In this case, it would be a powerful mechanism for the formation of ice crystals in natural clouds and as a trigger mechanism for the ice splintering process. Further controlled laboratory experiments are needed in which the natural freezing temperature of the individual colliding water drops is predetermined and the collisions take place in free fall.

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REFERENCES