Numerous tests have been made in field olfactometers with brevicomin, which was identified in the frass of female *D. brevicomis* (*6*). The material has consistently given indifferent results or been totally ineffective. However, when a representative assortment of natural terpenes was tested in conjunction with brevicomin, 3-carene proved to be effective in activating the substance. 3-Carene was superior to myrcene and other terpenes in tests made during the summer of 1968 (*7*).

The failure of brevicomin alone to compete with natural sources of attractants in the forest is distinctly different from the results reported by Bedard *et al.* (*8*). The brevicomin released from a tree in their experiments was probably associated with some natural component of the host. Their data show that myrcene might serve in this capacity, but it would be more logical to assume that 3-carene was responsible since it is a predominant component of oleoresin in ponderosa pine (averaging 38 percent) as compared to myrcene (averaging 15 percent) and is more active unit for unit than the latter.

The ultimate utilization of pheromones of *D. brevicomis* in forest management would not appear to be so bleak as the data of Bedard *et al.* would indicate. As we have reported and discussed in a seminar at the U.S. Forest Service Southwest Experiment Station in January 1969, male *D. brevicomis* produce frontalin. The material is effective in aggregating populations when used alone, but is strongly enhanced by 3-carene. Whereas a mixture of brevicomin and 3-carene attracts a high proportion of males, frontalin with 3-carene attracts a preponderance of females. Since the female is the key to attack density, the use of a three-component mixture of frontalin, brevicomin, and 3-carene may be the ultimate answer to manipulation of *D. brevicomis* populations. It is not clear whether brevicomin will be an essential component in the mixture, but it is being retained for the time being to reinforce aggregation of males in predetermined spots.

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Multiplication of Ice Embryos by Ice-Whisker Shedding

The observation of whiskers by Cross (*1*) on evaporating polycrystalline ice and by Micheli and Licenblat (*2*) on evaporating single crystals supports the credibility of the techniques for ice-whisker replication of Odencrantz *et al.* (*3*), in spite of the uncertainties of the method as pointed out by Smith-Johannsen (*4*).

If a necessary condition for the formation of ice whiskers is evaporation, my data indicate that the possibility of ice multiplication in slightly supercooled clouds by the whisker-shedding mechanism suggested by Odencrantz *et al.* (*3*) should not be ruled out as indicated by Cross's statement (*1*) that "it is therefore unlikely that such splinters would be found in the supersaturated region of the cloud where they could act as ice nuclei." Although no instrument provides a reliable measurement of the humidity of the air between cloud droplets under most conditions, on many occasions I have used either of the two techniques discussed below to detect unsaturated regions in dense clouds. (i) When a dry layer, generally less than a kilometer thick, is present throughout the mesoscale region in which clouds are located, the clouds often penetrate well above this layer. The clouds often show a "necking in" at this level, and later the less vigorous clouds will cut in two. An airborne dew-point hygrometer with a water-separating sample-entry configuration flown in this layer through even vigorous clouds frequently registers an average humidity below saturation. Since small droplets cannot be totally excluded from this instrument, its measurements indicate only an upper limit of humidity. In less vigorous clouds which penetrate the dry layer the average relative humidity is below 90 percent. (ii) If a cloud evaporator with a response of 0.02 second is used together with a Lyman-alpha spectral-absorption hygrometer (*5*) for measurements of total water content, traverses through the upper third of dense cumulus clouds frequently reveal patches 3 to 50 m wide (probably of large vertical extent) which are unsaturated, even if the moisture in the liquid and frozen particles present is included. More frequent occurrences would undoubtedly be found if we could measure the corresponding humidities with a spatial resolution of 3 m and could exclude moisture from the drops in the sample. Ice particles are often found in unsaturated parts of the cloud, even though the overall cloud is supersaturated.

Ice particle concentrations 2 to 4 orders of magnitude higher in clouds than the concentration of natural primary ice nuclei near or under the cloud (*5, 6*) have nearly always occurred in the presence of graupel or liquid drops larger than 100 μm in diameter. This suggests that, if the whisker-shedding mechanism contributes to the profusion of secondary ice nuclei, the shedding is nearly always coincident with the presence of particles larger than 100 μm in diameter. The shedding may occur (i) because of collisions between these larger particles and collisions of small evaporating ice particles with whiskers or (ii) because of the shedding of whiskers in the air stream from graupel falling at high terminal velocity. The same evidence also fits other mechanisms for the multiplication of ice embryos (*7*).

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