

cattle and horses. We, at the college, have met with no such loss for years.

#### POINTS TO BE CONSIDERED.

Bees are natives of a warm climate, which would lead to the conclusion that in rigorous climates they would need protection, especially at times of great cold. The fact that winter losses are never heard of in California and the south strengthens the argument, which seems almost demonstrated by the fact that our losses in the north always occur in winters of great and long continued cold.

Again, bees are very neat, and in confinement hold their fecal excreta, or try to till they can fly. If kept very quiet they eat very little—we have had single colonies of bees pass four and five months in the cellar without consuming more than four or five pounds of honey—and the food they do eat when thus quiet is largely, if not wholly of honey, and so there is very little waste. Thus when quiet bees need not fly to discharge their feces and so bear confinement for months with no harm. The best condition to maintain this needed quiet is uniform temperature, which experience has demonstrated to be about 45° F. I prefer the temperature about the hive to be kept at from 40° F. to 50° F. In a surrounding temperature much higher or lower the bees are disturbed, exercise much, eat more, and become diarrhetic.

From years of experience and observation it seems pretty well demonstrated that with enough good, wholesome food—30 lbs. of good honey or cane sugar syrup—and a uniform temperature as suggested above, our bees will winter invariably without loss.

#### DAMPNESS AND VENTILATION.

It would seem that a damp atmosphere, which, as we all know, is favorable to the growth and development of fungi, and inimical to health in higher animals, would be harmful to bees. It has been found however that in many cases, that even during the terribly disastrous winters like the past one, bees have wintered remarkably well in very damp cellars. Thus while we may presume that a very damp atmosphere is not the best, yet we may safely assert, other things being all favorable, that it of itself will not carry the seeds of mortality with it.

Ventilation has also been much discussed, and various theories have been offered. Yet the physiologist, and especially the physio-entomologist, will not be easily persuaded that insects whose functional activity is so slight, that a minimum of food supplies their wants stand in need of much air. One year at the College I sealed a large colony of bees with ice frozen

solid at the entrance of the hive, and yet the colony wintered exceptionally well. This colony remained for more than three months entombed in a snow bank. As the hive was glued or propolized at the top we can see that the ventilation was slight indeed. Thus physiology and experience both show that under the best conditions little heed need be given to ventilation. While bees do not hibernate in the sense of becoming totally inactive, yet they may and should have their vital activity kept at the minimum else they will need air and quite ample ventilation. As we have already seen, cold or heat—that is a temperature much below or above 45° F.—arouses bees, excites nutrition, and of course would necessitate more food and oxygen, and so more ventilation. Unless we can keep the bees then in just the condition to enforce quiet, we must arrange for ample ventilation.

It goes without saying, that the temperature inside a hive, in which bees are wintering, must generally be warmer than that outside the same. The fact that bees do not hibernate establishes this truth. The thermometer confirms it. We know that moisture is sure to collect on a cool surface; but water dripping upon bees cannot be healthful. The disturbance and the wetting would both be injurious. To winter bees then with the best success needs a covering that is not a good conductor of heat. Experiments on quite an extended scale have shown me that this is not all theory.

We see then that the requisites to success in wintering bees are: enough good food, uniform temperature without the hives at about 45° F., slight ventilation, and a cover to the hive which is a non-conductor of heat.

#### METHODS THAT HAVE SECURED SUCCESS.

##### Food.

The food may be either honey or cane sugar syrup. Any kind of honey, if wholesome and pleasant to the taste, will answer. Even last winter the bees at the college were wintered wholly on honey gathered in autumn, after the 25th of August, and all wintered well, and there was no sign of diarrhoea, except in a few cases where much pollen was left in the hives. Cane sugar syrup is quite as good, possibly superior to honey at times, as we can be certain that the syrup is free from deleterious elements. The syrup for winter food may be as condensed as possible, and yet it must not crystalize when cold. One-half to one-third as much water as sugar by weight is about right. A little honey added will also retard crystallization. A little tartaric acid is often used for the same purpose. It is best to feed quite early so all may be stored