

about each other. Now, the natural respirations of the honey bee when at rest on a warm day are about 200 per minute. On the approach of cold they begin to respire more slowly and necessarily develop less heat. Those on the outside of the cluster do not breathe over forty times a minute and many of them not over twenty. Inside the cluster I have not been able of course to count the respirations but they are certainly slower than in summer time. (Here I must digress a little.) To this extent and to the extent held by the Rev. Wm. F. Clarke, bees hibernate and the slow respirations and lessened development of heat are the evidences of it that are indisputable. Say what we may, bees do hibernate under favorable conditions. The following incident will illustrate a case of hibernation. On the 26th of last March about noon all of my colonies were flying but four nuclei (that had gone to rest) and one fine Syrio-Albino colony in a double-walled hive. With a steel hook I raked the debris from the bottom board and felt satisfied that they were alive. As none came out I hooked on to the frames and shook them, but no stir. I then pounded upon the hive but all was still. Some friends standing near finally remarked, "Doctor, its no use, that colony is gone up." But I kept pounding away and it was fully ten minutes before a bee appeared. They proved to be a very large and well wintered colony. They had not a particle of upward ventilation but a very large entrance into which the cold winds had blown so hard at times that I had felt very anxious about them.

The accumulations of water in the intestines of bees take place when they are required to consume a large amount of food in order to sustain a life heat. When it becomes very cold they are unable to maintain—in the presence of counteracting agencies—the forced, prolonged and high rate of the respirations necessary to expel or rather exhale the larger amount of water evolved in the oxygenation of so much food. Under the severe physical strain their vitality is early impaired when they become less and less able to keep up a proper temperature of the cluster. They respire slower and slower and there is less and less exhalation of water. Meantime they are eating largely, they have no kidneys and accumulations of water must take place in the intestines. If about this time we see a bee come out of the hive to die, we perceive that it breathes only three or four times a minute, drags itself along and tells only too plainly the story of exhausted vitality. A very damp atmosphere and thin honey are causes that favor the accumulations: the first by the prevention of free evaporation of water from the

surfaces of the air tubules, and the second from the taking of water in the food which must be carried off in the respirations at a time and under conditions when such exhalations are greatly impeded.

If we place an affected colony in warm quarters, so that it can dry out, it is immediately benefitted and without a flight the bloated state of the bees is greatly relieved. On the contrary, if the bee-bread were the cause there could arise no benefit whatever from the application of heat since "the cause" could not be removed without a flight. On no other hypothesis than the above can we satisfactorily account for the phenomena.

If the normal temperature of the cluster can be readily maintained above that of the surrounding medium, free evaporation and the expulsion of the vapor from the immediate vicinity of the bees is accomplished and they will be kept dry and healthy so long as a favorable temperature can be easily maintained. Now the bees are so ventilated that they will not get overheated they will hibernate. The principle involved here is the same as in drying out a damp and cool room. We place a fire in it, warm it up and the dampness is expelled. In the same manner, if we so prepare the bees for Winter that they can maintain a heat of fifty degrees just over the cluster, the bees and combs and hives will keep dry and no diarrhoea will result. Take a colony on the summer stand with the brood chamber tight on top as propolis can make it and with the cap filled with chaff, thrust the hand down on to the frames over the cluster; if it feels sensibly warm the temperature is fifty degrees and the colony is wintering all right. But if cold, and it remains so long, there is danger.

We consider heat to be the only true remedy for bee diarrhoea as it is the only reliable preventive. In my first article on wintering, see page 7, vol. 18, of the *American Bee Journal*, occurs the following passage: "Heat is life, or one of the essential conditions of life which the instinct of the bees has taught them to carefully conserve." In making this statement we had reference both to the protection and the system of ventilation that should be given. We have nothing to add to this now but believe more firmly than ever that on the conservation of the heat of a colony of bees will depend much of our success in the wintering of the future.

We have the following conclusions to submit: The use of pollen or bee-bread by bees in winter confinement is not detrimental to bees when they need it, and, like most other animate beings they need it or its equivalent pretty often.