

attack living brood, or that they can in any way be transformed into the bacilli of foul brood.

The microbe of foul brood is no more produced spontaneously than are pine trees or elephants. The writer in the *Encyc. Brit.* before referred to says, "No case of spontaneous generation has withstood rigid investigation." Huxley, Tyndal, and others might be quoted in corroboration of this statement. As to the microbe of putrefaction successfully attacking live brood, Klein says "microbes of putrefaction cannot exist in healthy blood and tissues. Dr. Burdon Sanderson, Dr. Ferrier and Herr J. Van Fodor confirm this view of the matter.

Neither is the microbe of putrefaction ever transformed into the microbe of foul brood. The author of "Microbes, Ferments, and Moulds." (No. 57 of the International Scientific series), says "up to the present (Sept. 1885) a septic microbe has not been proved to be transformed into a truly pathogenic microbe."

Under favorable circumstances bacillus alvei increases very rapidly. Cheshire found that in his culture tubes they multiplied every twenty minutes. At this rate a single microbe would increase in twelve hours to the astounding number of over fifty-three billions, and the increase in twenty-four hours would require twenty-two figures to express it. In the hive no doubt the increase would be more rapid still. A single dead larva frequently contains a billion of spores.

It has been demonstrated that while wet, the spores or seeds of the disease are not given off from the matter containing them. It is only after the matter dries up that the spores become floating germs in the air. Similarly, in the case of scarlet fever, the danger of catching the contagion is greater when exfoliation takes place, and in the case of small-pox when the pustules are drying up.

The microbes of foul brood have been found in the tissues and intestinal canal of adult bees by Schonfeld and Hilbert in Germany, by Cowan and Cheshire in England, and by Prof. McLain in America. Schonfeld found the microbes in abundance in the rectum of bees. An American experimenter mixed two grains of bee feces from a diseased hive in a quart of syrup, one half of which he fed to a hive of healthy bees ten miles off. These bees were permitted to fly under cover only. In thirteen days the disease appeared, and in four weeks the combs were reeking with foul brood. It is easy to understand how bees may distribute the germs of the disease for miles over the fields in the vicinity of a diseased apiary, by means of their excreta discharged while on the wing and as this excreta becomes rapidly

dried, how the microbes may be caught up by the winds and distributed as dust in the air over a whole country side.

The disease may be introduced into our apiaries from distant countries by the excreta of the escort bees accompanying queens. English beekeepers say the disease was carried to them with queens from Italy, and A. J. King, late editor of the *Beekeepers Magazine*, says it was brought to an apiary in Cuba, of which he had charge, with queens purchased in Ontario.

It has been said that the microbes do not adhere to the bees themselves, but this has been proved to be a mistake. In 1871 Schonfeld washed, with distilled water, bees from a foul-broody colony and found that this water contained mouldy pieces of rotten brood.

There is a general agreement amongst those who prescribe methods of cure that in diseased hives, the combs become contaminated, and should be melted into wax. It is agreed amongst bacteriologists that the maximum temperature required to kill mature bacteria, in water, is 140°. Many kinds are killed at a lower temperature. It has been proved that the spores, as compared with the adult organisms, possess a power of resistance to heat, in the proportion of 11 to 6, that is if 140° is required to kill the fully developed bacterium, 257° will be required to kill its spores. Wax melts at 142°, a temperature most likely inadequate to kill the spores of bacillus alvei. To what extent the disease has been spread by germs contained in comb foundation, made from the wax of infected hives will never be known.

Dessicated spores, like the dried seeds of plants, often refuse to imbibe water. In this state they resist the action of heat for a long time. It has been found that plant seeds, contained in fleeces of wool, imported from South America, sprouted and grew after the fleeces had been boiled for four hours. An examination showed that some of the seeds had not been wetted. Tyndal boiled his culture tubes for three, four, five, and in one case eight hours, without killing the microbes they contained. He afterwards discovered that by repeatedly boiling them for less than a minute at a time, at intervals of ten or twelve hours, he never failed to sterilize his cultures. Boiling hives and appliances may fail to disinfect them for the above reasons, unless the boiling is repeated several times.

Honey boils at 235°. If the boiling were repeated a few times any spores it might contain would no doubt be killed. Spores have been subjected to a cold of 180° below zero without being affected in the least.

The fully developed bacteria succumb to the