

SCIENCE.—SUPPLEMENT.

FRIDAY, APRIL 9, 1886.

REMARKABLE POWERS OF MEMORY IN THE HUMBLE-BEE.

PROF. EDWARD HOFFER gives in the last number of *Kosmos* a contribution to animal psychology, which will be of interest not only to the entomologist, but to all biologists. It furnishes evidence of some very strange powers of memory of localities, in this group of insects, whose brains, if we may use that term, one would hardly deem capable of such functions.

The author removed a nest containing numerous individuals of one of the common humble-bees (*Bombus terrestris*) from its original location, and carried it to his residence, about three miles distant. He further carefully watched the place for some time after having captured all those that had flown to the defence of their nest, and secured, it was believed, the entire colony. These he imprisoned for several hours in a wide-mouthed bottle, and safely re-united them in their new home. At his house he placed the nest, with its inhabitants, near a window, and, after they had become quieted, made a small entrance. Immediately they began to fly out, and in doing so must have observed their surroundings, for in a short time they one by one returned. The following night, however, there was a severe storm; and while the inhabitants of the forty other colonies near it, that had become accustomed to their surroundings, were not in the least troubled, these bees escaped, and hid themselves somewhere without during the storm. Upon searching for them early the next morning, the queen was found dead upon the ground, while fifty or sixty of the workers were seen flying about the house. From time to time one or another — probably those which had flown out of the entrance the day before — found the opening, and returned into their nest; while the remainder, after flying about for several hours, gradually disappeared, till not one was left. As it was supposed that they had, in all probability, returned to their previous nest, the place was visited in the afternoon, where, sure enough, at least fifty individuals were found. They had thus, it will be seen, distinctly remembered it, and, after they had sought in vain to find entrance to their new home, they had depended upon their wonderful sense of locality, and returned thither.

A similar instance was observed with another nest, which had been removed a distance of nearly five miles, and in which the same care had been exercised to capture all the individuals. In unskilfully handling the box containing the nest and bees, in its new location, about thirty of the workers escaped, and flew through the open window. After flying for a long time about the house, as though in search of their comrades, they likewise disappeared, and returned to their original nest and again established themselves, as was afterwards ascertained.

It was frequently observed, that, when nests had been removed but a short distance, the workers, during the first few days after their change, would fly swiftly in the direction of their old nest, when, discovering their mistake, they would change their course, and go to their new home. It seemed evident that these little creatures, through some mental process or other, thus discovered their changed circumstances.

In order to test further this remarkable sense of locality, the author marked a number of individuals with oil-colors, and carried them, enclosed in wooden cases, a distance of eight or nine miles, when he allowed them to escape. Very many of them, though not all, found their way back to their nests, and, as a rule, reached home sooner than the author did himself.

The author noticed that at his summer residence, where he had kept numerous hives of these bees, the following spring many individuals appeared, and seemed to be searching for their previous nests; but he was unable to determine whether they were individuals of the previous broods or not. Towards the close of July, 1884, he obtained three nests of *Bombus mastrucatus*, a large species, only found in the mountains, and especially the higher regions, and carried them to his residence in the city, where he placed them in a window of the second story. The house was enclosed by high buildings, with no garden attached, and yet they returned readily and directly from their excursions to their nests. They thrived, and by the first of October had increased to considerable numbers. By the middle of October they wholly disappeared; but, in the early part of the following April, individuals of this species were observed flying about the window, and, as soon as they found an entrance, sought the remains of their old nests, and took up their abode. They remained for a while, when their nest was accidentally injured, and they

left. Nothing more was seen of them till after the author's return from his summer vacation, in the middle of September, when a single female of this species made its appearance. In their inability to obtain an entrance through the closed window, they had evidently built a new nest in the vicinity, and reared their broods.

These circumstances indicate that the intellectual powers of the humble-bee are not as slight as we have been accustomed to believe. Here in this case, from October to April, — a period of six months, — had these bees remained dormant in the ground, or hidden in some crevice, and, upon regaining their activity, had not only remembered the place where they were, but had sought and found, despite the many difficulties, their last year's nest. That these individuals were from the previous year's brood, there was no doubt, as throughout the province the species nowhere else occurs, peculiar as it is to elevated and mountainous regions.

LIGHTHOUSE ILLUMINANTS.

At the meeting of the London society of arts held on March 10, Mr. E. Price Edwards read a report of the experiments on lighthouse illuminants made at South Foreland during 1884-85. The experiments show that in clear weather all the lights — electric, gas, or oil — were too good, and that for merely sending an effective beam of light to the horizon on a dark, clear night, no one was really better than the other, although it should be said that the electric light used, on account of its dazzling brilliancy, was regarded as a nuisance rather than otherwise by mariners in the near neighborhood of South Foreland. It is quite certain that for clear weather the lower powers of any one of the illuminants would be sufficiently serviceable for the requirements of the mariner.

The oil and gas lamps were rendered thus effective by superposing one upon another series of flames. It was found, that, in respect to the adaptability of the lights for occultations, — one of the distinctive characteristics used for lighthouses, — gas was especially available, as by simply turning off the supply an occultation is promptly produced in an economic and an effective manner; whereas, with the electric or oil lamp, the use of a revolving screen was found most suitable. For colored sectors, on the other hand, the electric light is most serviceable, as, on account of its small surface, the change in color may be made more abruptly.

The general results of the observations in hazy weather show incontestably that a single electric

light greatly excels the most powerful oil or gas light in penetrating-power. In an actual fog the electric also holds its own. The experience of fogs at South Foreland was not large, but was sufficient to furnish available comparisons; and it was proved beyond question that the single electric light pierces a greater depth of fog than the highest power available of either gas or oil, but in heavy fogs the mariner would not derive the slightest advantage from any of the lights used. The recorded distances to which lights were carried, or where they were picked up, in heavy fogs, range mostly from seven hundred to two thousand feet; and the superiority of the electric light is determined by penetrating two hundred or three hundred feet farther than the gas or oil light. The most powerful electric light was shut out on one occasion at fourteen hundred and fifty feet, on another at fifteen hundred, another at seventeen hundred, another at fifteen hundred, and another at thirteen hundred feet. It will be plain to all that no mariner could be benefited by a light which was not visible at such distances from the lighthouse; and, for the purpose of navigation, a difference in the visibility of the lights of two or three hundred feet is of no value whatever.

One fact stands out prominently; viz., the greater ratio of absorption by the fog of the electric rays as compared with that of the gas or oil rays. Fortunately for the electric light, as shown at South Foreland, it possesses a large reserve of initial intensity, which enables it, notwithstanding its much greater proportion of loss by absorption of its more refrangible rays, to penetrate farther than the other luminants. With three lights of equal candle-power, — one electric, one gas, one oil, — exhibited in a foggy atmosphere, there is little doubt that the electric will be eclipsed at a much shorter distance than the others. But as an electric beam can be made so much more intense than it is possible to make the gas or oil beam, the electric light, though heavily handicapped by its competitors, by the very superabundance of its own luminous energy, may be made to penetrate the farther.

The experiments have also shown clearly that the lights from gas and oil are very much alike in illuminating-power: indeed, under some conditions, the oil-flames seem to be rather the better. They have also shown that the oil-lights can be superposed with the same facility as the gas-lights. As yet, no oil-flame has been brought to the enormous size of the 108-jet burner; but, as this enormous size of flame is not required, the difficulty is of no great consequence. As the two lights were shown to be so nearly equal, the questions of convenience and economy assume