SCIENCE

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NOTES ON THE HABITS OF SOME COMMON ENGLISH SPIDERS.[1]

SOME years ago I sent to *Nature* (vol. xxiii. p. 149) an account of the behavior of the common small garden-spider when a sounding tuning-fork is brought near. If the fork is made to touch any part of the web, or the twigs or leaves by which the web is supported, the trembling of the web completely deceives the spider; so that, after rapidly finding which radial line is most disturbed, she runs along this one and attempts to secure the tuning-fork. She fails to discover in the cold and polished steel any thing different from her usual food; or rather, being led by instinct to eat that which buzzes, she struggles in vain to find a soft place in the armor of her prey.

On the other hand, if the tuning-fork is brought near one of these little spiders while she is waiting in the centre of her web, she generally drops instantly, but will climb up again as quickly as possible if the vibrating fork is made to touch the web.

More recently Mr. and Mrs. Peckham, who have made an elaborate study of the mental powers of spiders (*Journal of Morphology*, vol. i. p. 383), have repeated these experiments, and have confirmed them in every essential particular.

They found that many geometrical spiders would drop when a vibrating tuning-fork was brought near them, but that after much teasing in this way they would sometimes learn to take no notice. They conclude that this dropping habit is of direct service to them in enabling them to escape from birds or wasps which prey upon them.

While staying recently with Mr. Romanes, in Ross-shire, I made some observations in this connection which are possibly worth recording.

The small geometrical spiders which abounded on the gorse bushes near the sea behaved as described above, while, as I have noticed many times before, the diadema spiders, which also were abundant, were affected in a totally different manner. If the tuning-fork is held near them, they throw up their four front legs, either perpendicularly or even farther back, and as soon as the fork is within reach strike at it so violently that the blow may be plainly heard. A buzzing insect carried near is caught by the diadema spider in this way, and speedily wound up.

There were a number also of small brown geometrical spiders, which I believe were young diademas: these dropped when a sounding tuning-fork was brought near them even more readily than the full-grown little spiders.

[1] From Nature.

Instead of bringing a tuning-fork near the spiders, I made a sudden and high-pitched shout, taking care that my breath should not complicate the situation. The effect, when a great number of spiders were resting on their webs near together, was sufficiently striking. The diademas threw up their legs simultaneously, and struck in the air at the imaginary insect; while the full-grown little spiders, and what I believed to be the young diademas, all dropped out of their webs into the branches below.

The suggestion of Mr. and Mrs. Peckham, that this habit is a protection against wasps, is made the more probable by the difference in the behavior of the full grown diadema, which would certainly not be afraid of a wasp, and the little spiders. However, the tactics of a wasp that I watched left no doubt in my mind that this explanation is correct. The wasp, when I first saw it on a gorse spray, was evidently intent on something. It ran up the spray until it came to the silken tube in which the little spider dwells when not on the web. The spider retreated farther into the tube, while the wasp was struggling among the spines and the silk to dislodge her. After a short time the wasp gave up the attempt, and flew away for a few yards. It then very suddenly darted at another spider, seized her before she had time to drop, and carried her off to a branch close by. This was done so quickly that I could not follow the details of the attack; but it is certain that the wasp, which did not carry a spider a moment before, had, without alighting, taken the spider off her web. It would appear that the dropping habit of the spider has re-acted on the wasp, and has developed in it a speed of attack sufficient to counteract the spider's only means of escape.

I have not found that the little spider is less attracted by low notes than by high. A variety of forks, forceps from a box of chemical weights, or a carpenter's square banged on the knee, all seemed to deceive her equally well; but a vibration of great amplitude causes her to retreat to a place of safety. The spider seems to judge of the necessity for prudence by the violence of the insect rather than by the natural note of its wings. She is terrified by a heated tuning-fork which is not too hot to hold.

Mr. and Mrs. Peckham have formed a low estimate of the spider's intelligence as distinct from instinct. They found that a spider which has the habit of carrying its cocoon was quite satisfied with a lead shot slipped into the silk covering of the eggs, and laboriously carried it about. The following are a few of many experiments which I have made, which lead to the same conclusion A large diadema which had just caught and wound up a large fly, and had carried it up to

its retreat, left it hanging by a short line, while she proceeded, according to the usual habit of this kind of spider, to carefully clean herself before the meal. Meanwhile I managed to replace the fly by a piece of cork without disturbing the spider. When the toilet was complete, she pulled up the line from which the supposed fly was suspended, and tried to eat the cork. She was a long time trying every part of the cork before she finally let it drop. A piece of an india-rubber ring was twisted up until it had acquired a state (well known to school-boys) of spasmodic recoil. This was placed on the carpet-like web of a large black house-spider, which Mr. Pocock tells me is known to naturalists as *Tegenaria atrica*. These, like other house-spiders, appear to be far more wary than the geometrical sort. The india-rubber was made to move slightly by being pinched from below, and then the spider pounced upon it. I did not allow the spider to carry it off, but made it seem to struggle and resist by manipulation with a pair of forceps under the web. The spider became more and more desperate, and at last, when the web was much damaged by the battle, I dragged the rubber away; but the spider could not allow this, and clambering through the hole made in the web, and hanging by her fourth pair of legs, seized the escaping insect. I then let go, and the spider carried the piece of india-rubber away to her den, perfectly satisfied. However, she did not seem to appreciate her meal, for, after biting it on every side, she was obliged to take it to the edge of her web and drop it. I then picked it up, and was surprised to find the spider willing to be similarly deceived again.

These spiders will come to a tuning-fork once or twice perhaps, but the moment they touch it they fly terrified, as they do from a common bluebottle with mica on its wings. They seem generally thirsty, and will drink water placed upon the web; and if it is scattered in drops, they are able to find the drops, but by what process I do not know. The diademas, too, especially when old, and only able to mend old webs, not to spin new ones, are always ready to drink. They will hold a piece of wheat straw six or eight inches long which has a drop of water upon it until they have drunk the water; but while the little spider is so insensitive in taste as not to entirely reject a fly that has been soaking in a paraffine lamp, especially if it is made to buzz with a tuning-fork, the diadema has a strong objection to alcohol, even well diluted, and rubs her mouth against any thing near by after tasting it, so as to get rid as quickly as possible of the noxious fluid. Is it possible that the numerous spiders which are found in secondary batteries have been killed by the acid when attempting to drink, or are they destroyed by accidentally meeting the acid in their ordinary descents? The *Tegenaria* is aware of the shout which causes the diadema to strike and the little spider to drop, but the effect is a jump such as is executed by any one when suddenly startled.

It would appear that the only sense which is developed to any extent, and that most marvellously, is the sense of touch; hearing, taste, and smell to a small degree; but sight, as we understand the term, in spite of their numerous eyes, seems to be absent. The *Tegenaria* will stand within half an inch of a fly feigning death, without being able to find it; while the geometrical spiders, under like circumstances, gently pluck line by line until the effect of the inertia (not weight) of a motionless object guides them to the proper place.

These remarks do not apply to the hunting spiders.

C. V. BOYS.

THE PRODUCTION OF IMMUNITY FROM DISEASE.

A RECENT despatch to the newspapers stated that Koch's consumption "lymph" had been analyzed by a Vienna doctor, and that the principal ingredient was found to be a substance which the chemists know as albumose. Professor Koch himself, in his articles to the medical papers, does not give the method of preparation of the "lymph," but indicates that the material used is a sterilized culture liquid of the germ that causes tuberculosis.

This being the case, it is of interest to call attention to the fact that the principle which Professor Koch is applying received its first proof in a study of the fatal disease of hogs, known as hog-cholera, made by Drs. Salmon and Smith of the Bureau of Animal Industry, Department of Agriculture, Washington, D.C., in 1887. To explain clearly what has been done, it is a well-known fact that the germs which cause different diseases in men and animals can be isolated, and caused to multiply artificially outside of the body, by supplying them with food. Some germs require one sort of material, others a different one; but in general it may be said that beef-broth, or blood serum, or glycerine and gelatine, are the most useful substances. These prepared solutions are called culture liquids, or culture media. Into a tube or flask of the liquid are introduced a few of the germs it is desired to cultivate, and in a short time the germs are found to have increased so enormously that they can be seen by the naked eye. During this time great changes have taken place in the culture solutions: what was at first harmless beef-broth has been changed by the action of the germ to a liquid, which, after the germs have been removed by filtration or killed by heat, still contains poisonous alkaloids and albuminoids, which are generally fatal in their effects upon the animal body. Alkaloids formed in this way are called ptomaines; and the albuminoid bodies, albumoses; and each distinct disease-germ forms a peculiar and distinct ptomaine and albumose. The growth of the germ in the body is supposed to form ptomaines and albumoses from the blood and tissues, and these substances cause the fatal effects of the different diseases.

A horse can be gradually accustomed to arsenic; a man, to opium, nicotine, strychnine, and quinia: so that after a time a dose which would at first have been fatal to him can be taken without injury. The idea suggests itself at once, why not prepare and isolate the poisonous substances which germs form, give them in small doses to men and animals, thus gradually accustoming the body to their effect; and if then the disease-germ afterwards enters the body, the system will be already fortified against the poison which is produced, and able to resist what would otherwise be its bad effects.

This is exactly what Dr. E. A. v. Schweinitz, physiological chemist in the Department of Agriculture at Washington, D.C., has done in the case of the two diseases of hogs which cause such enormous losses to the farmers of the country; viz., hog-cholera and swine-plague. Dr. Schweinitz has made