

Boston"; he also sent over the "Hutchinson Letters," and underwent the memorial examination before the Privy Council.

Having been abroad ten years and six months, he turned his face homewards, and found that great changes had taken place; the city had grown considerably, and the people were more prosperous. The greatest change seems to have occurred in his family; his wife was dead, his daughter married, and his son estranged in politics. Luckily, Franklin was soon absorbed again in public affairs, so that he had no time to consider his misfortunes.

The day after he landed, he "was chosen a member of the Continental Congress, took his seat four days later, and served for 14 months; was on eleven committees, was made Postmaster-General; was sent on one mission to Washington at Cambridge, and on another to Arnold at Quebec; was despatched after the disastrous battle of Long Island, to confer with Lord Howe; and in September 1776, was sent out to join Arthur Lee and Silas Dine in France."

There he was received with great enthusiasm, and "became the sensation of the hour." He concluded the treaty of alliance with France, the treaty of amity and commerce, negotiated loans for great sums of money, and in 1783 signed the treaty of peace with Great Britain.

In 1785, old and loaded with honours, he returned to Philadelphia. Here he was made a Member of Council, and the Council and Assembly made him President of the State, and while holding this office he was sent to the Convention that framed the Constitution of the United States. It was about this time that his fame was at its highest, and everyone honoured and looked up to "the venerable Dr. Franklin, our illustrious countryman and friend of man," "the father of American independence." The closing years of his life were passed among his friends and admirers, and he died on April 17, 1790.

The epitaph that was placed over his tomb was written by himself, and is quite worth repeating:—

"The body
of
BENJAMIN FRANKLIN,
Printer
(like the cover of an old book,
its contents torn out,
and strip of its lettering and gilding),
lies here food for worms.
Yet the work itself shall not be lost;
for it will, as he believed, appear once more
in a new
and more beautiful edition
corrected and amended
by
The Author."

Franklin was a voluminous writer, and wrote with expression. To use the words of Mr. Brown Goode, who spoke on "the literary labours of Benjamin Franklin," "he wrote habitually with a single eye to immediate practical results. He never posed for posterity. Of all the writings to which he mainly owes his present fame, it would be difficult to name one which he gave to the press himself or of which he saw the proof. Yet he never wrote a dull line, nor many which the century of time has robbed of their interest or value."

The literary remains of Franklin may be classified as follows:—

- (1) "The Autobiography," from 1706-57.
- (2) "Poor Richard's Almanac," in twenty-six annual issues, 1732-58, culminating in "Father Abraham's Speech at the Auction."
- (3) Essays upon manners, morals, and the science of life, including the so-called "Bagatelles"; in all sixty titles or more.

(4) Tracts and papers upon political economy, finance, and the science of government; in all about forty titles.

(5) Essays and tracts, historical and political, concerning the American Revolution and the events which immediately preceded and followed, 1747-90.

(6) Scientific papers from 1737-90; in all 221 titles, and nearly 900 octavo pages.

(7) Correspondence, diplomatic, domestic, and literary, 1724-90; in all some twelve hundred letters, while many still remain unpublished.

Dr. J. W. Holland gave a very interesting account of the scientific labours of Franklin in the various branches of natural philosophy. Considered in their general character, they fall into a few groups, such as labour in sanitary science, in the art of navigation, in meteorology, and in electricity.

The science of electricity in Franklin's time was in its infancy. The only facts known about it were that some substances could be electrified, that the zigzag sparks which could be drawn from a rude machine resembled the lightning-flash, and that the Leyden jar enabled the experimenter to "imprison the fiery spirit and perform many remarkable tricks with it." Having reached middle age and just retired from business, he set to work with the frictional machine and the jar.

He first formed "a coterie for mutual suggestions and encouragement" with three of his friends who were very interested in these experiments; and between them they made a great advance, constructing their own machines, and making "new demonstrations of attraction and repulsion, and of the power of electricity to produce light, heat, mechanical violence, nervous shock, and even death." As a result of these and other experiments, he invented the lightning-conductor, which at that time was accounted "the most brilliant application of science that had been known," and projected his apt and simple theory of an electric fluid, explaining the cause of positive and negative action, which "held sway for so many years that to this day its nomenclature is retained in spite of defects revealed by recent advances in knowledge."

In concluding these brief extracts, we cannot do better than quote the words of one of the speakers:—

"Such men are few in any age; their number is not great in all the combined centuries that together make up the short life of our race upon this planet. It is only meet that we should cherish their names with respect, and gratefully hand down to posterity the story of their honourable and meritorious deeds."

NOTES ON THE HABITS OF SOME COMMON ENGLISH SPIDERS.

SOME years ago I sent to NATURE (vol. xxiii. p. 149) an account of the behaviour 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 anything 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 armour 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 further 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.

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 behaviour 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 further 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 reacted 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 seem 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 paraffin 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 anything 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 anyone 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.