PHILOSOPHICAL TRANSACTIONS

I. *Extract of a Letter from Dr.* John Ingenhouſz, *F. R. S. to Sir* John Pringle, *Bart. P. R. S. containing ſome Experiments on the Torpedo, made at* Leghorn, *January* 1, 1773 *(after having been informed of thoſe by Mr.* Walſh). *Dated* Saltzburg, March 27, 1773.

Redde, Nov. 10, 1774.

AS I could get no torpedos alive to my lodgings at Leghorn, I hired a fiſhing veſſel, called a *tartana*, with eighteen men in her, and went out twenty miles to ſea, where the bottom is muddy, and where thoſe fiſh are chiefly to be found. We caught five; of which, four were about a foot in length, and the other of a ſmaller ſize. Before the nets were taken up, I charged a coated jar by a glaſs tube, and gave a ſhock to ſome of the ſailors; who all told me, they felt

the ſame ſenſation as when they touched the torpedo. Thoſe people acquainted me, that this animal has but very little force in winter, and cannot live a long time out of the water. As ſoon as the whole quantity of fiſh caught was hauled up upon deck, I put the torpedos immediately into a tub, filled with ſea water, together with two or three other fiſhes, which I found not at all hurt by their company. I took one of the torpedos in my hand, ſo that my thumbs preſſed gently the upper ſide of thoſe two ſoft bodies at the ſide of the head, called (perhaps very improperly) *muſculi falcati* by REDI and LORENZINI, whilſt my forefingers preſſed the oppoſite ſide. About one or two minutes after, I felt a ſudden trembling in my thumbs, which extended no further than my hands: this laſted about two or three ſeconds. After ſome ſeconds more, the ſame trembling was felt again. Sometimes it did not return in ſeveral minutes, and then came again, at very different intervals. Sometimes I felt the trembling both in my fingers and thumb. Theſe tremors gave me the ſame ſenſation, as if a great number of very ſmall electrical bottles were diſcharged through my hand very quickly one after the other. The fiſh occaſioned the ſhock, or trembling, as well out of the water as in it. The ſhock laſted ſometimes ſcarce a ſecond; ſometimes two or three ſeconds. Sometimes it was very weak; at other times ſo ſtrong, that I was very near being obliged to quit my hold of the animal. The torpedo having given one ſhock, did not ſeem to loſe the power of giving another of the ſame force ſoon again; for I obſerved

ſerved ſeveral times, that the ſhocks, when they followed one another very faſt, were ſtronger at laſt than in the beginning; and this was the ſame when the fiſh was under water as when kept out of it. The preſſure of my fingers, more or leſs ſtrong, did not ſeem to make any alteration in the powers of the torpedo. Applying a braſs chain to the back of the fiſh, where I had put my thumb before, I found no ſenſation at all in my hand, though I repeated the experiment often, and applied the chain for a ſpace of time in which I always perceived a ſtroke(a). This was probably owing to the weakneſs of the fiſh in winter; or, perhaps, becauſe I neglected to put my finger to its oppoſite ſide. Having inſulated myſelf on an electrical ſtand, and keeping the torpedo in my hand, in the manner abovementioned, I gave not the leaſt ſign of being electrified, whether I received a ſtroke from the fiſh or not. The torpedo being ſuſpended by a clean and dry ſilk ribbon, it attracted no light bodies, ſuch as pith-balls, or others, put near it. A coated bottle applied to the fiſh, thus ſuſpended, did not at all become charged. When the fiſh gave the ſhock in the dark, I heard no crackling noiſe, nor perceived any ſpark. When pinced with my nails, it did not give more or fewer ſtrokes than when not pinced. But by folding his

(a) Dr. INGENHOUSZ means, that he felt no ſhock, though he ſaw the animal, by the contortion of its body, give one to the chain. At that time he did not ſeem to know, that though the ſhock would be communicated by a rod of any metal, it could not be ſo by a chain, or where there was the leaſt interruption of continuity.

body, or bending his right ſide to his left ſide, I felt more frequent ſhocks. Dr. DRUMMOND made theſe experiments with me.

We diſſected ſome of the torpedos, and found, if I remember well, four very large bundles of nerves, paſſing ſidewards from the head into the two ſoft bodies, called *muſculi falcati*, and diſtributed by denſe ramifications through their whole ſubſtance. Theſe nerves ſeem to terminate in round threads, which ſurround certain cylinders of a tranſparent gelatinous ſubſtance, which ſeems to conſtitute the material part of theſe ſingular bodies that appear to be the reſervoirs of the electric power: theſe cylinders are parallel to each other, and have their direction from the under to the upper ſide of the fiſh. I did not obſerve whether theſe ſoft bodies changed in ſize when the torpedo gives a ſhock; but I ſuſpect they do. I waited for a better opportunity to make a good many more experiments, and repeat, with more care, thoſe already made. But though I have not been fortunate enough to find any other than what is above mentioned, I thought it my duty to inform you of what I have attempted, howſoever incomplete my reſearches have been. And if ever any further opportunity ſhould offer, and in a better ſeaſon, I ſhall not fail to make all the experiments I can think of, for illuſtrating ſo curious and intereſting a ſubject. I am, &c.