

AN EXPERIMENT UPON ELECTRIC FISH MADE BY GALVANI.*

Translated from the *Revue Scientifique* by the Marchioness
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Among the objects which are to be found in the *Musee Retrospectif*, is a little note book that once belonged to Louis Galvani. This note book, which has been kindly placed at our disposal by the Chevalier Auguste Mattioli, a great nephew of Galvani, contains autographic notes made by the illustrious forerunner of Volta, relative to some experiments performed upon torpedos in the year 1795, during a voyage to Sinigalia and Rimini, taken expressly by Galvani that he might study electric fish.

We find the following dates in the note book, 14th, 16th, and 17th of May, relating probably to Sinigalia, and that of the 19th of May to Rimini, where Galvani remained but two days.

The facts and considerations registered in the note book are partially to be found also in the fifth memoir addressed by Galvani to Spallanzani. But the whole has not been produced heretofore, and it will be a matter of some interest doubtless to learn that the autographic notes of Galvani contain passages which show us that in all probability he was the first to make observations relative to electric *polarization*. He would, perhaps, have carried the study further had not death interrupted his career on the 14th of December, 1798, when he was but sixty-one years of age.

The unpublished manuscript which I am going to produce does not detract from the merits of Gautherot, Ritter or any other *savants* who have given particular attention to the phenomena called by de la Rue *electric polarization*. It is no less interesting and curious, however, to be able to affirm that Galvani had observed them and distinguished them from other phenomena, four years before the pile was discovered.

In order to fully understand what I shall translate to you, it must be borne in mind that to Galvani muscular fibre represented a Leyden jar into which the nerve thread entered that played the rôle of conductor for the interior armor of the jar, while the exterior surface of the muscular fibre represented the outer armor of the small condenser. This hypothesis is advanced in Galvani's memoir entitled, *De viribus electricitatis in motu musculari, commentarium*, printed in Bologna, 1781.

Here now are the notes: no. 1, page 22.

"May 14-16, 1795.

"After a prepared frog has undergone several contractions upon the torpedo, if it is held by the feet with one hand, while a finger of the other hand is applied to its nerves, new contractions occur successively whenever the finger is separated from the nerves—that is to say, whenever the arc is interrupted.

"As I had made quantities of experiments in the ordinary manner without witnessing anything of the kind, I thought that in this case electricity was communicated from the torpedo to the frog, and had charged the little Leyden jars which I supposed were there."

No. 2, page 68.

"May 19, 1795.

"In operating upon two prepared frogs, whose nerves were detached from the spinal marrow, it happened that after they had been applied to the torpedo's back, and experienced several successive convulsions, particularly from shocks given directly by the torpedo, they contracted habitually when they were held by the feet with two fingers of one hand, or by a silken thread, while their nerves were touched by the fingers of the other hand, moistened by contact with the torpedo. The convulsions took place each time that the nerves ceased to be touched by the fingers, that is, whenever I interrupted the arc formed

by the two arms and the corresponding part of the thorax, which arc was applied at one end to the frog's feet and at the other to its nerves.

"This phenomenon lasted for some time and appeared more pronounced in the frog which had become convulsed by being applied merely to the torpedo's back without receiving any shock whatever.

"Once exhausted the phenomenon did not repeat itself, probably because the electricity from the torpedo having entered the nerves had weakened the muscular power of contraction.

"I have often used the same arc while experimenting upon numbers of frogs, but never before observed so many contractions produced so rapidly. It would not be unreasonable therefore, to suppose, that in this case the torpedo transmits a portion of its electricity to the frog and charges the little animal Leyden jars which exist in my imagination.

"It might perhaps be discharged again, produce a fresh charge and give rise to other contractions. The first supposition however, appears more probable.

"Whichever it may be, the entire modification occurs in the frog and not in the fingers or the hand which touch the torpedo. For having moistened the back of the hand which certainly did not come in contact with the torpedo, the result, on repeating the experiment, was precisely the same."

If I am not seriously mistaken, we have here actual phenomena of polarization provoked by the rapidity of the discharges from the torpedo (direct or indirect) across the nerves or muscles of the prepared frogs. The first observation of these facts is due to Galvani, although he employed no other instruments than these same frogs which had already made him familiar with the phenomena attributed to Volta to the contact of metals, and from which was soon to arise that wonderful apparatus called the Pile, whose marvellous development has been fully attested.¹

AN IMPORTANT CONTRIBUTION TO THE DOCTRINE OF CEREBRAL LOCALIZATION.

BY E. C. SPITZKA, M. D.

With the collapse of phrenology, an undue reaction set in against all attempts to undue functions in the convolutions of the human brain. The important anatomical theorization of Meynert, who taught that while the anterior zones of the brain were rather motor, the posterior and temporal lobes rather sensory in character, opened the path to the experimental inquiries of Hitzig who demonstrated the former truth by means of localized electrization in dogs, and thus suggested a rational distribution of simple functions in the organ of the intelligence, in no respect however comparable to the erroneous schematizations of Gall. The most recent and important contribution to this subject is entitled:

UNTERSUCHUNGEN UBER DIE LOCALIZATION DER FUNCTIONEN IN DER GROSSHIRNRINDE DES MENSCHEN, by Prof. Sigmund Exner, of Vienna.

¹ M. du Bois Reymond made a few remark upon the notes read by M. Govi. He wished to call attention to the fact that Galvani's experiments, although very interesting in themselves, are far from procuring a polarization in the actual sense of the word. All that really occurred was this: the frogs that gave no shock without metal, produced one after being exposed to the torpedo's discharges. This phenomenon could not be assimilated to polarization, that is to the production of secondary properties in the conductors by the fact of a primary current traversing these conductors. M. du Bois Reymond does not pretend to explain definitely the phenomena observed by Galvani. It is probable however that the frog's greatest sensibility to its own current was simply the effect of the immersion of the muscles and nerves in the sea water and mucus upon the torpedo's body. By this immersion the tendinous extremities of the gastrocnemius and the exterior of the femur would acquire the negativeness which belongs to them in a state of mechanical or chemical transverse section. That is, the muscular current would be increased in intensity. This according to M. du Bois Reymond, is the most probable explanation of the phenomenon mentioned in Galvani's note-book.

*This communication was made by M. Govi before the Congress of Electricians, October 5, 1881.