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## On the Electric Spark from *Gymnotus electricus* (Part 1) and its Electrical Sense (Part 2):

John Walsh's 1777 Draft Letter to the Royal Society of London

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### **Abstract**

This note presents new evidence concerning the existence of a Draft Letter written by John Walsh MP FRS, describing the generation of an electric spark from *Gymnotus electricus*, submitted for publication to the President of the Royal Society Sir John Pringle in the summer of 1777. It confirms Walsh's intention to publish a description of his spark experiments plus his observations of the eels' mysterious "electrical sense". For reasons that have never been understood, Walsh failed to publish a formal account of the *Gymnotus* spark generation, despite its perceived importance.

### **Introduction**

Wealthy nabob Colonel John Walsh MP FRS (1726-1795) undertook a historic fishing expedition to the coastal town of La Rochelle and nearby Île de Ré in the summer of 1772. There he successfully gave the first conclusive demonstrations, at least to modern eyes, of the electrogenicity of the marine Torpedo Ray by showing that the transmission of a physiological shock from the Torpedo required an electrically conducting path.

Walsh reported his success to the Royal Society of London in the form of a letter to his mentor, Benjamin Franklin, published in the Philosophical Transactions in the following year (1773, 462). In awarding him the Society's prestigious Copley Gold Medal in 1774, its President, Sir John Pringle stated (1775): "*If these reflections be just, we may with some probability foretell, that no discovery of consequence will ever be made by future physiologists, concerning the nature of the nervous fluid, without acknowledging the lights they have borrowed from the experiments of MR WALSH upon the living torpedo and the dissection of the dead animal by MR HUNTER.*".

### **The Elusive Spark**

The acclamation of his peers was not universal however and Walsh himself worried that he had been unable to detect the expected signature of the "electric fluid", the deflection of pith balls and the generation of a visible spark discharge. Walsh's other collaborator, natural philosopher Lord Henry Cavendish rebutted these and other objections raised by the sceptics by constructing a physical model of an electric torpedo ray charged by a battery of Leyden Jars (Schaffer 2004). Nevertheless, the absence of a visible spark remained a sticking point to widespread acceptance of the electric fish hypothesis despite Cavendish's clarification of the separate concepts of electric spark-enabling "pressure" (*Potential*) and shock-producing *Charge*.

Walsh realised, from the work of Williamson (1755), Cavendish (1776) and others, that the South American electric “eel”, then named *Gymnotus electricus*, was a better spark-generating candidate than the Torpedo Ray by virtue of its higher discharge potential, typically of the order of 500 volts, capable of administering a shock to a loop of as many as 40 people. He imported several healthy *Gymnotus* specimens from Dutch Guinea and succeeded in demonstrating a visible spark to an audience of Royal Society Fellows, including the President Sir John Pringle in 1776 (Finger and Piccolino 2011). His demonstration capped four years of experimentation with electric fish which began with the expedition to La Rochelle in 1772 during which he confirmed the electrogenicity of the marine Torpedo Ray.

Walsh’s London spark demonstration briefly became the “talk of the town”, and was reported in numerous journals and newspapers, including *The Gentleman’s Magazine*. It was widely reported in scientific circles on the European continent as well, following publication of an article by Walsh’s physician acquaintance Jean-Baptiste Le Roy in the *Observations sur la Physique* (1776). Walsh had written to Le Roy informing him of his success with the spark and Le Roy quoted Walsh’s letter in his article, adding Pringle’s imprimatur. Other reports circulated, including those of eye witnesses, but Le Roy’s article is believed to contain the only published account written by Walsh himself of what was considered by the scientific community to be his crowning achievement.

Walsh’s unaccountable failure to report his work on the spark from *Gymnotus* has led to considerable speculation. Suggested reasons for this mysterious omission have included writers’ block, family business and political pressures, the absence from England of his former mentor Benjamin Franklin, rapid dissemination within the “*Republic of Letters*” following Le Roy’s report, and a desire to obtain more experimental data from the eels (Finger and Piccolino, Piccolino, Piccolino and Bresadola).

### **New Evidence**

We report here the discovery of a copy of an extract from a letter written by John Walsh to his nephew Francis Fowke in Bengal dated July 7<sup>th</sup> 1777 (Benn-Walsh 1852) which reveals Walsh’s intention to publish, not only his work on *l’étincelle électrique*, but also his observations of the eels’ mysterious “electrical sense” which had evidently supplanted the spark in his research interests.

Walsh wrote to Fowke:

*“At the last meeting of the Royal Society before their Summer recess, I delivered in a Draft of a letter to the President, concerning the spark exhibited by the Gymnotus a very extraordinary property I had observed in that animal: In short, no less than a new sense, by which the Gymnotus perceives the presence of a better conductor of his electricity than the water which surrounds him. By the application of which principle I can, at his tub-side, or even in the next room, govern him as if I had a bridle in his mouth, by making him stop short, or reverse, turn to the right or to the left as I please: the lightest Varnish on the Metallic Conductor Masks it so far that he cannot perceive it by his electrical sense, as I am disposed to call it. It is difficult for me to explain more of this matter to you without taking a wide compass, so that I believe I must refer you to the printed letter whenever it appears. He has passed through the winter very well & is now returned to Warfield for the Summer.”*

“Warfield” refers to his country residence Warfield Park in Berkshire to which he had evidently returned for the Summer, together with the long-suffering *Gymnotus* eel.

In passing we note Walsh’s ingenious use of an insulating varnish to interrupt the flow of current between the metallic conductor and the surrounding water in order to verify the electric nature of the phenomenon. He had employed the same principle at La Rochelle to verify the electric character of the Torpedo’s shock transmitted around a conducting loop.

### **Walsh’s *Gymnotus* Spark Presentation**

Further enquiry (Mills, private communication 2021) has revealed that, according to the minutes of the final meeting of the Royal Society held on June 19 before the Summer recess, “*part of a paper was read on the gymnotus electricus by Mr Walsh*”. No further mention of Walsh’s paper is made in the minutes of the next meeting, after the recess, on November 6. Unfortunately records of the Society’s Committee of Papers (its Publications Committee) are incomplete before 1780 (Mills, Private communication) so that it is not clear whether Walsh’s “*draft of a letter*” was ever submitted to the committee for its consideration. It seems from his letter to Fowke that Walsh presented his draft letter directly to Pringle, perhaps in the expectation that Pringle would communicate it to the *Transactions* on his (Walsh’s) behalf as Franklin had done previously for his 1773 Torpedo paper.

It seems clear that on July 7, nearly 3 weeks after the meeting, Walsh fully anticipated seeing “*the printed letter, whenever it appears*”. According to Finger and Piccolino (2011), Pringle wrote to Albrecht von Haller in a letter dated June 28, a week before Walsh wrote to Fowke, that “*he expects Walsh will have an article on these sparking eels in the Philosophical Transactions*”. Pringle continues “*The most curious memoire of the second part will be, I imagine, that other of Mr Walsh upon the Gymnotus electricus or Surinam eel ....of which he has other interesting circumstances to tell*”.

This suggests that the missing Draft Letter was in two parts, the first an account of the spark experiments, delivered by Walsh at the June 19 meeting of the Society; the second more controversial part, concerning the eel’s “electrical sense”. Although Pringle appears not to have taken issue with this “electrical sense”, it may have been a step too far for the Committee of Papers – hence the non-appearance of the Letter in the *Transactions*.

Another contributory impediment to publication may have been Pringle’s preoccupation with the quasi-scientific lightning-conductor controversy involving Franklin, Cavendish and others which led to Pringle’s resignation and the accession of royal favourite Joseph Banks to the Presidency in 1778.

Whatever the reason, 60 years passed before Faraday was to unknowingly repeat Walsh’s spark demonstration, and nearly 200 years passed before electro-sensing was rediscovered by Lissman and Machin in 1958.

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## References

Benn-Walsh J. Memoir of Lady Walsh. 38-40. Mss Eur 032. British Library: India Office Records and Private Papers.

Cavendish H. 1776. An Account of some Attempts to Imitate the Effects of the Torpedo by Electricity. *Philosophical Transactions of the Royal Society of London*. 66: 196-225. [Google Scholar].

Finger S. and M. Piccolino 2011. *The Shocking History of Electric Fishes*. New York. Oxford University Press.

Hunter J. 1773. Anatomical Observations on the Torpedo. *Philosophical Transactions of the Royal Society of London*. 63: 481-489.

Hunter J. 1775. An account of the *Gymnotus electricus*. *Philosophical Transactions of the Royal Society of London*. 65: 395-407.

Le Roy J-B. 1776. Lettre adressée à L'Auteur de ce Recueil: Observations sur la Physique, 8: 331-335.

Lissman H.W. and K.E. Machin 1958. The mechanism of object location in *Gymnarchus niloticus* and similar fish. *Journal of Experimental Biology* 35, 451-486.

Mills V., 2021. Private Communication. Royal Society Archives.

Piccolino M. and M. Bresadola 2002. Drawing a Spark from Darkness: John Walsh and Electric Fish. *Trends in Neurosciences*. 25: 1. 51-57.

Piccolino M. 2003. *The Taming of the Ray*. Florence. Leo S. Olschki.

Pringle J., 1775. Discourse on the Torpedo. Delivered at the Anniversary meeting of the Royal Society, November 30 1774. Royal Society of London.

Schaffer S. 2004. Fish and Ships: Models in the Age of Reason. In *Models: The Third Dimension of Science*, eds. S. de Chadarevian and N. Hopwood, 71-105. Stanford Ca. Stanford University Press.

Walsh J. 1773. On the Electric Property of the Torpedo: in a Letter to Benjamin Franklin. *Philosophical Transactions of the Royal Society of London*. 64: 461-480. [Google Scholar].

Williamson H. 1775. Experiments and observations on the *Gymnotus electricus*, or electric eel. *Philosophical Transactions of the Royal Society of London*. 65: 94-101. [Google Scholar].