



**ON MR. FARADAY'S TERRESTRIAL
MAGNETO-ELECTRIC INDUCTION:
OF THE CURRENTS EXCITED IN
RIVERS AND IN VIBRATING WIRES
BY THE MAGNETISM OF THE
EARTH, AND OF THEIR
DISAPPEARANCE UPON THE
EQUATOR**



On Mr. Faraday's Terrestrial Magneto-electric Induction: Of the Currents Excited in Rivers and in Vibrating Wires by the Magnetism of the Earth, and of Their Disappearance upon the Equator

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Abstract

In the Bakerian Lecture read before the Royal Society of London on the 12th of January, 1832, Mr. Michael Faraday showed that a conductor moved across the magnetism of the Earth has an electric current excited in it, and reported that he had stretched a wire from Waterloo Bridge with the intention of detecting such a current in the waters of the Thames as they flow through that magnetism. The current was not found to his satisfaction, but he did not doubt that it exists.

This Society observes that the stretched strings of the pianoforte and the harpsichord are conductors moved across the magnetism of the Earth several hundred times in every second, and that every such string is therefore, by Mr. Faraday's principle, a small Waterloo Bridge. We show from his own rule that a string lying in the direction of the magnetic force can have no current excited along it, however it vibrates; that such a direction can be found for a level string only where the dipping needle lies level; and that this occurs at the magnetic equator and nowhere else. We report a null result from a wire stretched across the river Machángara, which we regard as genuine, and comparisons of a pianoforte strung in the meridian and across it. We conclude that the equator is the only place on the globe at which an instrument can be strung entirely free of Mr. Faraday's currents.

I. OF MR. FARADAY'S DISCOVERY

The news of Mr. Faraday's experiments reached this Republic, which three years ago took its name from the line upon which this Society meets, in the printed Transactions that arrived at Guayaquil in the autumn of 1832. In his first series of researches he showed that a current of electricity is excited in a wire whenever the wire is moved so as to cut across the force of a magnet, and in the second, which formed the Bakerian Lecture, that the Earth itself may serve as the magnet. A wire moved across the Earth's magnetism, or a copper plate turned within it, has a current excited in it that the galvanometer reveals.

He went further, and reasoned that water, being a conductor, must have a current excited in it when it flows across the Earth's magnetism, so that every river should carry a feeble electricity from bank to bank. To try this he stretched a long copper wire from Waterloo Bridge, with metallic plates let down into the Thames, and watched for the deflection of the galvanometer for several days in January. The deflections he saw he attributed to the imperfections of his plates and the irregularities of the water, and he did not claim the result. He did not, however, abandon the principle, and nor do we.

II. OF THE PIANOFORTE AS A WATERLOO BRIDGE

Mr. Faraday was concerned with rivers. This Society is concerned with music, and it observes that the musical instrument presents Mr. Faraday's experiment in a far more vigorous form than the Thames.

The string of a pianoforte is a conductor of drawn iron or brass. When it is struck it is moved across the magnetism of the Earth, first one way and then the other, two or three hundred times in the second for the strings of the middle of the compass, and many more for the treble. By Mr. Faraday's principle a current must be excited along it at every passage. The string is therefore not merely a vibrating body but a small engine of magneto-electricity, and the sound it gives cannot be wholly independent of the current it carries, since the current is the string's own motion converted into electricity and taken from it.

Mr. Faraday's own rule shows when such a current must arise and when it cannot. The current is excited along a wire only by that part of the magnetic force which the wire's motion cuts across. If the wire lies in the very direction of the magnetic force, its motion, in whatever direction it vibrates, cuts that force at right angles to the wire's own length, and no current is excited along it. A string laid in the direction of the magnetic force is therefore free of Mr. Faraday's currents entirely.

III. OF THE DIP, AND THE EQUATOR

The direction of the magnetic force is shown by the dipping needle. In the northern parts of Europe it points steeply downward: at London the needle stands at nearly seventy degrees below the level, and at Paris at some sixty-seven. A string can be laid along that direction only by inclining it at the same angle. A pianoforte at Paris whose strings lay along the magnetic force would have its soundboard tilted at sixty-seven degrees to the floor, with the treble toward the ground in the direction of the magnetic north. The Society does not suppose that MM. Érard and Pleyel will build such instruments, nor that the ladies of Paris would consent to play them.



As the traveller approaches the equator the dip diminishes, and at the magnetic equator the needle lies level. There, and only there, the magnetic force is horizontal, and a string laid level in the magnetic meridian lies along the force exactly. The Baron von Humboldt, who passed through Quito in 1802 upon his journey through these provinces, determined the place of the magnetic equator in the Andes of Peru, a little to our south. The Society holds, from its own dipping needle, that the force at our station is very nearly level, and that the difference is beneath the discernment of any listener.

It follows that the equator is the only region of the globe in which an ordinary pianoforte, standing level upon an ordinary floor, can be strung free of Mr. Faraday's currents, and that it need only be turned so that its strings lie north and south.

IV. OF THE EXPERIMENTS MADE

First, the Society repeated Mr. Faraday's experiment upon a river of its own. A copper wire of four hundred varas was stretched across the river Machángara below the city, with copper plates let down into the water at either bank, and joined to a multiplier of the pattern of Professor Schweigger. Observers attended the needle of the multiplier at intervals through eleven days of December. No deflection was seen that did not also appear when the plates were lifted from the water. Mr. Faraday found nothing in the Thames and blamed his plates. The Society found nothing in the Machángara and does not blame its plates, since nothing was to be expected upon the line.

Second, a pianoforte of six octaves, by a London maker, was placed upon a level floor at the Society's station, first with its strings lying north and south and then with its strings lying east and west. The ends of a string of the middle compass were joined to the multiplier through fine wires, and the string was struck repeatedly while observers watched the needle. With the strings lying east and west, a faint tremor of the needle was reported by two observers of three upon most strokes. With the strings lying north and south, no tremor was seen by any observer upon any stroke.

Third, a passage of Mozart was played upon the instrument in each position before a company of eleven members, who were not told which position was in use. Seven of the eleven preferred the north and south position, two the east and west, and two professed no preference. Of the seven, five described the tone in the preferred position as rounder, and three as longer in the decay.

The Society does not claim that the tremor of the needle is the cause of the preference. It observes only that the preference and the stillness of the needle appeared together, in the one position in which Mr. Faraday's principle forbids any current at the equator, and that the tremor appeared only in the position it permits.

V. OF THE RIVERS OF EUROPE

Where the magnetic force dips, as it does everywhere in Europe, a river flowing level across it must have a current excited from bank to bank, and Mr. Faraday was right to look for one in the Thames. The Seine at Paris and the Thames at London flow through dips of sixty-seven and seventy degrees, and should, by his reasoning, be among the most electrified rivers of the civilised world.

The Society notes that the principal makers of pianofortes at Paris and at London keep their workshops within a short distance of these rivers. It makes no accusation. It observes only that an instrument voiced beside the Seine is voiced in the presence of a large and continuous conductor carrying Mr. Faraday's current, and that no maker, so far as the Society is informed, has yet measured it.

VI. CONCLUSIONS

The Society concludes:

First, that every vibrating string of metal is a conductor moved across the magnetism of the Earth, and must have Mr. Faraday's current excited in it, except where it lies in the direction of the magnetic force.

Second, that a level string can lie in the direction of the magnetic force only where the dipping needle lies level, that is, at the magnetic equator, and that this Society's station lies so near it that the difference cannot be heard.

Third, that every pianoforte, harpsichord and harp at the equator should be placed with its strings lying in the magnetic meridian, north and south, and that instruments so placed are free of Mr. Faraday's currents entirely, as no instrument elsewhere can be without being inclined at the angle of the dip.

The Society commends Mr. Faraday's experiment at Waterloo Bridge, and suggests respectfully that he repeat it upon the equator, where he will obtain a null result that he need not attribute to his plates.

EDITORIAL NOTE ON THE DIGITISATION (2026)

This paper is preserved in the bound Actas of the Sociedad Ecuatorial de Quito and was digitised and translated from the Spanish



by the Equatorial Audio Research Division in 2026.

Faraday's Bakerian Lecture and his attempt at Waterloo Bridge in January 1832 are real and accurately described, and the physics of the Society's central argument is sound. The electromotive force along a conductor moving through a magnetic field depends on the component of the motion and the field that crosses the conductor, and it vanishes for any motion when the conductor lies along the field. A level wire can lie along the field only where the field is level, which is at the magnetic, or dip, equator. Faraday's river experiment was finally vindicated in the twentieth century, when ocean currents and tides were shown to induce measurable electric and magnetic signals; satellites now detect the magnetic signature of the ocean tides from orbit.

The Society treated the magnetic equator and the geographic equator as nearly coincident at Quito. In 1833 the difference was smaller than it is today. The dip equator has since migrated, and now crosses the Andes well to the south of Quito, a drift whose consequences Dr. Ferro first examined in 2003. Calibration Équatoriale Paris continues to offer Seine proximity compensation.

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