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A survey of the history of electrical stimulation for pain to 1900

DENNIS STILLINGS

Stillings, D. A survey of the history of electrical stimulation for pain to 1900. *Med. Instrum.* 9: 255-259, 1975.—This paper traces the history of the use of electricity to treat pain, beginning with the first century A.D. practice of using the torpedo fish to treat gout, continuing through the eighteenth-century use of electrostimulation as an analgesic, up to 1900 when electroanalgesia fell into disrepute. The author recognizes the early empiric nature of electrotherapy as it was catalogued by the Reverend John Wesley, and the beginnings of speculation on the mechanism of pain relief by Berlioz, Sarlandière, and others.

history of electrical stimulation; electrotherapy; pain relief; electroanalgesics; electroacupuncture; electrical stimulation for pain

THE BEGINNING of electrical stimulation for pain is coincident with the beginning of electrotherapy itself. In 47 A.D., Scribonius Largus reported on the case of Anteros, a freedman of Nero, who was cured of the pains of gout (arthritis) by accidentally coming into contact with a live electric ray, or "torpedo fish," while strolling along the beach (16). Scribonius, as well as his contemporary Dioscorides, recommended electroichthiotherapy for headache (5,16). Claudius Galen also experimented with this peculiar fish and reported:

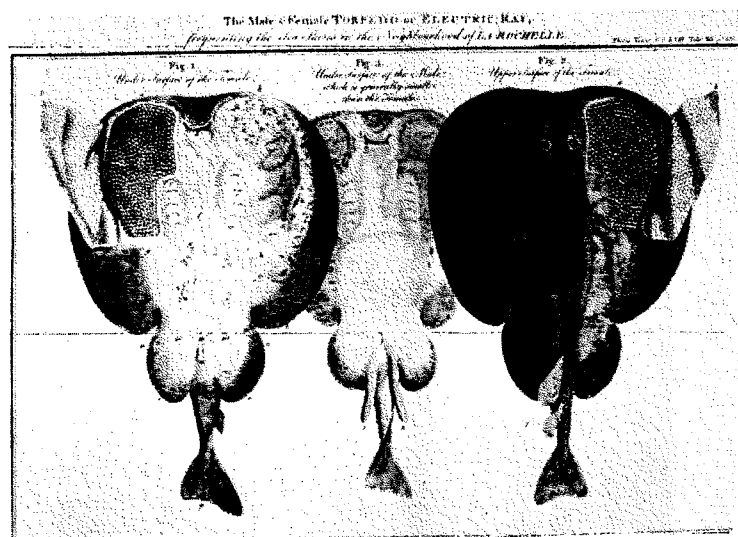
The whole torpedo, I mean the sea-torpedo, is said by some to cure headache and prolapsus ani when applied. I indeed tried both of these things and found neither to be true. Therefore I thought that the torpedo should be applied alive to the person who has the headache, and that it could be that this remedy is anodyne and could free the patient from pain as do other remedies which numb the senses: this I found to be so. And I think that he who first tried this did so for the above-mentioned reason. [9]

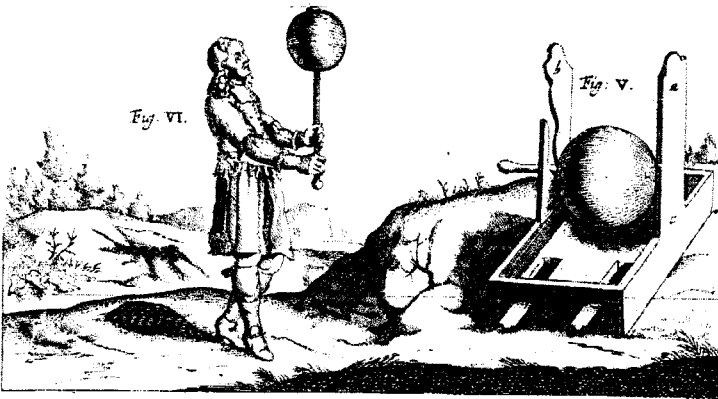
Recommendations for application of the torpedo in cases of cephalalgia and arthralgia persisted throughout the Middle Ages, listing among its advocates Avicenna and Averrhoës. In the sixteenth century, Dawud al Antaki declared the torpedo to be efficacious in relieving "chronic headache, unilateral headache, and vertigo even in desperate cases" (15).

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The seventeenth century brought with it the first controlled artificial production of electricity: Otto von Guericke's electrostatic sulfur sphere (7). This crude implement was elaborated into an electrostatic generator by F. Hauksbee early in the eighteenth century. With this new tool, in combination with the Leyden jar condensers invented independently by

The torpedo or electric ray. (Plate from *Philosophical Transactions*, LXIII [1774])





Von Guericke's electrostatic sphere: the first electrical machine. (Detail from *Iconismus XVIII* of his *Experimenta nova . . .*, 1672)

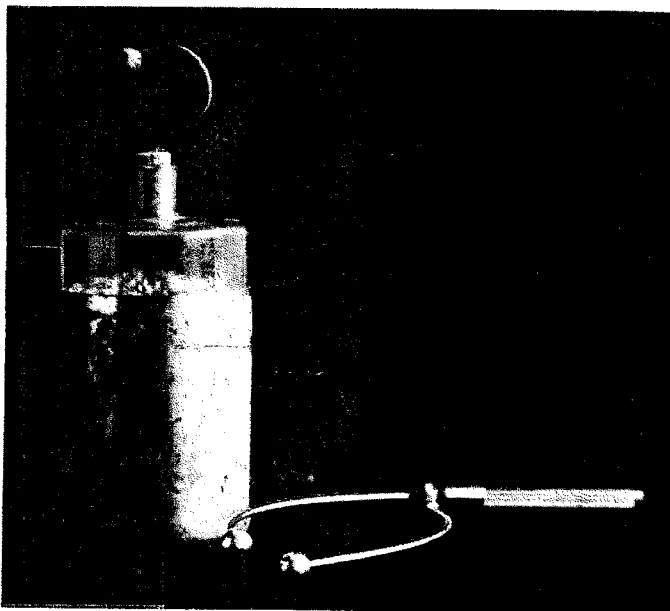
Georg von Kleist and Pieter van Musschenbroek in 1745 and 1746, medical applications of electricity, and especially applications for pain, multiplied rapidly.

Empiric Approach to Electroanalgesics

John Wesley, one of the earliest of the eighteenth-century electrotherapists, listed a number of cases of pain relief following electrical treatment.

[A Mr. Greenfield was reported to be] dying . . . of the gout in the stomach, but on observing the symptoms, I was convinced it was not the gout, but the angina pectoris (well described by Dr. Heberden and still more accurately by Dr. McBride of Dublin). I advised him to take no more medicines but to be electrified through the breast. He was so. The violent symptoms immediately ceased and he fell into a sweet sleep. Slight Attacks of the *Gout* are suddenly and effec-

Leyden jar, used to store electrostatic charge; shown with a discharging rod. (In the collection of the Museum of Electricity in Life)



tually removed, by drawing Sparks from the Part affected.

A Man of *Bromsgrove*, afflicted for near a Fortnight with a violent and constant *Head-ach*, was twice electrified by a few light Shocks, with half an Hour's Interval, and entirely cured.

Mr. *Joshua W—* of *Pershore*, was troubled for seven or eight Years with a Pain in his second Toe. Tho' nothing was to be seen, it was as tender as a Boil, and the Pain was so great, particularly in walking, that he at length determined to have it cut off. By drawing Sparks he was cured in an Hour.

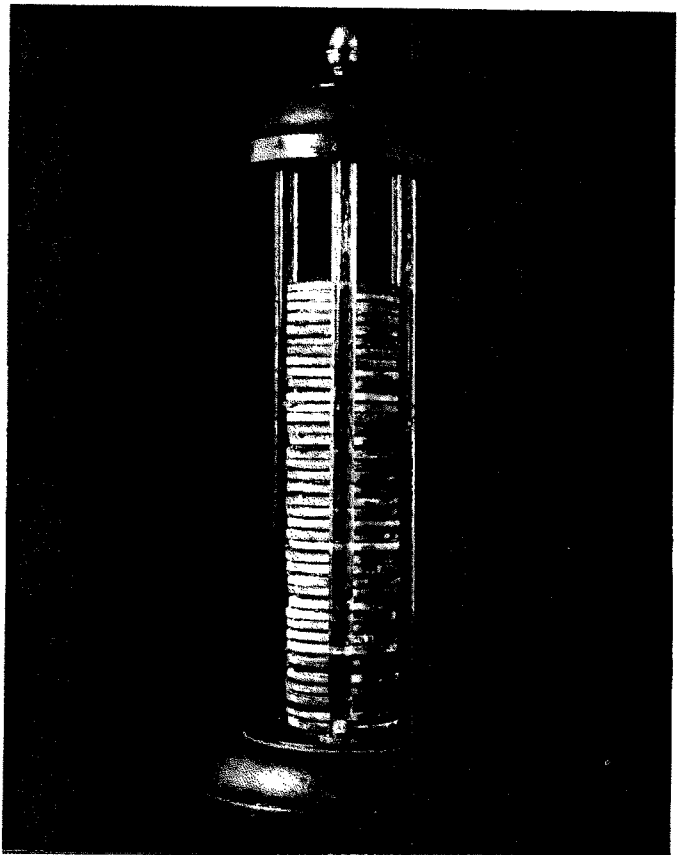
Mary Butler, aged 86, living in *Eagle-street, Red-lion-square*, having been afflicted with the *Sciatica* for more than twenty Years, was last Month electrified ten or twelve Times, and has been easy ever since.

It seems the Electric Fire in Cases of this and of many other Kinds, dilates the minute Vessels, and capillary Passages, as well as separates the clogging Particles of the stagnating Fluids. By accelerating likewise the Motion of the Blood, it removes many Obstructions. [18]

Such cataloguing of cases is evidence of the strictly empirical approach that dominated electroanalgesics in the eighteenth century. The wonder of sudden pain relief by discharging the marvelous electrical "fire" through the afflicted body parts seemed to obviate any speculations regarding the physiology of the procedures.

Roughly coincident with the development of electrotechnology, the practice of acupuncture began to be imported from Asia. In 1683, Ten Rhyne published his work *Dissertatio de arthritide: mantissa schematica: de acupuncture . . .*, bringing the details of the method of acupuncture for the first time to the West. In 1712, Engelbert Kaempfer's *History of Japan* appeared, giving the first English account

An early example of the Volta pile, the first battery (ca. 1800). (In the museum collection)



of Japanese acupuncture. From then until early in the nineteenth century, acupuncture received scant attention.

Speculations on Mechanisms of Pain Relief

In 1821, James Morss Churchill's tract on acupuncture (4) caused considerable renewal of interest. Subsequently J.-B. Sarlandière published an extensive work on "electro-puncture," which chiefly discussed the great benefits for pain resulting from the combination of electricity and oriental needling (11). This procedure had already been suggested by L. V. J. Berlioz in 1816 for the treatment of pain (3), and we begin to hear, for the first time, speculations on the mechanisms of pain relief. Speaking of his own experience with needling, Berlioz reported:

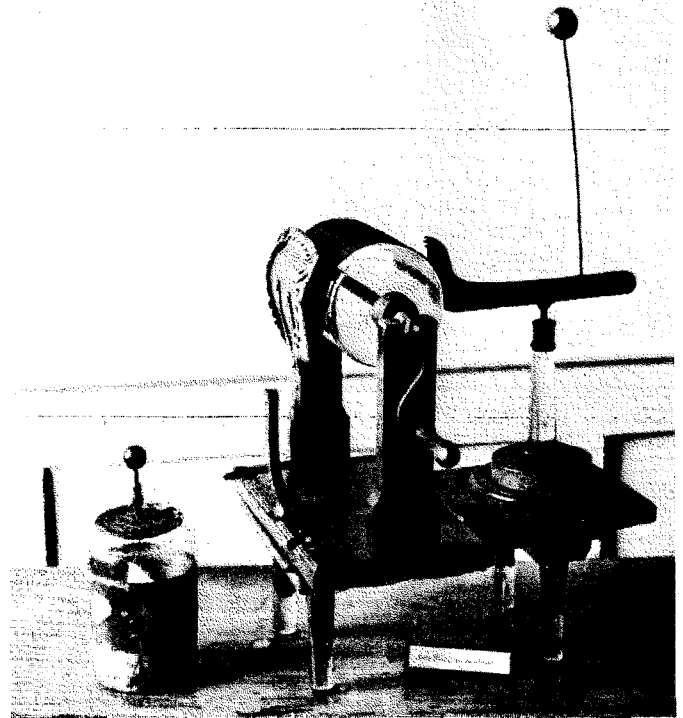
The introduction of several needles does not seem to me more efficacious than that of a single one. This leads one to believe that acupuncture does not work by replacing one form of irritation with another. Further, I repeat, it is never more successful than in cases where the procedure involves little or no pain. It appears, on the contrary, that this remedy works by stimulating the nerves, or by restoring some quality of which they were deprived by the effects of the pain. Nevertheless, there is little difference in the results obtained whether, after having introduced two needles of different metals, one brings them into contact directly or whether one uses a third needle. Apparently the application of a galvanic shock produced by a Volta pile heightens the medical effect of acupuncture.

Sarlandière, in his work, also speculated on the mechanisms of pain relief by electroacupuncture:

Electro-puncture or electrical acupuncture differs from acupuncture proper in that the needle does not play the principal role in the operation, but rather serves as a conductor of electricity, which, introduced through the skin into the muscle tissue itself, or into fibrous tissue, changes the vitality of these tissues until the very nature of the pain is altered, and the irritation ceases. How does this marvel take place? Does it change the mode of irritation, forcing the nerves to feel the pain in a manner different from that to which they have become accustomed? Does it overcome the sharp and lacerating pain of gout and rheumatism by means of a shock, a convulsion, a stimulus which forces an entire muscle or a whole section of fibrous tissue to contract so that the irritation is disturbed and finally overcome? [12]

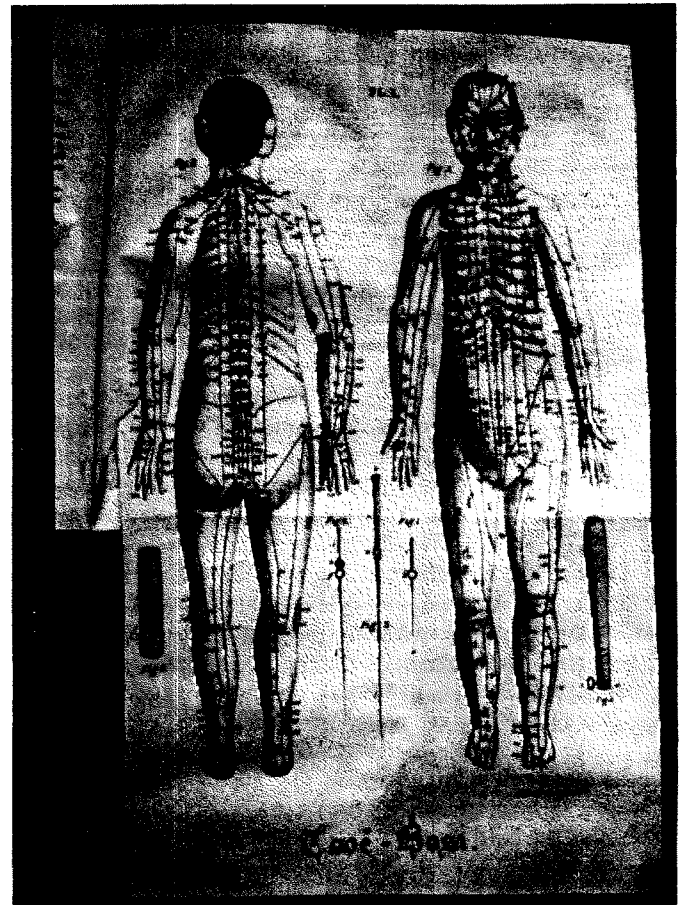
Sarlandière further elaborated his pain theory:

As I have said, even the lightest discharges upon the needle introduced into our tissues will cause a feeling of vibration all through the suffering part. If this part is a muscle, one can feel, and even see, the contraction through the skin. Heavy discharges result in a sort of convulsion, and, by its being suddenly shaken in this way, the nervous functions of a suffering part are modified, and pain is relieved. Today all doctors agree that gout and rheumatism are not caused by a humor that must be forcibly expelled; this belief is relegated to the ignorant. Modern research has taught us what we know on this subject: that irritation of a muscular or nervous tissue, whether it be caused by cold, by gastric excesses, by immoderate exercise of the genital organs, etc., is the sole cause of these disorders; this irritation, fixed in or moving vaguely about through the muscles or fibrous tissues of the joints, appears to reside specifically in the nerves. Every time inflammation combines with nervous irritation, we see the antiphlogistics,



Electrostatic generator and Leyden jar used by John Wesley, ca. 1750. (Photograph courtesy of Wesley's Chapel, London, England)

Electroacupuncture diagrams from Sarlandière's *Mémoires sur l'électro-puncture*, 1825.



and especially leeches, cataplasms, fomentations, baths, diet, calming agents, succeed; but when there is no inflammation, one can generally displace the pain only with the help of violent revulsives such as mustard, frictions, vapors, moxas, vesicants, strong purgatives, the Pradier cataplasm, etc. . . . and all the excitants following this same principle. I have put this question to enlightened practitioners and to disinterested physiologists: How do these methods act [successfully]? They evidently serve as perturbators; they set up other sensations, other stimuli, which, as they are communicated to the nervous system of the affected part, act so as to alter the mode of irritation, destroying the pain that was contracted! . . . But all these methods, violent in themselves, fatigue the patient by alternation of stimulations and pains; these forces exhaust all the patient's powers in fighting them; too often the sensibility of the viscera is heightened, and it is at their expense that the pain in the outer parts is relieved. [13]

Electro-puncture is, in my opinion, the most proper method of treating rheumatism, nervous afflictions and attacks of gout, when the inflammatory symptoms that sometimes accompany them have been sufficiently subdued, which calls for a well-understood medical approach. One attacks the illness directly and, so to speak, at its root; one changes the mode of being of the very nerves that make the pain felt; one forces pain to disappear by the power of the electrical vibrations; and one administers shocks gradually and in reasonable intensity. Since, in this operation, one is making use of an agent whose strength always surpasses that of the nervous activity, and overcomes it, no matter how tenacious it may be, one can always be sure of attaining the goal desired; namely, of changing the defective mode of sensibility and the defective mode of action [of the affected part]. [14]

The analgesic effects of electrostimulation received wider recognition and acclaim throughout the nineteenth century. In 1844, E. Hermel treated sciatic and lumbosacral neuralgia by galvanic "electro-puncture" using two needles for electrodes (8). Julius Althaus, Moritz Meyer, and Robert Remak also extolled the pain-relieving effects of electrostimulation. Later in the nineteenth century, the illustrious Wilhelm Erb wrote:

At the present time we possess in the electrical current one of the most certain and brilliant remedies for neuralgia, although we must admit that much progress has not been made in our knowledge concerning its mode of action in these forms of disease. [6]

George M. Beard and A. D. Rockwell, authors of the most widely read book on electrotherapy of the late nineteenth century, reviewed extensively the use of electroanalgesia. They catalogue previous results reported in the literature as well as their own considerable experience. They cite the theory of Dr. A. Tripier that "faradic anaesthesia is explained by the interference of the different impressions that are made on the nerve. The impression made by the faradic current first reaches the cerebral center, and neutralizes, or, at least, diminishes, the impression made at the same time by any other irritating influence. This theory seems to us sensible and just. Dr. Tripier further recommends a return to the practice of faradic anaesthesia for slight operations" (1). Beard and Rockwell do mention also that Dr. Knorr of Munich had used this form of anesthesia for "opening felons and buboes" (2).

In 1890, a Dr. J. B. Mattison read, before the Medical Society of the County of Kings, a paper entitled "New and

Improved Galvanic and Faradic Batteries, with New and Original Electrodes, in the Treatment of Narcotic Habitués" (10). It is worth quoting at length:

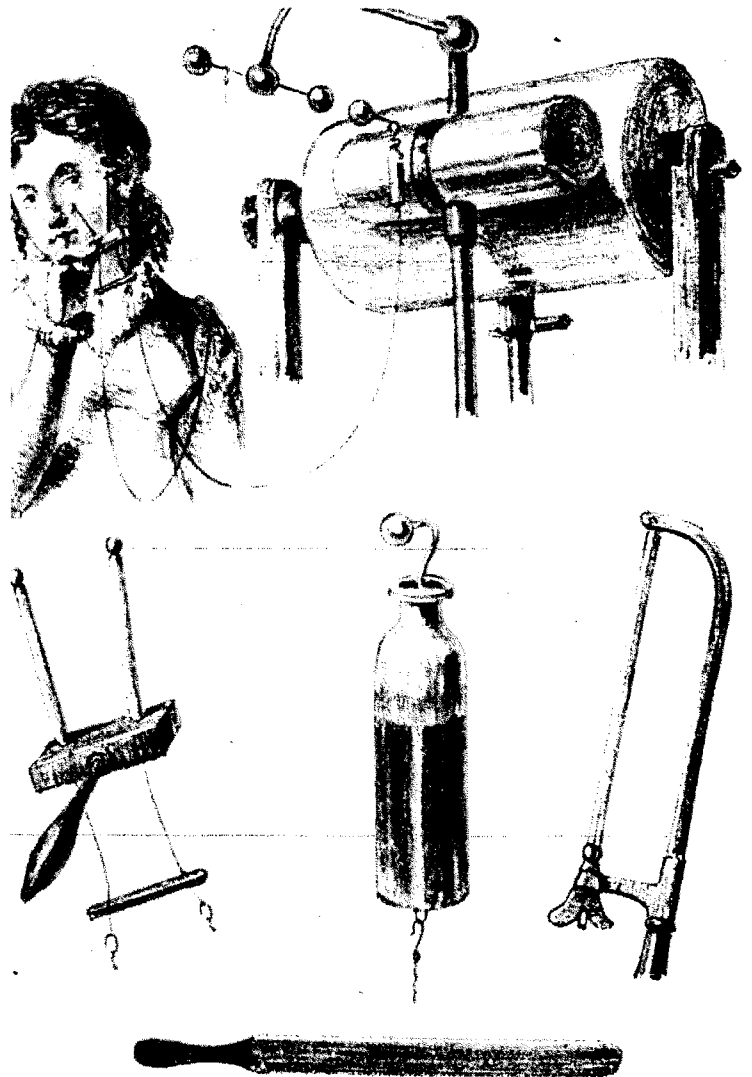
My special object is to call your attention to the value of Galvanism and Faradism for the relief of pain—neuralgic and myalgic pain.

Bartholow says: "There is no fact more certain than the power of Galvanism to relieve pain." Anstie, in his peerless treatise on neuralgia, asserts: "The constant current is a remedy for neuralgia unapproached in power by any other save only blistering and hypodermic morphine, and even the latter is often surpassed by it in permanence of effect, while it is also applicable in not a few cases where blistering would be useless or worse."

Those who have not had practical experience with Galvanism to relieve neuralgic pain have no fully adequate idea of the possibilities for good in a well-equipped, well-managed battery. As an anodyne, substituting opium, in habitués to that and other drugs, it is our most valued ally. Some strikingly good results from its use have been noted.

We have had a patient in a perfect storm of femoral night pain find ease in four minutes, and sleep in six. We have seen a man with a clavus-like head pain, se-

In 1824, Charles Bew found electrotherapeutic treatment "a peculiar, and easy mode of ascertainment and cure" for tic douloureux or trigeminal neuralgia.



queling morphia quitting, so severe that he was quite dazed, unable to think or talk straight, find entire relief in a few minutes.

We have known a lady recovering from a ten years' morphia addiction, have thirteen well-marked attacks, some specially severe, of ovarian neuralgia—the genesis of her poppy taking—and every one relieved in from six to sixteen minutes.

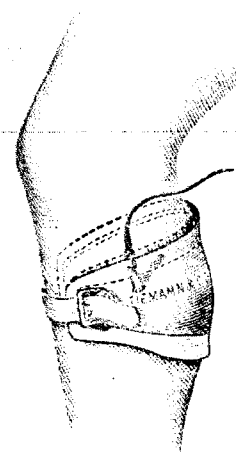
Medical annals, at home and abroad, teem with like cases. Two of the most notable ever recorded, were noted by Niemeyer; they were of the facial type—one an epileptiform tic. The patients were aged sixty-four and seventy-four years. The latter had suffered thirty years, the other five years. One had tried every possible variety of medication; eleven surgical operations—some severe, including ligation of the carotid, and resection of the superior maxilla, had been performed without relief, and in both cases the success with Galvanism was most striking.

Some of the best attested clinical facts that have ever gone into history have been along the line of Galvanism for relief of neuralgic pain.

This is one of the last testimonials to electroanalgesia. After 1900, the use of electrical stimulation for pain is scarcely even mentioned in the literature, and a giant unexplained gap extends from that time up to the present.

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Electrodes pictured in Mattison's 1890 paper on the galvanic treatment of neuralgic pain accompanying narcotic addiction.

Souvenir Series

Announcement: Souvenir Series

The Souvenir Series of 1976 will be worthy of the Bicentennial. The January-February edition will present Michael Leeming's "Probabilistic Assay of Device Dangers." This controversial thesis has already evoked such mixed responses among an unconscionable number of reviewers that the editors do not know whether they are in peril for allowing an attack on sacred cows, or for unyoking a bull in the electronic shop. In any event, the editors' mailbox will be crowded.

Subsequent issues will compare and criticize operating room devices, defibrillators, endoscopes, circulatory assist devices, and heart valves. Guest editors, giants in each field, are equipped to marshal succinct symposia to update the field. We know who they are. You may guess now, but look, read, and be edified later.

Whether one practices, produces, patrols, or profits by better personal or public health, all will welcome the Souvenir Series.