

NOMINATION FORM

IEEE MILESTONE IN ELECTRICAL ENGINEERING AND COMPUTING

Date: 16th October 2004

To: Director
IEEE History Center
Rutgers University
39 Union Street
New Brunswick, NJ 08901-8538
ph. 732-932-1066,
fax 732-932-1193
history@ieee.org

From: Seán McLoone
Secretary IEEE UKRI Section
Dept. of Electronic Engineering
National University of Ireland Maynooth
Maynooth, Co. Kildare, Ireland
ph. 00353 1708 6313
ph. 00353 1708 6027
s.mcloone@ieee.org

NOTE: This two-page form is intended as a cover sheet for submitting nominations. Fill in items (a) through (e) and present items (g) and (h) on additional pages. Items (d), (g), and (h) should reference supporting material. Attach the supporting material for them and list in item (i).

(a) Name of proposed Milestone:

Rev. Nicholas Callan's pioneering contributions to electrical science and technology.

(b) Location(s) of proposed Milestone (be specific):

Foyer of the Electronic Engineering and Biosciences Building, North Campus, NUI Maynooth.

(c) Present owner(s) of site(s):

NUI Maynooth

(d) Disposition of owner(s) toward Milestone (attach supporting material):

The Milestone has the full support of NUI Maynooth and St. Patrick's College. A letter of support from the President of NUI Maynooth is attached [1].

(e) Significant date(s):

1826-1864

- (f) Proposed citation (optional; absolutely limited to 75 words; 50-60 is preferable. NOTE: Whether or not the nominator suggests a citation, The IEEE History Committee shall have final determination of the wording of the citation):**

Proposal A (preferred): Rev. Nicholas Callan (1799-1864), a priest and professor of Natural Philosophy at St. Patrick's College Maynooth, was a pioneer in electrical science and technology. In addition to building the first induction coil and step-up transformer in 1836 he made important contributions in the development of electromagnets, galvanization, batteries and equipment to generate high voltage electricity.

Proposal B: Rev. Nicholas Callan (1799-1864), a priest and professor of Natural Philosophy at St. Patrick's College Maynooth, was a pioneer in electrical science and technology. He made key contributions in the invention of induction coils and transformers, including building the first successful mechanical rapid current breaker and the first induction coil with separate primary and secondary circuits. He also made important advances in the development of batteries, electromagnets, galvanization and equipment to generate high voltage electricity

- (g) Historic significance of this work: its importance to the evolution of electrical and computer engineering and science and its importance to regional/national/international development. Answer on a separate sheet, and reference and include supporting material. Be sure to be clear about the scope of the importance.**

As a pioneer in the study of electromagnetism and the development of electrical technology for the production of large currents and high voltages, Nicholas Callan made several internationally relevant contributions:

- Invented the induction coil and step-up transformer (1836)
- Built the first successful mechanical current breaker (1836) (which he called a 'repeater')
- First to establish the link between rate-of-change of current and electromagnetic induction (1836)
- First to discover the principle of the self exciting dynamo (1838)
- Made significant advancements in battery technology (1854-1855)
- Patented a method for protecting iron from rust – an early form of galvanization (1853)
- Built the most powerful batteries and electromagnets of his time (Encyclopedia Britannica, 1860)

A focus of Callan's research was to develop equipment to convert low voltage electricity (as obtained from batteries) to high voltage electricity. Influenced by the work of Faraday and Henry, he worked on the idea of the induction coil from 1834 onwards and developed his first induction coil in 1836. He also developed a mechanism to generate an interrupting supply (changing current) and built the first step-up transformer in 1836.

The historical significance of the work lies in the fact that without the induction coil, radio waves, x-rays, and the electron would not have been discovered and exploited as they have. In addition his discoveries in relation to the generation of high voltage electricity are equally significant, given the importance of transformers in the transmission of electricity worldwide.

The significance of his work was also recognized by many of his contemporaries with his experiments and apparatus being copied and extended by many scientists in Europe and America. (e.g. Sturgeon, Nesbit, Joule, Page, Clark, and Bacchoffner, [2], page 53).

The evidence for Callan's inventions can be found in the papers that he published on his research. A full list of Callan's publications and details of how they relate to his contributions can be found in [2, pp.88-91] and [4]. Those specifically relating to the invention of the induction coil and step-up transformer are:

- Sturgeon's Annals of Electricity (1,493: 11 Sept 1837)
- Philosophical Magazine (Dec 1836).

Callan also presented his case for the invention of the induction coil in 1857 at a meeting of the British Association for Advancement of Science held in Dublin. According to Casey [4], the report of this meeting (*Report of the British Association for the Advancement of Science, 1857* (pt.2) 11-13) quotes Callan as saying:

'It is now more than twenty years since I discovered the method of making the induction coil, or a coil by which an electric current of enormous intensity may be produced with the aid of a single galvanic cell-a coil which is now to be used for working the Atlantic Telegraph. Mr Faraday was the first who developed the laws of electrical induction; but he did not discover the method of making a coil by which a current of very great intensity may be obtained by means of a very small battery. This was first discovered in Maynooth College in 1836. In the summer of 1837, I sent the late Mr Sturgeon a small coil which he exhibited at a meeting of the Electrical Society in London and from which he gave shocks several of the members . . . This was the first induction coil of great power ever seen outside the College of Maynooth. The first notice of the discovery of the coil is found in a paper of mine published in the London Philosophical Magazine for December 1836. . . . In April 1837 I published in Sturgeon's Annals of Electricity a description of an instrument which I devised for producing a rapid succession of electrical currents in the coil by rapidly making and breaking communication with the battery . . . Thus before April 1837 I had completed the coil as a machine for producing a regular supply of electricity'.

It is clear from Callan's own words that he was aware of the significance of his invention with respect to the working the Atlantic Telegraph. Callan published a revised version of this paper in the Philosophical Magazine for Nov. 1857. A copy of this version is attached [8].

Other notable acknowledgements of Callan as the inventor of the induction coil can be found in

- Noad's Treatise on Electricity: Noad H., *Lectures on Electricity and the State of Electrical Knowledge in 1844*, Vol. 2, No.8: 138-146 and Noad H.M., *A Manual of Electricity* (Lockwood and Co., London, 1859),
- *Encyclopaedia Britannica 1910*, (11th edition), 'The induction coil' Vol. 14, pp. 502-503. (attached [9])
- Fleming J.A., *The Alternative Current Transformer in Theory and Practice*, Vol.2, London: The Electrician Printing and Publishing Co. Ltd., 1903, p7ff. (attached [10])
- Shiers G., *The Induction Coil*, Scientific American 224, 80-87 (1971)
- Rowbottom, M. and Susskind C., *Electricity and Medicine, History of their Interaction*. San Francisco Press Inc, 1984.

Fleming, for example, in his account of the historical development of the induction coil and transformer in [10] states on page 12:

Hence it is to Callan that we owe this simple piece of apparatus, now found in every physical laboratory, and it is to him that we are indebted for an induction coil having two separate wires, one thick and one thin, used as an induction coil.

Further evidence is provided by some of his contemporaries who explicitly acknowledge his contribution in their own publications. ([2, pp. 98-99])

Two other Callan papers worth mentioning are

- Sturgeon's *Annals of Electricity* 1 (Feb. 1836), 229-30
- Sturgeon's *Annals of Electricity* 2 (Feb. 1838), 317-8

In the first Callan describes his 'repeater', the first successful mechanical rapid contact breaker, while in the second, in addition to pointing out the priority of his induction coil, Callan also documents his discovery of the principle of the self-exciting dynamo. (See [2, pp. 55] for further details.)

**(h) What features or characteristics set this work apart from similar milestones?
Answer on a separate sheet, and reference and include supporting materials.**

Since Callan's contributions represent pioneering work when the field of electrical technology was in its infancy it is difficult to identify similar milestones. Certainly his contributions together with those of his contemporaries lay the foundation for modern society.

One characteristic, which sets Callan's contributions apart from those of others, was the scale of his efforts. Driven by a desire to obtain large currents and high voltages he built the largest batteries, electromagnets and induction coils of his time. His electromagnets could lift 20 tons (Encyclopedia Britannica, 1860) and he succeeded in generating voltages of the order of 600 kV that could produce 15-inch long sparks. See [2], [8] and [10] for further details. When describing Callan's Great Induction Coil Fleming [10] noted 'Although constructed 30 years ago, it is still one of the largest coils in existence'.

(i) List of supporting materials included:

- [1] Letter of support from NUI Maynooth.
- [2] P.J. McLaughlin, *Nicholas Callan, Priest-Scientist (1799-1864)*. Dublin: Clonmore & Reynolds, 1965. Pages 41-56, 88-91 and 98-99 are attached with this document for convenient reference. The full text is also included as a separate item.
 - Pages 41-56: An account of Callan's research
 - Page 88-91: A list of his research publications and how they relate to his research contributions
 - Page 98-99: An extract from Nature, vol. 180, pp. 730-2, 12 October 1957.
- [3] C. Mollan and J. Upton, *The Scientific Apparatus of Nicholas Callan and other Historic Instruments*, Sr. Patrick's College Maynooth and Samton Ltd, 1994.
 - Page 49-69: Examples of Callan's batteries, electromagnets and induction coils
 - Page 84-85: Example of Callan's repeater
- [4] M.T. Casey, *Nicholas Callan, Priest Professor and Scientist*, Physics Education, Vol.17, 1982, pp.224-234
- [5] C. Mollan, W. Davis and B. Finucane, (editors), *Irish Innovators in Science and Technology*, Publ. Royal Irish Academy, 2002, pp.79-80
- [6] E. Katz, *Nicholas Joseph Callan*, The history of electrochemistry, electricity and electronics website: <http://chem.ch.huji.ac.il/~eugeniik/history/callan.html>
- [7] D.P. Currier, *A Biographical History of induction coils*, Essay by Dean P. Currier (dpcurr@aol.com) posted on www.radiantslab.com/quackmed/Deanbio.html
- [8] Rev N. Callan, *On the Induction Apparatus*, Philosophical Magazine, Nov 1857.
- [9] *Encyclopaedia Britannica 1910* (11th edition), 'The induction coil' Vol. 14, pp. 502-503.
- [10] J.A. Fleming., *The Alternative Current Transformer in Theory and Practice*, Vol.2, London: The Electrician Printing and Publishing Co. Ltd., 1903, p7ff.

Seán McLoane

Signature of Chairman, Section History
Committee or Other Nominator.

G. Doherty

Signature of Section Chairman.
Print name and address below.