The Great Marconi Beacon Experiment of GB3SSS and VO1NA,

Poldhu Amateur Radio Club and Marconi Radio Club of Newfoundland;

An Exercise in Learning from A Scientific Reenactment.

A presentation to the Poldhu Amateur Radio Club,
June, 2010, by

Bart Lee, K6VK, (*impresario* of the event)

with special thanks to
Keith Matthew, G0WYS and Joe Craig, VO1NA

ITU: 'Technical Investigations'

- The Amateur Radio Service is defined by the International Telecommunications Union (ITU) as:
- A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is by duly authorized persons interested in radio technique solely with a personal aim and without a pecuniary interest.

“How,” not “If”

- The premise of this investigation is that Marconi and G.S. Kemp in St. John’s, Newfoundland, on December 12 and 13, 1901 did receive Fleming’s high power pulse transmitter operating in Poldhu
- The experiment
- 1) proved a medium-wave path to be open 24 hours a day, propagation programs to the contrary, and
- 2) engendered a better understanding of both the power of the transmitter and the sensitivity of the receiver.

21 A.W.A. Review 1 (2008), Lee, Craig & Matthew

Lee, Craig & Matthew

AWA Review

The Marconi Beacon Experiment of 2006-07*

ABSTRACT

The success of the 2006-'07 Marconi Beacon Experiment shows the skill and tenacity of amateur historians and amateur radio operators on both sides of the Atlantic. The International Telecommunications Union defines amateur radio: "A radiocommunication service for the purpose of self-training, intercommunication and *technical investigations* carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest." [1] This technical investigation not only shed welcome and favorable light on Marconi's claims of transatlantic signals in 1901, it also resulted in revisions to one of today's most sophisticated radio propagation models to account for its success. Moreover, the critical role of engineer John Ambrose Fleming and his high power pulse transmitter (Figure 1) in Marconi's success now comes to the fore.

INTRODUCTION

The Marconi Beacon Experiment, U.K. call sign GB3SSS, created and documented an extended technical experiment in the service of radio history: How did Marconi get across the Atlantic in December of 1901? Did he do what he claimed, that is, did he hear the letter "S", the three dots, near Cabot Tower on the hill overlooking St. John's, Newfoundland? Could these jury-rigged primitive wireless outfits do it in the daylight, between 14:00 and 18:00 London time? Did he hear it on the 800 KHz frequency he thought it was transmitted on? Could his 1901 transmitting and receiving apparatus do it at all?

Some distinguished authorities, such as John S. Belrose, VE2CV, are long on record that Marconi's 1901 claim was at best self-deception. [2] Marconi historians concede: "... the transmis-

Fig. 1. A drawing of the Poldhu 1901 spark transmitter, after a contemporary photograph [see footnote 29 below]; note the spark gap by the window which is retouched in the photograph. The inductors are in the foreground (e.g., H12), and the condensers towards the back, with horizontal handles on their drawers.

*This article is dedicated to the memory of our colleague Lane Upton, IEEE.

The Published Report

www.californiahistoricalradio.com/
Photos69, or History/Bart Lee for
the full scan and also an emended text

The History of Science, and the Art of Science History

- Our technology shapes our understanding, and our interpretations, but today's technology can mislead us about yesterday's, about which we have often forgotten …

Clio

- History, unlike physics, has a muse, Clio.
- All of the techniques of the historian, *e.g.*, marshaling and interpreting evidence, come into play, but guided by physical laws, and reported and reliable data over time, and possibly aided by experiment, to tell a story.

The Constant and the Variable

- Physical laws don't change, conditions do.
- Everything but physical laws changes – the world in which the laws of physics operate evolves in response to their effects.
- People in the aggregate have also changed the physical world since toolmaking and the mastery of fire.

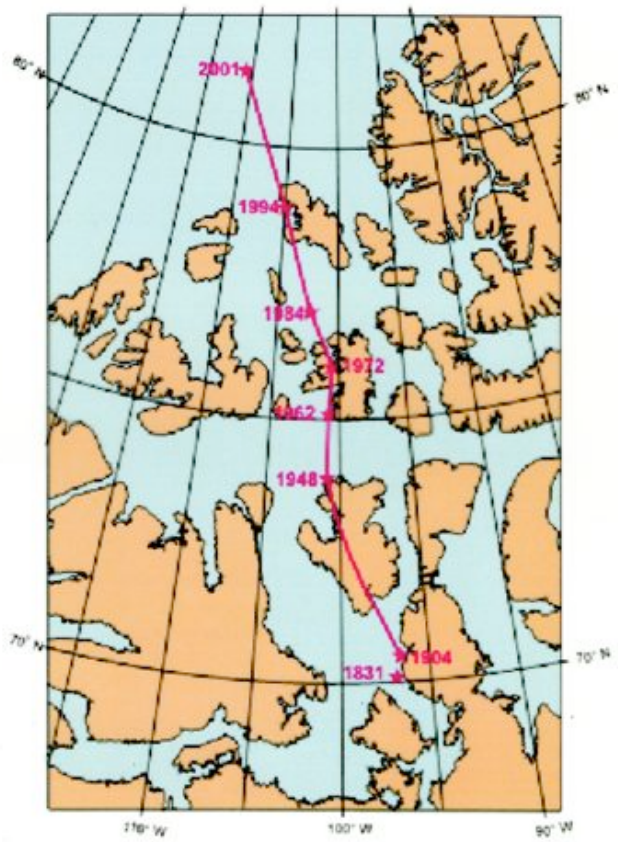
What is different 100+ years later?

- The Sun; *e.g.*, variations in activity, weaker blocking by the D-layer of the ionosphere in 1901.
- The Earth; *e.g.*, magnetic North 1000 km South, and very little man-made noise in 1901.
- The interface between the Sun and the Earth, the ionosphere, reflecting both solar and terrestrial conditions.
- *E.g.*, quieter ionosphere then, and less nitric oxide produced maybe to leak up to the D-layer.

Telling the Tales of Science

- The art of qualitative analysis is at least as rewarding as quantitative comparisons with very wide margins of error.
- In the absence of sound quantitative analysis, qualitative analysis can still tell an interesting and persuasive tale about our relation to the world mediated by our sciences.

Magnetic North Migrates (North)!



1831 to 2001, about 1,000 km

The Sun and the Sunspot Cycle; the Beacon Experiment took advantage of low sunspot numbers predicted for December 2006 to be like 1901

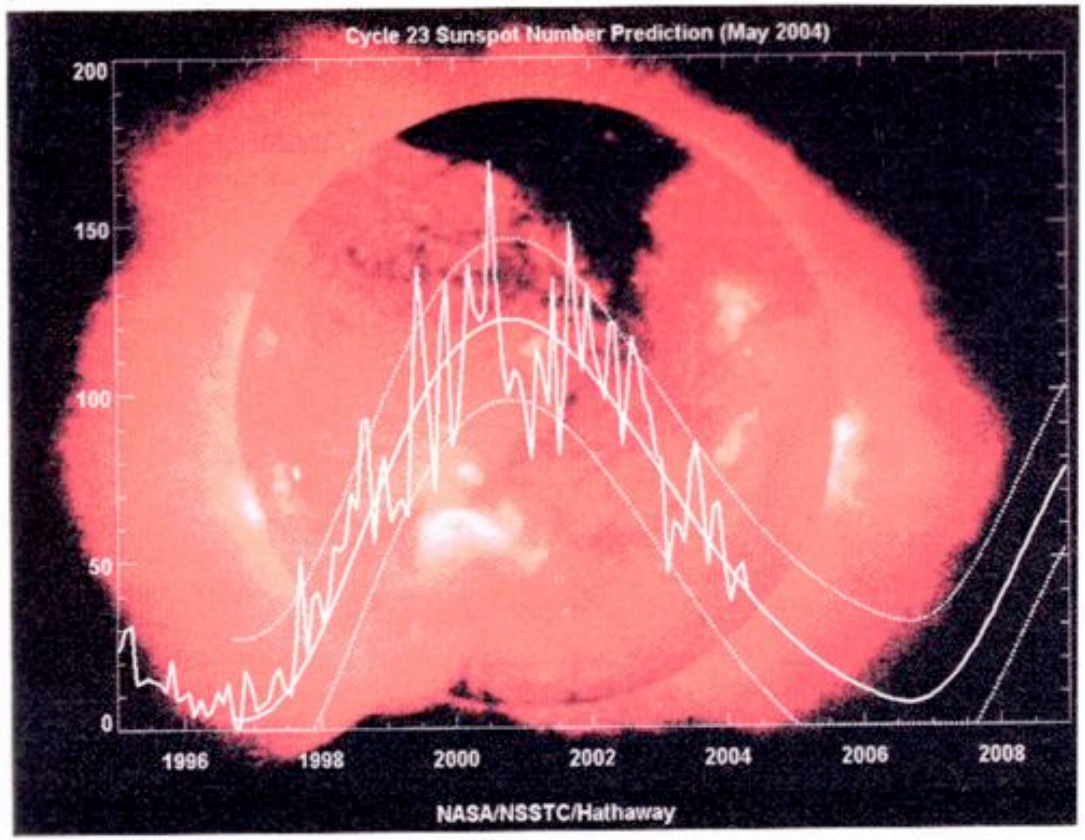


Figure 1—Actual and predicted sunspot numbers for Cycle 23. After David H. Hathaway at **science.msfc.nasa.gov/ssl/pad/solar/images/ssn_predict_l.gif.**

The Beacon Experiment: GB3SSS site, POLDHU, CORNWALL, UK

Aerial Photo courtesy of Poldhu Amateur Radio Club, 2007

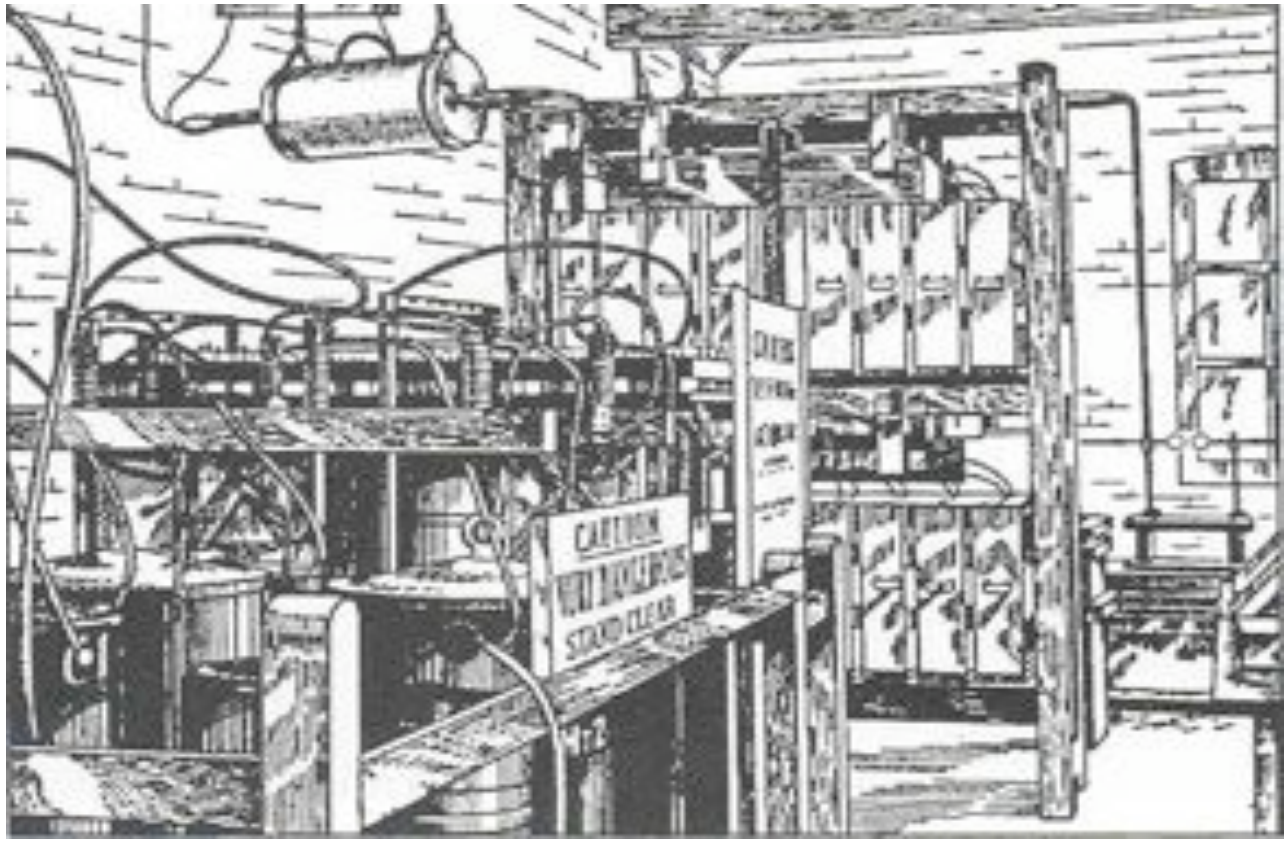
Keith Matthew, G0WYS, a principal of the 2006 Beacon Experiment

Photo by Bart Lee, Poldhu at GB2GM 2005, Keith Matthew at the mic

G4JNT ANDY TALBOT'S BEACON GB3SSS on 1960 KHZ 24/7, 100 W

Photo of the GB3SSS Beacon Transmitter courtesy of Poldhu Amateur Radio Club, 2006

Fleming's 1901 double spark gap transmitter, 13 KW (200+ KW pulse?)

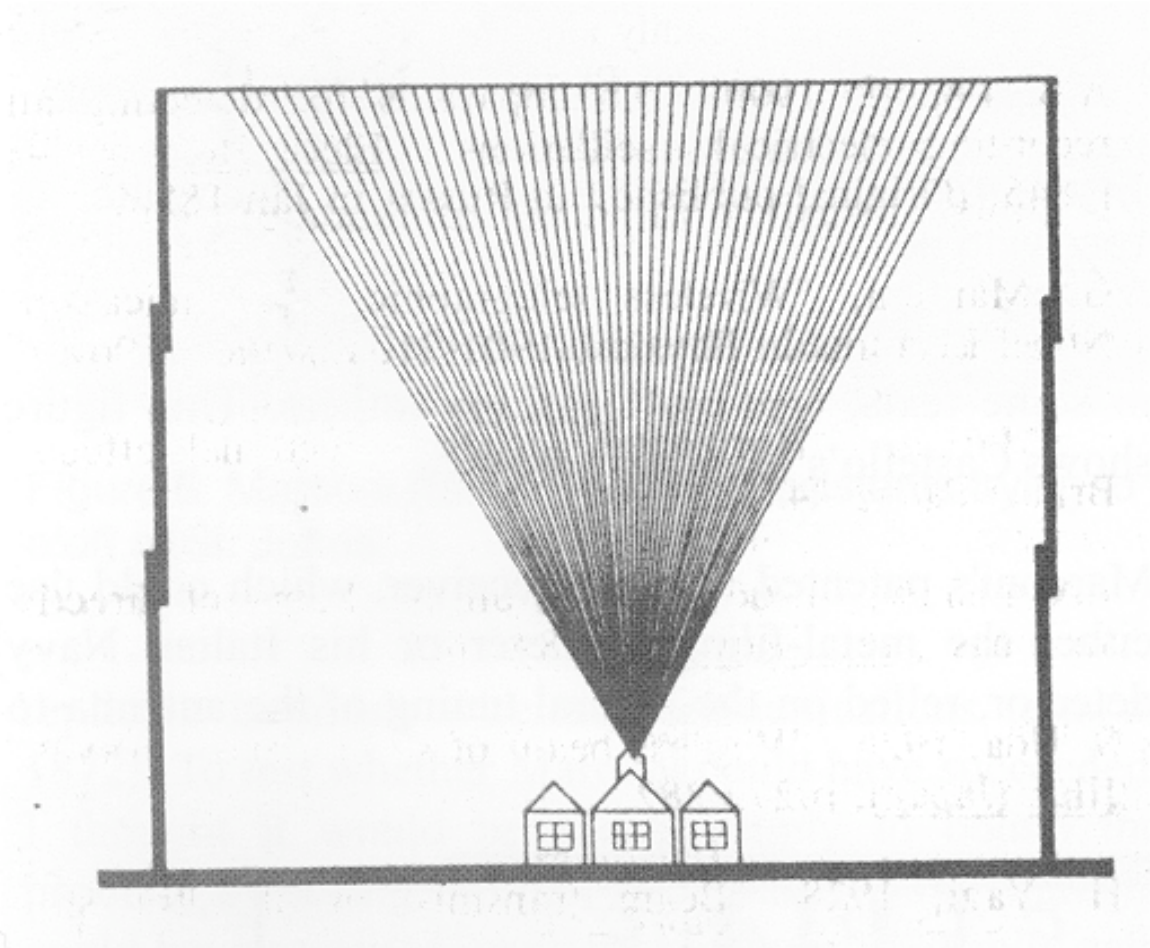


A drawing from a Pye Radio Company publication, after a 1901 photograph

John Ambrose Fleming; his unique high power two stage spark transmitter enabled Marconi's success

Fleming did the transmitter design and implementation but Marconi, by contract, took the credit; Professor Fleming had a background in high power AC design. Fleming was not at the key; operator Sam Maddams was.

The Fan antenna of 50 wires, more or less vertical, estimated 45 degree take off angle, resonant at <= 1 MHz



Getting GB3SSS Out – Thanks to G3AGA E.L.D. 'Davey' Davey- Thomas

- Only an extensive tuned radial system worked for the GB3SSS transmitter, and that was substantially the work of 'Davey' George Davey-Thomas, G3AGA, whose many decades of radio work came into play.
- Marconi's original antenna had to have worked against a ground, but what?

‘Davey’ Davey-Thomas, G3AGA

He made it work! (that’s Marconi in the background)

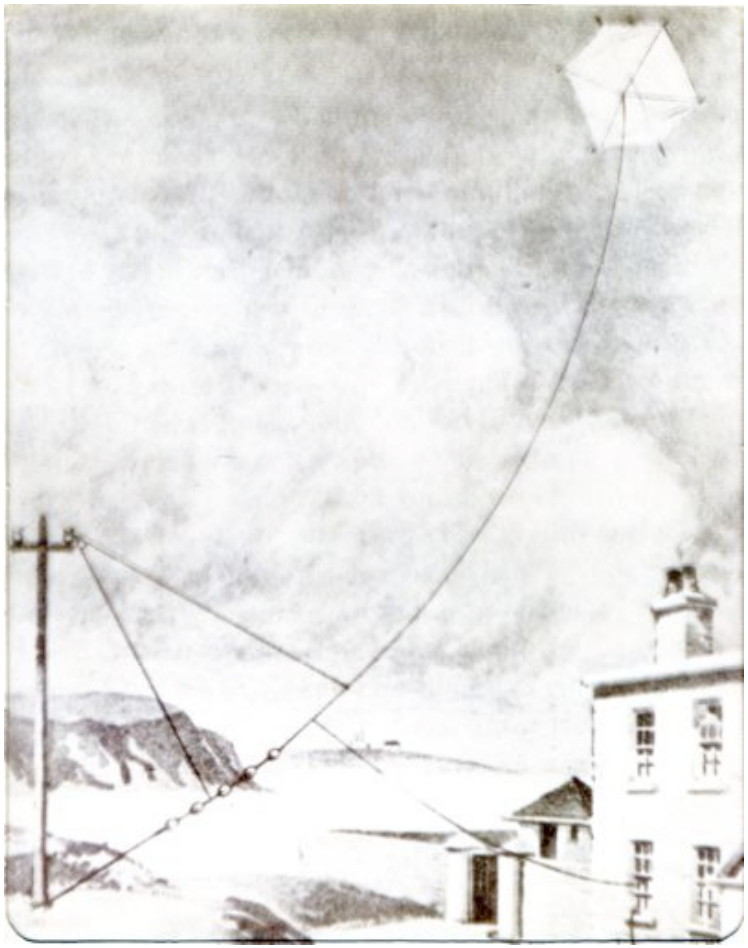
Cabot Tower, St. John's; the view from Marconi's actual 1901 site next to it:

Photo Bart Lee, 2005, Cabot Tower, St. John's, Newfoundland, Canada

Getting the kite antenna up in front of the now-gone fever hospital on Signal Hill, next to the Cabot Tower

Artist's conception after contemporary photographs

The kite antenna secured and flying



Graphic from RCA files, which took over American Marconi in 1919

Marconi (Solari/Bose) Mercury (not a passive) Detector

Now shown to act as a pulse amplifier by Eric Wenaas 21 AWA Review 45, 60 ff (2008); Photo Bart Lee, 2005, Science Museum.

Dec 1901, ZERO Sunspots, low absorption frequency, low MUF, quiet ionosphere, ideal for MW skip

++ Sunspot numbers by year and month:

YEAR	MON	SSN	DEV	YEAR	MON	SSN	DEV
1901	7	0.7	2.1	1901	11	3.8	4.3
1901	8	1.0	2.7	***1901***	***12***	***0.0***	***1.0***
1901	9	0.6	2.2	1902	1	5.5	8.1
1901	10	3.7	5.9	***1902***	***2***	***0.0***	***1.0***

Pioneer (1937) Radio Astronomer Grote Reber, W9GFZ, first noticed this many years ago, according to a note of his to the AWA Old Timers' Bulletin; in February, 1902 Marconi again achieved transatlantic reception but with a coherer and inker aboard ship, fully documented by the Captain.

Grey Line Path, Poldhu to St. John's, every December 12 at 14:00 GMT

Minimal D-layer strength near the terminator, away from the peak Sun to the South (W6EL propagation program image).

The Noise Conditions

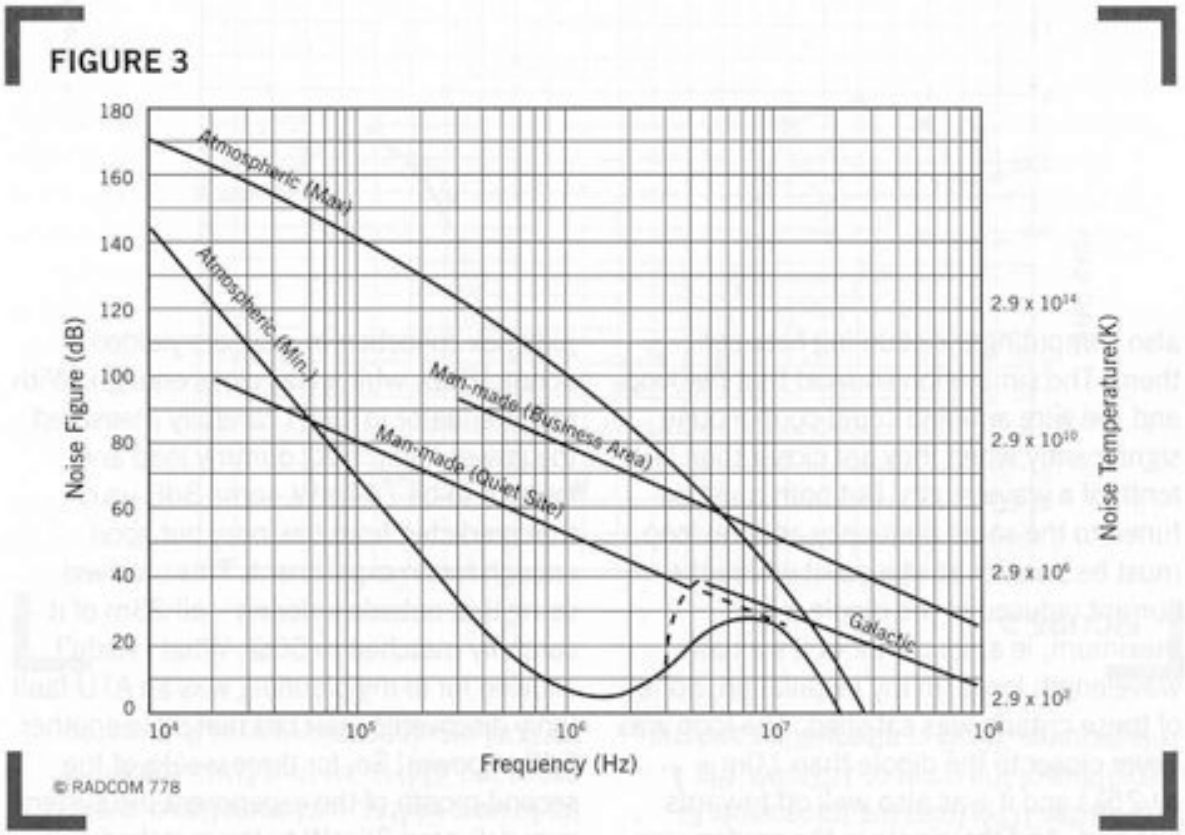
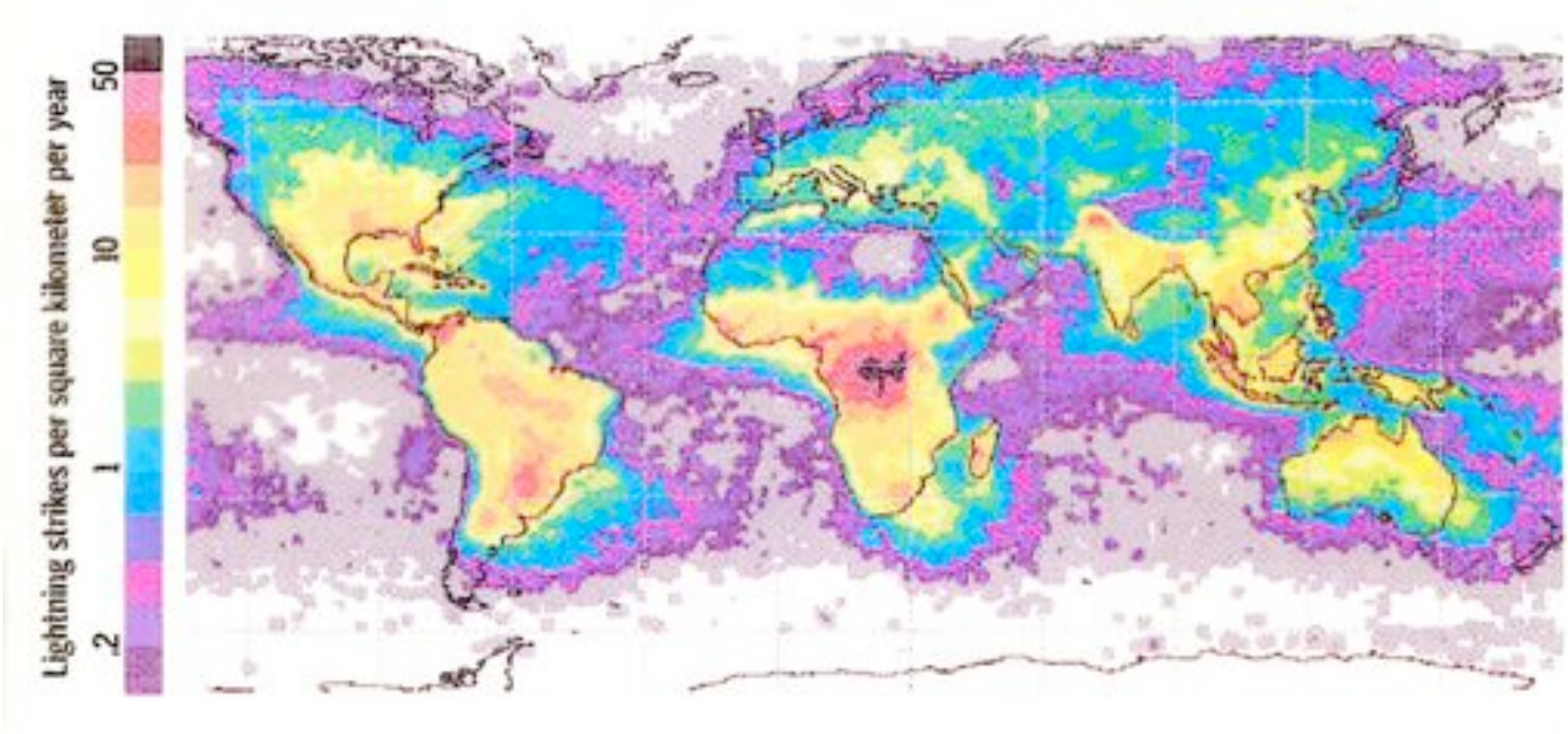


FIGURE 3: THE VARIATION ACROSS THE SPECTRUM OF ELECTRICAL NOISE FROM NATURAL AND MAN-MADE SOURCES [8].

Minimal winter atmospheric noise between 700 kHz and 1.2 MHz, and likely little man-made noise in 1901 (Crawford MacKeand (VP8CMY/WA3ZKZ) graph)

Winter Lightning Noise is far away, in Africa and South America



Success: Marconi and Kemp, 1901

Using a mercury detector and a telephone earpiece receiver at St. John's, they heard the three dots (clicks) from Poldhu about 36 times, December 12 & 13th, 1901. Their announcement of this success caused the Atlantic cable monopolies to lose half their market capitalization: the shares plummeted. (Photo posed with an inker).

Mileposts at St. John's, NFLD at the Cabot Tower, for Radio Tourists

Poldhu, 2,155 miles North East of St. John's, NFLD

Joe Craig, VO1NA (physicist), a principal of the Beacon Experiment

Joe Craig, VO1NA, at the Marconi memorial plaque at Signal Hill, Cabot Tower, St. John's, Newfoundland (Bart Lee Photo, 2005)

Joe Craig, VO1NA, receiving GB3SSS atop Signal Hill, St. John's, 2006

VO1NA using a handheld solid state receiver for the first medium wave reception at Signal Hill from Poldhu since December, 1901 (photo courtesy of Joe Craig, 2006)

VO1NA demonstrating his 137 KHz transmitter; he got across the pond.

Joe Craig, VO1NA, drawing a spark at St. John's, Photo Bart Lee, 2005

Jeff Briggs, K1ZM/VY2ZM, monitored the Beacon from Prince Edward Island

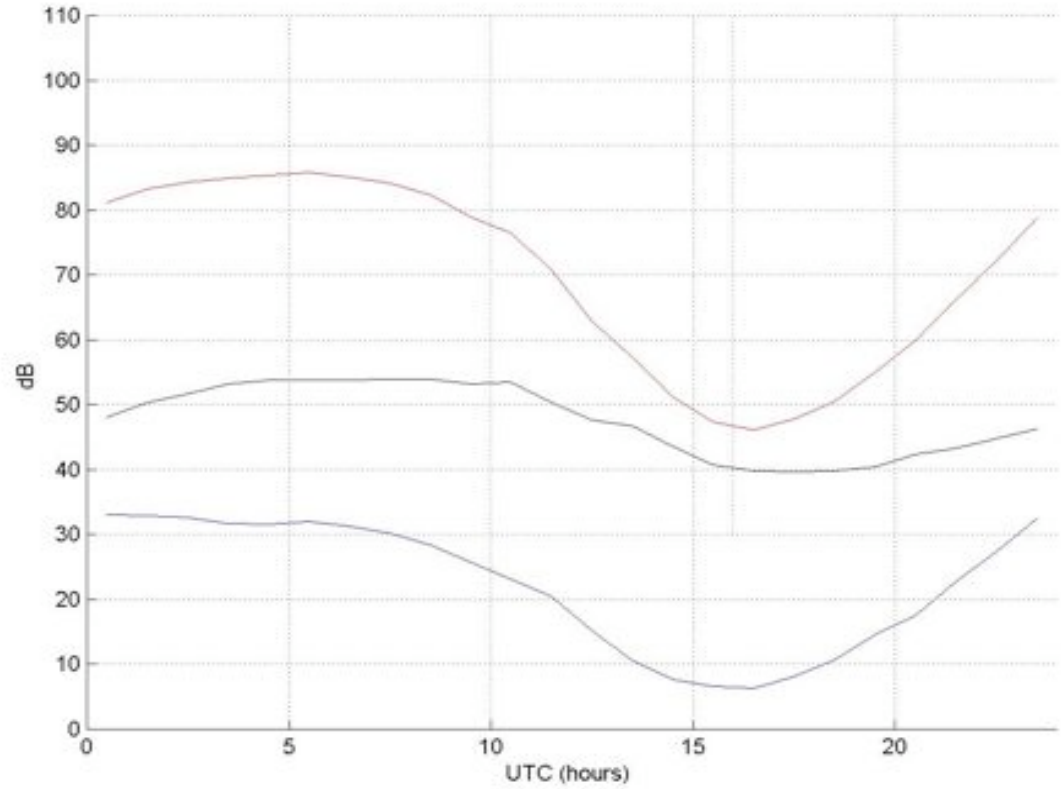
Clear copy, mid-day, from P.E.I., Canada: "like BLACK INKSPOTS hitting a clean white sheet of paper"

Photo courtesy of Jeff Briggs, who also won the CQ 160 meters CW contest in winter 2006 from PEI with his steerable vertical array (+8dB gain)

Joe Craig's receiving site, the VO1NA radio shack

Bart Lee, now K6VK, in Joe Craig's radio room, St. John's, NFLD, in 2005 (photo by Joe Craig). Joe used a Beverage antenna and sophisticated signal processing to record GB3SSS for three months.

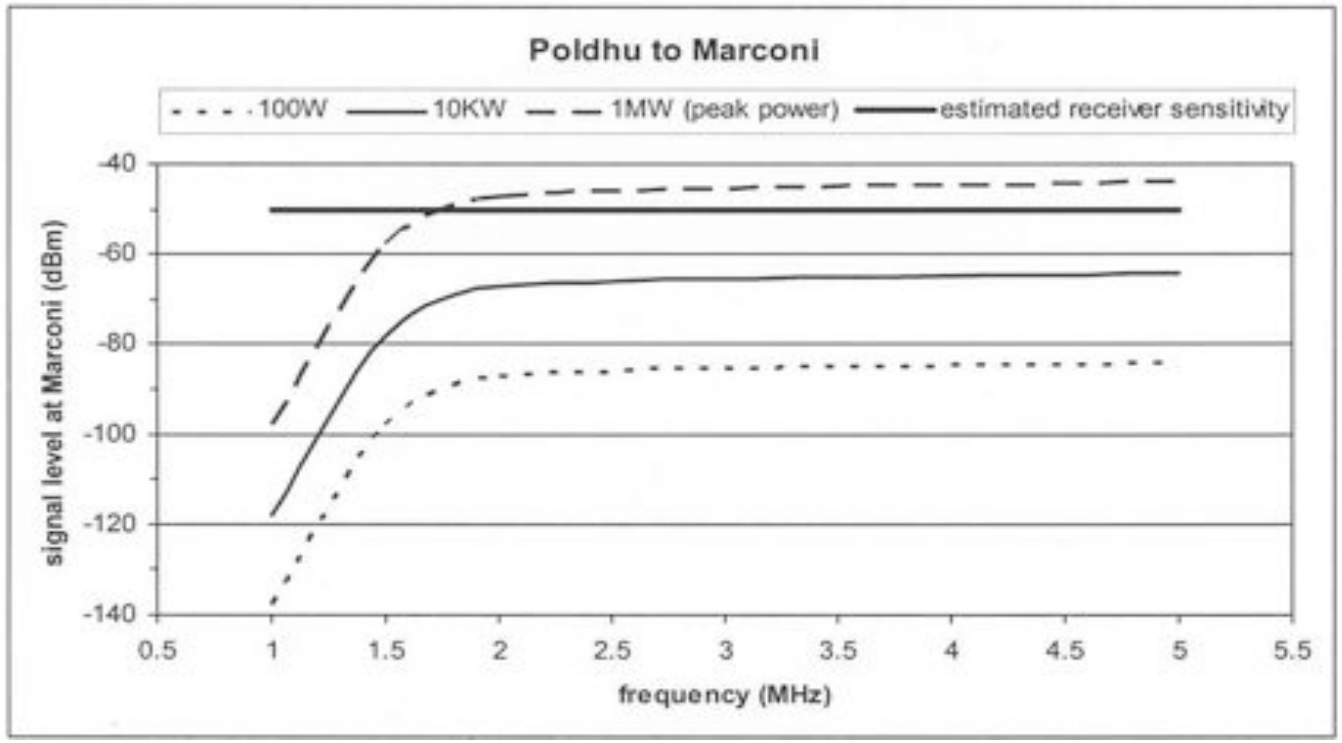
The Reception of GB3SSS, at least 6dB above noise



Noise (middle line) is the same shape as the Beacon, top line (as received on a directional Beverage antenna pointing to Poldhu), implying

1) The noise is propagated from the East (man-made in Europe), and
2) It wasn't there in 1901, because of so few noise sources then.

Receiver Sensitivity vs. Power of Transmitter (by K9LA)



K9LA, Carl Luetzelschwab, published this graph in WorldRadio, analyzing and supporting the conclusions of the Beacon Experiment, and modifying the leading propagation program.

As the transmitter is more powerful, and as the receiver is more sensitive, the reception is more likely. Did Marconi have both a more powerful transmitter and a more sensitive receiver than is commonly understood? The data suggests: "YES."

What's New as a result of the Beacon Experiment?

- We can duplicate Marconi's feat in roughly similar conditions using a low power transmitter and sophisticated receiver techniques instead of a high power transmitter and a primitive receiver (Matthew & Craig)
- The modern propagation programs saying there is no path are simply wrong because they ignored available data (K9LA)

What More do we Know about 1901?

- Fleming's 1901 13 KW transmitter put out astonishingly powerful pulses of RF energy by design, hundreds of kilowatts for very short pulses (MacKeand & Lee)
- Marconi's 1901 receiver could act as a pulse amplifier of remarkable sensitivity, perhaps ten nanowatts input for change of state (Lee & Wenaas)
- The sunspot cycle and time of year were ideal for Marconi's 1901 medium wave test (Reber & Lee)

Success

- This successful experiment in the history of technology has many fathers, acknowledged here and in the AWA Review Report of the event.
- Cooperation among British, Canadian and American amateur radio operators and clubs has provided a sound basis for accepting Marconi's 1901 claim of a daytime transatlantic wireless signal on a medium wave frequency – and the rest, as they say, is History.
- 73 de Bart Lee, K6VK, WPE2DLT, xKV6LEE [END]##