Guglielmo Marconi

An appraisal, on the centenary of his birth

by W. J. Baker

Guglielmo Marconi, who was born on April 25, 100 years ago, was a many-sided genius who, in his lifetime, probably achieved more honours, including the Nobel Peace Prize, than any man before or since. For all that, there was a curious thread which ran through his life; it was rather as if some daemon, while providing him with pre-eminence, always contrived to give it a bitter-sweet quality; a denial of the full satisfaction that was his goal.

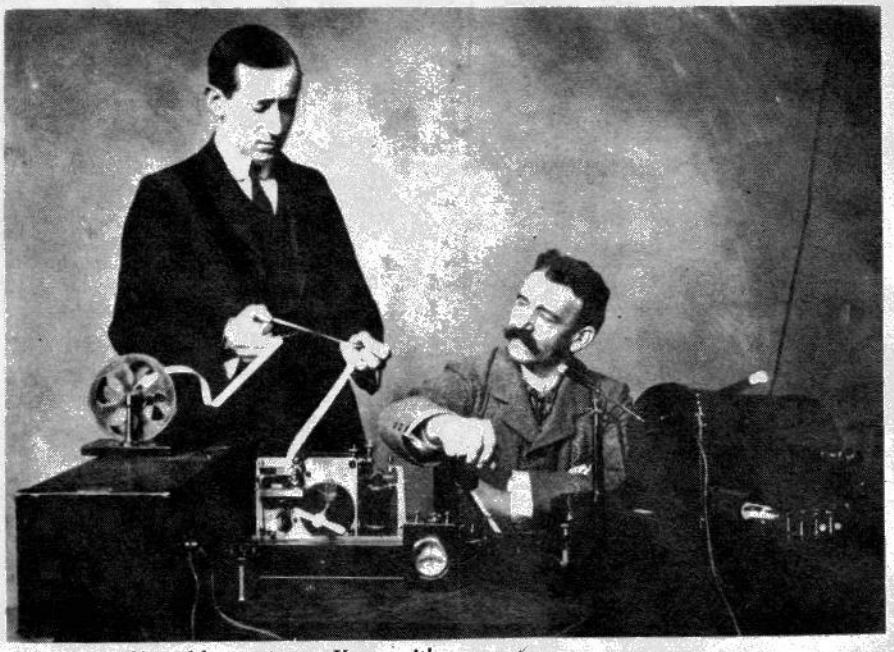
If genius is a matter of acquiring the right genes, then Marconi collected his by a circuitous route. The story of his birth has all the ingredients of a romantic novel[1]. It begins when one Andrew Jameson, together with his brothers, emigrated from Scotland to Ireland, where Andrew founded a distillery (even tee-total readers will have heard of Jameson's Irish whiskey). Concurrently he founded a family of four daughters, the ménage being a moated manor, Daphne Castle of Enniscorthy. One of these girls, Annie Jameson, was not only beautiful but possessed a singing voice of a quality which brought her an offer to appear at the Royal Opera House, Covent Garden.

At this juncture papa put his foot firmly down. No daughter of his was going to appear on the stage; however, by way of recompense he offered Annie the prospect of going to Italy, to stay with some banker friends of the family in Bologna, where she might study *bel canto*. So, half a loaf being better than nothing, Annie went.

Andrew Jameson's attempt at family diplomacy boomeranged with painful accuracy. For his Italian friends had a son-in-law; a widower with one child. Annie was still a minor; the widower was seventeen years her senior, but they fell in love and Annie returned to Ireland to ask permission to marry. This time papa jumped with both feet. Allow his daughter, a mere child, to marry an unknown Italian, almost old enough to be her father, and of a different religious persuasion? Unthinkable! Annie was kept at home and forbidden to communicate with this foreigner. But somehow she did and as soon as she became legally of age she fled via England to France, where at Boulogne she was met by her suitor. On April 16, 1864, Annie Jameson was married to Giuseppe Marconi, whereupon the pair returned to Bologna. A year later their first child, Alfonso, was born. Almost as if reluctant to enter the scene, a further nine years elapsed before their second child arrived, on April 25, 1874. So, Guglielmo Marconi's maternal grandfather was a Scot and I am rather surprised that they have not made more of this north of the border.

In spite of the foregoing, this is not a biography of Marconi. Those readers who are sufficiently interested will already have read at least one of the several which are around[1,2]. Those who regard history as bunk would only be bored by a potted account of what he accomplished. All I propose to do is to select one or two of the bitter-sweet episodes referred to earlier, by way of illustration of what I meant. So no more of the boyhood of Marconi, except to say that his father was a well-to-do landowner who was intent that his sons should eventually manage his estates; to this end his younger son's interest in physics was ruthlessly discouraged and the electrical apparatus he constructed was destroyed whenever it was discovered. It is a miracle that Marconi survived this antagonism and that he did is due to his obdurate refusal to give in and to the secret encouragement and devotion of his mother, Annie Jameson Marconi. Nor must we forget Alfonso, nine years older than his brother, but helping him whenever possible; Alfonso was Marconi's first assistant, the hewer of wood and the drawer of water; never making the headlines, just staying quietly in the background and, after father Giuseppe's death, looking after their mother while Guglielmo was pursuing his endless quest for improvements to wireless telegraphy. Both Annie Marconi and Alfonso are buried in Highgate cemetery, Guglielmo in Italy.

Throughout his life Guglielmo Marconi was a loyal Italian, and his first act, after bringing his wireless telegraphy system to a workable state, was to offer it, unprotected by patents, to the Italian P. and T. Understandably, they were not particularly interested, for what had this odd contraption, with its slow speed and mere mile or so of range, got to offer against their inland telegraph system? It was a mistake; had it been offered to the Italian Navy the reaction would doubtless have been different, for at sea wireless telegraphy had no competitor. But, stung by the P. and T's indifference, the Marconi family



Marconi (left) and his assistant Kemp with apparatus

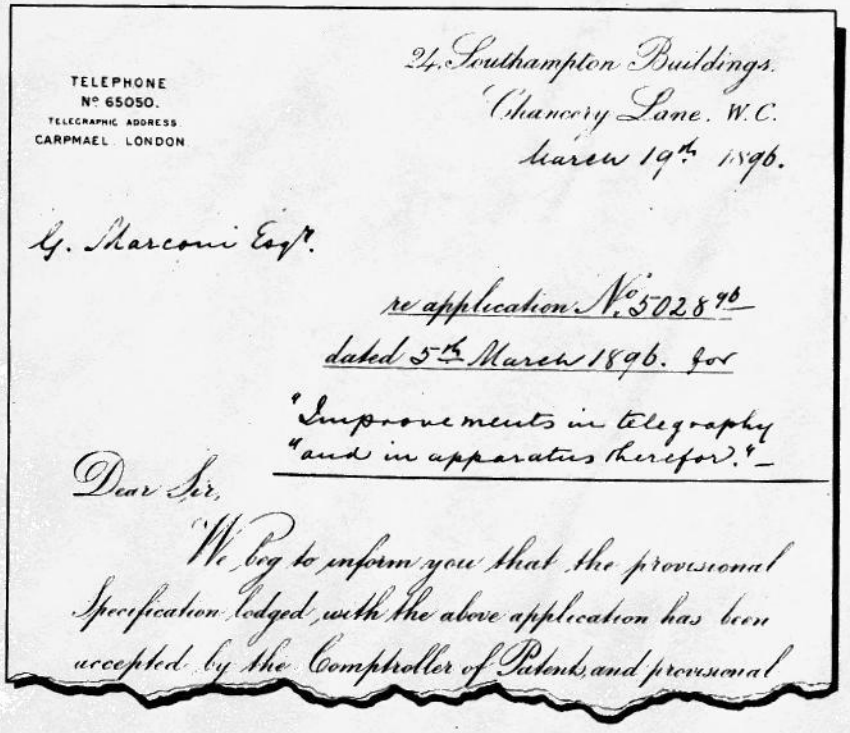
(Giuseppe had grudgingly come around by this time) decided that England, where they had influential relatives, was the place to send Guglielmo. Britain, too, had the most powerful navy and the greatest mercantile fleet in the world—both potentially valuable customers.

So, Marconi, at the age of 21, came to London accompanied by his mother. They arrived in February 1896 and until recently it has always been assumed that he made his first patent application on June 2 of that year. Recently however, it has been discovered that the initial application was on March 5, 1896 (Application No. 5028/96). Provisional protection was granted on March 19—almost three months earlier than supposed and soon after his arrival in England.

Who was the first to "invent" wireless telegraphy? The controversy, over the years, has unfortunately become political rather than technical, involving rival ideologies in terms of prestige and doing nothing to enhance the prestige of either Prof. A. S. Popov or Guglielmo Marconi. It is futile for many reasons. One is that, prior to the critical year 1895, about 20 "inventions" for signalling through space without wires had been made, at least two of which employed Hertzian waves. Another is that, had neither man ever lived, wireless telegraphy would have come almost as quickly. It is also futile because the partisans adopt differing rules and standards and because certain acts of faith are called for.

Prof. Oliver Lodge was the first man to demonstrate publicly that the tube of metal filings that he christened the coherer could be actuated by Hertzian waves. The coherer consisted in essentials of a glass tube containing two metal contacts between which metal filings were loosely packed to give a high resistance. It had been known for years that when a Leyden jar (capacitor) was discharged in the vicinity of the tube the filings cohered and formed virtually a short-circuit, but it was generally accepted (except perhaps by Prof. E. Branly of France, who did much useful experimental work) that it was the light of the spark discharge that operated the device.

Lodge, in two lectures given in 1894, showed otherwise and presented to the world a much more sensitive means of detecting the presence of Hertzian waves than had been known before. But the Branly type of coherer, as used by Lodge, needed to be tapped to restore it to the high-resistance state after the advent of every wavetrain and it could never be relied upon to return to the same resistance value after successive taps. As a consequence its sensitivity varied pro rata; thus, although, when carefully adjusted in the laboratory, it would unerringly trigger on the first half-cycle of a wavetrain and thus detect its presence, the subsequent decohering tap might well restore it to a comparatively insensitive state. It follows therefore that when used to receive telegraphy it would miss a large proportion of the dots and dashes.



TELEPHONE
No 65050.
TELEGRAPHIC ADDRESS
CARPMAEL LONDON

24 Southampton Buildings,
Chancery Lane. W.C.
March 19th 1896.

G. Marconi Esq.

re application No. 5028/96
dated 5th March 1896. for
"Improvements in telegraphy
"and in apparatus therefor."

Dear Sir,

We beg to inform you that the provisional Specification lodged with the above application has been accepted by the Comptroller of Patents, and provisional

Part of a letter from Marconi's patent agents, dated March 5, 1896, informing him of the acceptance of the provisional specification for "Improvements in telegraphy and apparatus therefor".

Between the mere initial registration of the presence of Hertzian waves and the faithful following of telegraphy signals there was a great gulf fixed, as both Marconi and Popov were to find out. Both constructed apparatus deriving from Lodge's demonstration equipment, including the electric bell type of tapper, and both ran into trouble. We know that Marconi had to produce several designs of coherer and experimented with 300–400 different types of metallic filings mixtures, as well as introducing important modifications to the electrical circuits of the tapper before a recognizable message could be received. Popov, too, had the same trouble apparently for he, too, completely redesigned the Branly coherer and modified the tapper.

Back now to Popov versus Marconi. As far as can be gathered the Russian claim is *not* that on May 7, 1895 Popov actually demonstrated wireless telegraphy but that the apparatus he used for a lecture on that occasion was capable of sending and receiving telegraphic signals had he so wished. During the lecture he did, in fact, show how the coherer could be used as a detector of thunderstorms but as electrical storms do not occur to order even for eminent scientists he used a Hertzian transmitter to simulate natural disturbances. A short antenna was used at the coherer receiver.

That Popov had telegraphy in mind around this date is shown by a newspaper report a week later, which stated that the importance of his experiments lay in their theoretical application to signalling over distances without wires. His own description of his apparatus was published in January 1896 and this also expresses the hope that "when further perfected" the apparatus might be used for signalling over a distance.

Undeniably, Popov was the first to demonstrate in public a practical use for the coherer. Undeniably, he was the first to publish an account of his apparatus. Undeniably, *on paper*, the equipment had an inherent capability for achieving short-range wireless telegraphy. The critical question is—was Popov's coherer sufficiently good to follow every dot and dash of a Morse message? We do not know, neither are we ever likely to now. The only clues are that the minutes of the meeting make no mention of telegraphy and both the newspaper and Popov's own published article refer to it in the future tense.

One point that further confuses the issue is that Popov was a civilian scientist in the employ of the Russian Navy and therefore subject to security restrictions. It is not impossible therefore that even before May 7, 1895 Popov had demonstrated telegraphy to Russian Navy officials in the privacy of his laboratory and was restrained from doing more than hint at its possiblity in print. But this is pure speculation, unsupported, as far as I am aware, by any shred of evidence.

All that can be said is that if military security robbed Popov of his rightful credit then it did so in vain, for in the Russo-Japanese war of 1904 the Russian Navy was using German wireless equipment while Marconi stations were installed on land.

As for Marconi, his early work was done in secrecy because he had no patent protection. We have his own unsupported statement that he first had the idea of wireless telegraphy "in the fall of 1894 or possibly early in 1895" and that he began his experiments in the early summer of 1895. By September of that year he was demonstrating ranges of one to two miles to close friends (including a Mr William Miller of Dublin). The first official document is the patent application of March 5, 1896, and this was followed by the complete specification on June 2. In that month Marconi was giving demonstrations to William Preece, Engineer-in-Chief of the British Post Office and to War Office officials, all of whom were impressed. Preece gave a public lecture on the demonstrations in September, 1896 and a more complete account at Toynbee Hall, London in December. Technical details of Marconi's apparatus were not published until some time after, for obvious reasons of commercial security. What is certain is that Marconi registered the world's first patent for wireless telegraphy; that he formed the world's first radio company (1897) and the world's first radio factory (1898). As to whether Popov or Marconi sent the first experimental wireless message—well, the partisans will probably always go out by the same door which they came in. There are indications that neither of them was the first, but as the other candidates also demand acts of faith as a condition of acceptance, perhaps we had better leave them alone.

Another bitter-sweet triumph for Marconi was the famous transatlantic experiment of 1901. The details of this episode are well known, so suffice it to say that Marconi claimed that on December 12 and 13, 1901, he and his assistant, G. S. Kemp, operating a temporary receiving station on a cliff-top at St. John's Newfoundland, received signals in the form of the three dots of the letter S in Morse code, sent by prearangement from Marconi's new high power transmitter at Poldhu, Cornwall.

It would be idle to pretend that this news did not provoke controversy at the time and indeed there is an informed school of thought today that maintains that the signals did not get across. It is not difficult to see why, quite apart from the facts that no witnesses were present and that no further listening watches were possible because of the intervention of the Anglo-American Telegraph Company, which had the message-carrying monopoly in the area. The transmitter at Poldhu was experiencing teething troubles; it was

Marconi demonstrated his ultra-short-wave radio telephone system in Italy between Santa Margherita Ligore and Levanto, a distance of 25 miles, on November 19, 1931.

feeding an antenna which had been built in one week (to replace the original, destroyed in a gale). The radiated frequency according to Marconi himself was about 800kHz (366 metres) and therefore quite unsuitable for daylight operation over long distances, although no one was aware of this at the time. The radiated power is not known with certainty but figures lying between 3kW and 12kW have been given.

At the receiving end the antenna consisted of 400ft of wire, elevated at one end by a kite, which was flapping madly up and down in an Atlantic gale. The receiver itself consisted of what was subsequently known as an Italian Navy self-restoring coherer with a telephone earpiece and a Leclanché cell in circuit with it, the whole being connected between the antenna and earth, either directly or via a jigger or h.f. transformer (it is not known which particular approach was in use at the times the signals were stated to have been heard). No tuned circuits were employed and no amplification was possible.

The self-restoring "coherer" consisted in essentials of a glass tube with threaded rod inserted from either end. One rod terminated in a small cylindrical block of iron, the other in a similar block of carbon. The two were screwed into close proximity and a tiny blob of mercury inserted between them. For many years I have maintained a belief that this was not a coherer at all, but a solid-state rectifier with an oxide film on the mercury's surface providing the rectifying agency. One of these devices has recently been examined by Dr G. L. Grisdale of the Marconi Research Laboratories who has confirmed that this is so. The specimen on test was shown to have a rectifying performance (at best) of about 7dB below that of a modern germanium point-contact rectifier.

It has frequently been said that a couple of months later Marconi vindicated his claim by his tests aboard the liner *Philadelphia*. For these he used an antenna slung between two 150ft masts and connected to one of his new tuned receivers which embodied a Marconi coherer and a Morse inker. Sailing westward he received messages at a distance of 1551 miles from Poldhu, and isolated Morse letters at 2099 miles. This however is not a vindication of actual reception of signals at St. John's, for the ranges quoted were obtained at night. Daylight reception ceased at 700 miles (roughly one-third of the Poldhu–St. John's distance). The Italian Navy device was also tried on the *Philadelphia* but the range obtained was never better than 700 miles. What the *Philadelphia* experiment did do was to prove conclusively that Marconi was right in his basic belief that signals could cross the Atlantic, albeit (at the frequency employed) only over a night path. (It has always seemed to me to be curious that this was the first time the "night effect" had been noted, considering the number of stations which were by then in operation.) On this occasion Marconi made no mistake; the messages and signals were automatically recorded on paper tape and duly witnessed by ship's officers.

So, to return to the Newfoundland experiment, it will be seen that the doubting Thomas school of thought has a strong case. Let us now consider the other side of the coin. Marconi would have been insane to have pretended that he heard the signals, as exposure would inevitably follow. Furthermore, for him to have done so would have been completely out of character, for he was always meticulous in his public statements.

Various suggestions have been made in attempts to account for the mystery. Some have believed that he genuinely mistook static discharges for the three dots of the letter S. This is hardly likely;

both Marconi and Kemp were far too experienced to have been thus deceived, particularly as the Poldhu signals were machine-sent and precisely timed. Others have theorized that in all good faith he imagined he heard what he so badly wanted to hear—a common human experience. Others have invoked earth currents in order to explain the matter. Another suggestion has been that he heard faint signals but that these emanated from nearer at hand than Poldhu, and it is true that one or two transatlantic liners were by this time wireless-equipped (the *Lucania* for one was within feasible range). There were also a few shore stations in the USA and Canada and at least one amateur.

Now, after over 70 years of speculation comes a startling theory, namely that Marconi did, after all, receive the Poldhu signals; not, as he believed, on the fundamental frequency, but via a harmonic at h.f. This is a theory which, to my knowledge, has been privately expounded for some years by Mr G. R. M. Garratt, formerly of the Science Museum and a well-known authority on telecommunications history. I believe that detailed calculations are being made and that there is some reason to suppose that these will vindicate Mr Garratt's ingenious and far-seeing suggestions. I understand that the matter has been discussed in a paper at the joint IEE/IERE colloquium "The Marconi Heritage" on April 25.

The bitter-sweet transatlantic episode had at least one major effect on Guglielmo Marconi. His summary treatment by the cable company turned him into an implacable foe of all such organizations and with obsessive energy he flung himself into the problems of providing a commercially viable transatlantic service, often working a sixteen-hour day and pouring money into his projects at a rate which alarmed his fellow directors. Initial failure gave way to limited success. Invention followed invention, the magnetic detector, the directional antenna and the rotary disc discharger being only three of many. Not until 1907 was a fully reliable day and night two-way transatlantic service possible, by which time the wavelength used had gone from 366 metres to 6000 metres and the power from the original 3–12kW to 300kW. For this purpose a giant station had been built at Clifden, Ireland and was communicating with the refurbished Glace Bay station in Canada[3].

Even then Marconi was denied complete satisfaction, for the bulk of the traffic was between London and New York. The messages were transferred across the Atlantic quickly enough but the link between Glace Bay and New York was 800 miles of landline which was permanently overloaded, occasioning up to 12 hours' delay. Not until 1914 when Caernarvon (transmitting) and Towyn (receiving) stations were built in Wales and equivalent stations at Tuckerton and New Brunswick in New Jersey State in the USA could the wireless service compete on equal terms with the cables. Triumph at last for Marconi? Not so. Almost immediately, war broke out and the two British stations came under the control, first, of the Post Office and then of the Admiralty.

For some years prior to this, Marconi had enlarged his anti-cable horizons to the whole world. His ambition now was to own and operate a chain of high-power stations that would link the major areas of the (then) mighty British Empire. Time after time the prospects brightened in this respect, only to cloud over again by reason of Government prevarication or change. Not until 1924 did anything definite emerge and even then it was only half a loaf. An Empire Chain was decided upon, but a Government Committee decided that the Post Office should own and operate all stations in Britain which communicated with the Empire (with a partial exception in the case of Canada) while private enterprise should be free to develop communication between Britain and foreign countries. This by no means was what Marconi had worked for through the years, but at least he already held contracts for building giant long-wave, high power stations in Australia and South Africa, with more in prospect in other countries.

Behind the scenes the Marconi-Franklin h.f. beam system was being developed, with promise that world communication could be achieved at a fraction of the size, power and cost of the mighty long-wave stations. The system was not, however, fully engineered and had not been tried on a long-term basis. Should it be kept secret and the long-wave stations proceeded with? Or should Marconi inform everyone concerned and give them the choice? It was a difficult decision, but in the event the customers were told and elected for the untried beam system. So, for once, Marconi got something approximating to his desire. He built all the beam stations in Britain and throughout the world; they were successful beyond all expectations and, to Marconi's intense satisfaction, cast gloom over the world's cable interests. It seemed that at last Marconi had achieved total success.

But no. His daemon intervened again in the form of the British and Dominion governments, who, as a belt-and-braces insurance in the event of war, wanted to retain the cables. Pressure was brought to bear to bring about a merger between the various cable interests and the Marconi Company. In this, Marconi's seemed to hold all the aces, because by 1927 the cable companies had already lost half of their traffic to the beam system. Incredibly, in view of this, a merger was agreed in which the Cable Group held 56.25% of the voting power and the Marconi Company 43.75%.

Thus in April 1929 Cable and Wireless Ltd came into being; the Marconi Company ceased to be directly involved in message-carrying as a source of revenue and thereafter was limited to the areas of research, invention, development and manufacture. The lifelong ambition of Guglielmo Marconi, which began on the cliff-top in Newfoundland, was over almost as soon as he had achieved it.

A lesser man would have retired from the scene but Marconi went on to pioneer microwave communications and, towards the end of his life, despite recurring heart attacks, was feverishly working on marine navigation by microwaves and investigations into what eventually became known as radar.

Marconi was from first to last a patriotic Italian subject. He was a member of the Senate and, admiring the way in which Mussolini had so successfully raised the standard of living in Italy in his early years of office, had become a member of the Fascist party in 1923, although never a politically active one. On the other hand, he had a deep affection for England, which had given him his opportunity and where much of his work was done.

Then, at last, the daemon relented. On July 20, 1937, yet another heart attack occurred, this time fatal. At least he had been spared the mental crucifixion which his divided loyalties would inevitably have brought when Italy and Britain went to war.

A strange man; almost, one would think, unknowable. Those who were his chosen assistants served him with fanatical loyalty, yet he was always "Mr Marconi". He could be ruthless; he could be extremely kind, but always aloof. In his later years he seemed to be in some fear of his life; at Marconi House, London, he would never share the lift with someone he did not know personally. He seldom was without an innocent-looking walking stick which concealed a rapier. This, however, might have some justification. Mentally deranged people not infrequently wrote to him complaining that "his" radio waves were the cause of their disturbance.

He sincerely believed that the true role of radio communication was to save lives; although he spoke little of it there can be no doubt that the steadily increasing part that the technology was playing in weapons of destruction brought periods of self-examination, as for instance on the occasion when he was elected Lord Rector of St. Andrew's University, he remarked to the Principal "Have I done the world good or have I added a menace?"

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2. "Marconi" by Prof W. P. Jolly. Constable, 1972.
3. "A History of The Marconi Company" by W. J. Baker. Methuen, 1970.