When I Think Back...

by Neville Williams

Aleksandr Stepanovitch Popov – The 'Inventor of Radio', or not?

If Soviet propaganda is to be taken seriously, a man born in the Urals in the 1850's and educated at the University of St Petersburg – A.S.Popov – was the real 'father' of wireless telegraphy and the real 'inventor of radio'. The Russians even set aside a day each year in his honour. But few outside the Soviet Bloc accept the claim, and it's even doubtful that Popov saw himself as anything more than one of many pioneers.

No, I certainly don't remember Popov directly – because, to do so, I would need to have been around for more years than I already have. But Popov's name does crop up at odd times and, in searching through available references for the preparation of this background article to the relevant period, I've gained a better understanding of his place in electronics history.

Ask any number of reasonably informed enthusiasts who to credit with the invention of wireless/radio/electronics, and most will answer – correctly – that there never was one single inventor. Over many long years, a whole retinue of scientists and experimenters have worked out and demonstrated the basic principles of what has since become the world's most pervasive technology.

Pressed for more information, they might come up with names like Michael Faraday, Heinrich Hertz, Joseph Henry, Samuel Morse, Sir Charles Wheatstone, James Clerk Maxwell, and others who made notable contributions to the science of wireless communication, particularly in the latter half of the last century.

Their ability to recall these and other pioneers is not due to a retentive memory, but to the fact that many of them have been immortalised by having their names chosen to identify various fundamental electrical quantities.

Sir Oliver Lodge is remembered for his long life and his colourful mix of science, technology and metaphysics. Guglielmo Marconi comes to mind as the person who, perhaps more than any other, got it all together and showed that wireless waves could transport information through space – not just as an intriguing scientific phenomenon, but as a technology that could be put to very practical use.

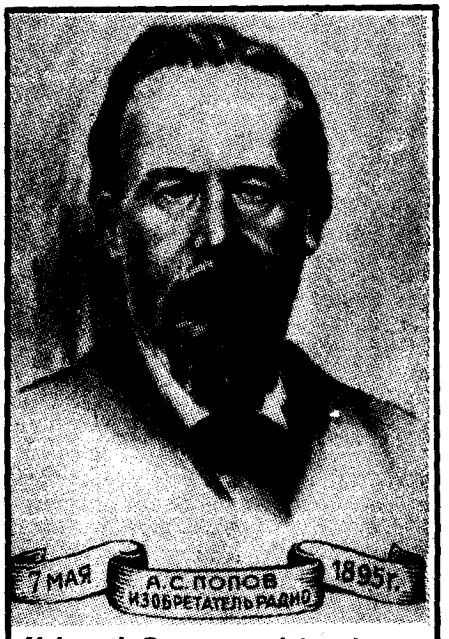
But only rarely, in western society, does anyone mention the name of Professor Aleksandr Stepanovitch Popov, more commonly identified as A.S. or Alexander Popov. Most will have heard of him, but usually in the context of being just another scientist that the post-revolutionary Russians have promoted as the 'real' inventors of just about anything you may care to nominate.

Never immortalised

A modern table of electrical units reads like a nineteenth century who's-who, but to the best of my knowledge, you'll search in vain for a 'Popov'. The one whimsical suggestion I've heard along these lines is that the name might lend itself to the guaranteed minimum service life of electronic components. Some, for example, might carry a maker's rating of 5 years Popoff!

Seriously, however, Alexander Popov may well have been the unfortunate posthumous victim of his own country's promotion and other countries' prejudice. Whether or no, he has certainly been relegated to a minor role in most western texts dealing with electronics history.

I can't recall, personally, when Popov's name first came to my notice but there is no doubt about the date of an article which I elected to file from the British journal *Electronics Weekly*: June 12, 1963. Written by an unnamed 'Special Correspondent', it was entitled 'The Popov Claim – Who was the inventor of wireless telegraphy?'.



Aleksandr Popov, as pictured on a Russian amateur QSL card circa 1961. It carries the banner: A.S.Popov, Inventor of Radio, May 7, 1895.

Illustrating the article, and reproduced herewith, is a Russian radio amateur's QSL card which carries the legend: 'A.S. Popov, Inventor of Radio, May 7, 1895'. The timing of the article suggests that the author was a British amateur who had received the card as the result of a contact on or around Russia's annual radio day – first proclaimed in 1945, 50 years after the year that wireless communication supposedly became a reality.

By contrast, it is noted in the article that (in 1963) Popov rated only six lines in the British Museum's *History and Development of Radio Communication*.

Born in 1859, Popov was virtually a generation ahead of Marconi (1874-1937) but was nevertheless his contemporary in respect to the historic transmission and reception of wireless teleg-

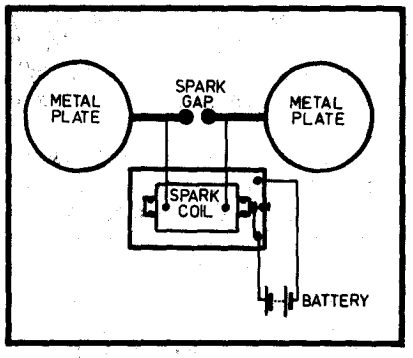


Fig.1: The original Hertz oscillator, with a wavelength possibly as small as 1" (2.5cm or 12GHz).

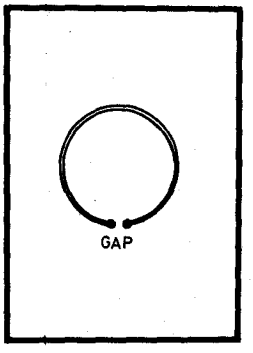


Fig.2: The original Hertz resonator, or receiving loop.

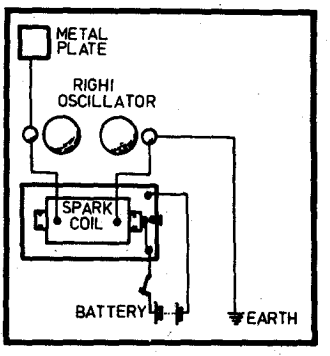


Fig.3: An early Marconi transmitter, based on the ideas of Augusto Righi.

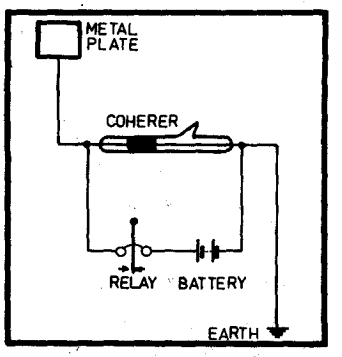


Fig.4: An early Marconi receiver showing an evacuated, sealed coherer.

raphy signals in the 1890s. But whereas Marconi had a flair for publicity and the opportunity in Britain to benefit by it, Popov was less fortunately placed.

Existing foundations

He certainly made an important contribution to the early technology of wireless telegraphy but, like Marconi, Lodge, Tesla and others, Popov was really building on foundations already laid by other researchers such as Oersted, Faraday, Maxwell and Hertz.

As Professor of physics at Kings College, London (1860-1865) Maxwell had met Faraday and had the opportunity to rethink Faraday's ideas from the viewpoint of a specialist mathematician. Maxwell subsequently returned to his Scottish Estate to work on his *Treatise on Electricity and Magnetism*, in the course of which he was able to predict the existence of electromagnetic waves, and to suggest their likely properties. This was around 1870.

In 1888, the German physicist Heinrich Hertz was able, in turn, to verify Maxwell's theory and to demonstrate in a practical way the existence of wireless waves. (Figs.1 & 2). While doubtless aware of the wider implications of his work, it was, to him, primarily academic research that needed to be pursued in its own right, rather than as the means towards a particular technological objective.

Hertz subsequently discovered that incoming wireless waves could be detected with the aid of a glass tube containing two contacts and a quantity of metallic filings. With no natural affinity for each other, the filings would clump together or 'cohere' spontaneously in the presence of high frequency energy to form a more effective electrical conductor. (See separate panel)

Edouard Branly, Professor of physics at the Catholic University of Paris, refined Hertz' 'particle' device into a so-called *coherer* which could react to an encoded sequence of incoming wireless pulses – with a little manual assistance: it had to be 'de-cohered' by gentle tapping after each pulse, so that it would be ready to respond to the next one!

In London, about the same time, Sir Oliver Lodge had also followed up Hertz' findings and worked out a system for receiving Hertzian wireless waves

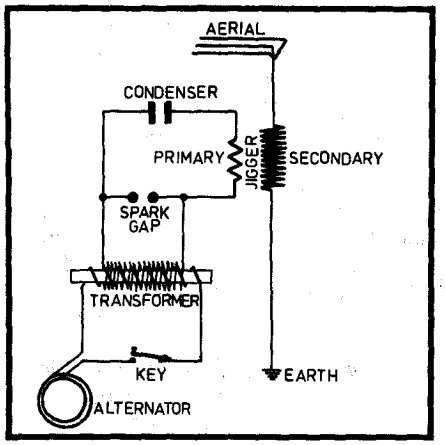


Fig.5: Again, from a turn of the century publication, circuit details of a then-typical spark transmitter.

What was a coherer?

A basic problem which faced the pioneers of wireless communication was how to discern and demonstrate the presence of incoming electromagnetic energy. Initially, Hertz used a metal loop with the two ends, terminating in polished brass balls and separated by a minute air gap (Fig.2). In the presence of sufficient incoming electromagnetic energy, small sparks could be seen in the gap. It could not respond to typically weak signals.

The *coherer* was the first 'detector', as such, but one that was limited to the reception of coded (telegraphy) transmissions. Magnetic detectors, crystals and thermionic diodes came later.

It consisted, essentially, of a horizontal glass tube containing two metallic contacts, with the intervening space lightly filled with metallic filings and/or dust. Over the years, copper, iron, brass and zinc were all used, but the most favoured mix appeared to be 95% nickel and 5% silver. (See Fig.4)

In its normal state, contact between the filings in a 'particle' coherer was such that it presented a relatively high overall resistance, with very little current flowing through the associated coherer/battery/relay circuit.

In the presence of high frequency energy, however, the particles tended to clump together or 'cohere', presenting a much lower resistance. In other words, it operated rather like a switch, turned on by the arrival of a high frequency pulse.

When this occurred, current from the associated battery would register on a meter or, as indicated, operate a relay and a telegraphic printer. Experienced operators, however, often preferred to listen to the incoming clicks on headphones, because they were better able to distinguish between deliberate man-made signals and the erratic crackle of atmospheric static.

Early coherers needed to be tapped by the operator to de-cohere the particles ready for the next pulse – a slow and tedious routine. Improvements by Branly, Marconi, Lodge, Popov and others involved the nature of the particles, and the physical configuration of the tube and contacts. The provision of a magnetic tapper to de-cohere the particles automatically after each burst of signal resulted in the more convenient 'self-acting' coherer.

The ultimate coherer, referred to in Marconi's biography, was a self-acting type using mercury rather than discrete particles.

Alexandr Popov

over a distance of about 60 yards (55m). Demonstrated before the British Association in 1894, it used Lodge's own version of the coherer, in conjunction with a standard telegraph inker, to produce identifiable Morse code signals.

Real contribution

As it transpired, Lodge's demonstration to the British Association came to the notice of Alexander Popov in Kronstadt. By this time Popov had graduated from the University of St Petersburg.

In his biography of Marconi (*Guglielmo Marconi*, Heron Books, 1970), David Gunstan confirms that in 1895, one year before Marconi migrated to Britain, Popov had effected a number of improvements in a receiver that he had set up to study storm activity.

He had added an automatic tapping device to the Branly coherer, to restore the filings to a loose state after each signal pulse. He had also introduced a relay into the coherer circuit to operate an inker, and erected an elevated aerial to improve weak signal pickup.

Reflecting this work, Gunstan records that, in December 1895, Popov appended a note to the paper which he had written in that same year that read:

"I entertain the hope that, when my apparatus is perfected, it will be applicable to the transmission of signals by means of rapid electric vibrations – as soon as a sufficiently powerful generator of these vibrations is discovered."

In January 1896, Popov described his experiments to the Physico-Chemical Society in a paper entitled 'Apparatus for the Detection and Recording of Electrical Oscillations'.

According to a note in the Society's records, he also gave a series of short demonstrations at a Society meeting on March 24, 1896. But unfortunately the original records do not indicate the nature of the demonstrations. At about the same time he had also been been experimenting with Rontgen rays (X-rays).

Seeds of controversy

Popov spent the summer of 1896 at Nizhniy Novogorod, where he installed one of his storm detectors. It was while there that he heard about Marconi's demonstrations of radio signalling over a distance of several miles. He was obviously startled, that the prediction in his note of a few months earlier had been fulfilled so soon.

Returning to Kronstadt, he published a letter – the first of many – pointing out that Marconi's receiver, details of which had not thus far been published, must 'very likely' be quite similar to his own.

He later wrote a letter for publication in Paris stating that, apart from the abovementioned paper, he had no other published papers that could verify his involvement in the search for a practical solution to the problem of wireless telegraphy. He made no claims whatever in regard to wireless transmission, presumably because most of his research had been into naturally occurring electromagnetic phenomena.

These statements were repeated in a letter to a British magazine. Significantly, he did not claim that Marconi had copied his receiver, but simply that the two were nearly identical.

Nor did he seek to contest the Marconi patent 12039 (1896) relating to receivers with elevated aerials. This omission – if omission it was – can hardly be attributed to an ignorance of British patent procedure because he, himself, had obtained a patent for an improved coherer.

When Popov died in 1906 (some records quote 1905), contemporary historians noted his development of apparatus for detecting lightning and credit was given for his work as one of the pioneers of wireless communication. But this could not be construed as evidence that he was regarded as the actual inventor of wireless telegraphy.

Popov & propaganda

That claim came much later, according to the *Electronics Weekly* article, when an official of the Soviet Weights and Measures Department, V.S.Gabel, wrote a commemorative article for *Wireless World* about Popov in 1925, specifically mentioning Morse communication by wireless.

The unfortunate Professor Hughes

If anyone had reason to complain about his treatment by the scientific establishment of his day, it could well have been David Edward Hughes.

Emigrating to America with his family at age 7, he received his early education in Bardstown, Virginia. In 1857, he devised a new form of printing telegraph and, 20 years later, back in London, he developed an improved version of Bell's microphone. Sir Oliver Lodge once described him as 'a man who thought with his fingers'.

But David – by now Professor – Hughes had also become interested in what he called 'aerial' transmission and, in 1879, set out to discover for himself the true nature of electromagnetic waves.

In the process, he succeeded in transmitting signals from one room to another in his Portland St home, using his own transmitter and receiver and his own version of a coherer. He succeeded later in capturing signals over a distance of 500 yards (460m), with a portable receiver and a clockwork mechanism set up in the house to trigger the transmitter.

In February 1880, Professor Hughes arranged a demonstration for the President of the Royal Society, a Mr Spottiswoode, together with two secretaries, Professor Huxley and Sir George Stokes. They were duly impressed but, when it came to the point, Stokes refused to accept Hughes' presentation, asserting that what he had demonstrated could all be put down to 'ordinary induction effects', which they already understood.

Hughes was devastated by their rejection, to the point where he refused even to write a paper for the Royal Society. The record of his research remained unpublished for years and, even then, he resolutely refused to accept any credit for his research into radio telegraphy. Indeed, his work may well have remained unknown but for the support of Sir William Crookes – notable in his own right as one of a perceptive group who foresaw the ultimate possibility of television.

Ironically, most of the above is drawn from Dunstan's biography of Marconi; the more so because, if Hughes' demonstration had been accepted by the Royal Society, he would have gone down in documented history as the man who anticipated the findings of Hertz by nine years, and the supposedly rival inventions of Marconi and Popov by about sixteen!

In fact in 1879, Marconi was still a lad of 15, and just beginning to take an active interest in 'electric waves'.

For good measure, the writer in *Electronics Weekly* adds the name of Sir Henry Jackson, as someone else who may well have been at least as deserving of recognition as Popov. He was the man behind the early use of radio telegraphy on ships of the Royal Navy but, at the time, it was all top secret.

When the claim was queried, Gabel quoted as his source letters from O.D. Khvolson, V.K. Lebedinsky and V.V. Skobelcyn, who all stated that they had been present at the demonstration before the Physico-Chemical Society on March 24, 1896. They recalled that a Morse code message had been received on Popov's apparatus and chalked letter by letter on the blackboard, spelling out the words 'Heinrich Hertz'.

In their minds, there was no doubt that what they saw had been a practical demonstration of wireless telegraphy.

The claims have been maintained ever since. Twenty years later, in 1945, on the 50th anniversary of an earlier but undocumented presentation at the St Petersburg University, May 7 was officially proclaimed in Russia as 'Radio Day' in memory of Aleksandr Stepanovitch Popov, the 'inventor of Radio'.

It would appear from the *Electronics Weekly* article that the Russian claim prompted an engineering-level investigation of the matter, firstly by Professor Howe and later by Charles Susskind of the University of California, using original sources. Susskind published his findings in the *Proceedings of the IRE*, in an issue identified only as 'recently' in the *Electronics Weekly* article.

Susskind's firm findings were reportedly that:

1. On the basis of printed publication, the claims for Popov must fail.
2. If any one person is to be regarded as the inventor of radio telegraphy on documented evidence, it must be Marconi.
3. While there is indirect evidence that Popov did demonstrate the transmission of intelligence by radio, there is comparable evidence that Marconi did so – though not to a scientific audience – at an even earlier date.

The *Electronics Weekly* writer refers to the above findings, but stresses that the claims made on behalf of Popov are not supported by Popov's own actions in not contesting or even disputing the Marconi patents. At most, he claimed parallel and contemporary research.

Popov's own attitude

In this context, David Dunston, in his biography of Marconi, quotes an incident involving the Italian warship *Carlo Alberto* in 1902. It was in British waters for the coronation festivities for King Edward VII, and was being fitted with wireless by Marconi. When the naval review had to be postponed when Edward fell sick, the *Carlo Alberto* was ordered to Kronstadt with Marconi and his equipment still on board, so that King Victor Emmanuel could visit the Czar. I quote:

There was one very significant caller to the cruiser, as she lay in Kronstadt Harbour. Helped on board by an Italian sailor he said: "I want to pay my respects to Marconi, the father of wireless". He was Alexander Stepanovitch Popov, another pioneer worker in radio, who had discovered as early as 1895 that a coherer could detect the presence of storms from a distance.

In view of the fact that Popov has been widely given credit for the invention of wireless himself, and in the Soviet propaganda is usually named as the only pioneer worthy of mention, his remark on that day on July, 1902, needs to be remembered.

Dunstan also records that, when Marconi married in 1906, Popov sent the couple a sealskin coat and a silver samovar – scarcely the action of an embittered man.

Perhaps the reality that emerges from all this is that the question at the head of this article is, itself, out of order. Many pioneers over many long years contributed to the theory and technology of wireless/radio communication, each largely building on the work of others. Even to rank them in order would be difficult enough, but to nominate any one of them as the real inventor of radio would be a highly dubious exercise.

It would appear that, around 1895, Popov and Marconi had ended up with very similar receiving technology, but directed towards quite different objectives. Popov was a mature scientist, interested primarily in the electrical phenomena evident during thunderstorm activity. The idea of applying the technology to communication was an interesting possibility to be pursued as and when time permitted.

But to the young and ambitious 21-year old Marconi, wireless meant exactly what the term implied: communication without wires – as an end in itself. Marconi was an innovator in his own right, but he was also a visionary and entrepreneur. By its very nature, what he did attracted the publicity which he both needed and enjoyed.

But Marconi didn't *invent* wireless/radio communication either. He had the vision to pick up the strands of nineteenth century research, add quite a few of his own and bring them all together into what the world needed – practical and rapid communications across and between continents and with ships at sea.