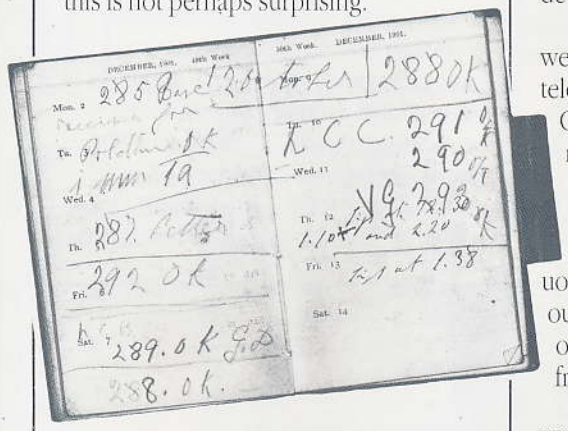
Milestones in Broadcasting

No 1

GENESIS

It is a sobering commentary on human nature that the frontiers of science are pushed forward at a far greater rate in wartime than they are in peacetime. But when survival and technology needs must go hand in hand, this is not perhaps surprising.



Marconi's personal diary opened at the historic date of the first transatlantic wireless transmission, December 12th 1901. The small writing 'Sigs at 12.30 . . .' records the event. He subsequently used the diary for other notes and wrote over it.

Marconi was no longer the solo actor on the commercial stage; wireless manufacturers, some of them of considerable stature, were springing up in Europe and the United States. Competition and the sheer number of scientists engaged in wireless technology were hastening the rate of development.

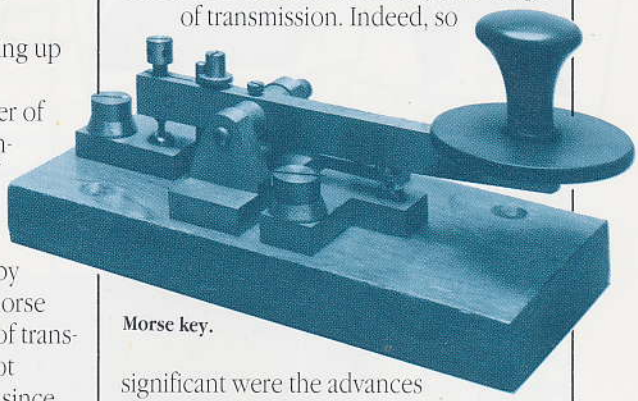
The genesis years of wireless were unquestionably dominated by telegraphy. It was the era of the Morse Code. However, the possibility of transmitting the human voice had not escaped investigation. Indeed, since 1900, when it was discovered that an arc was capable of generating continuous waves, experiments were carried out in an attempt to crack the problem of modulating such waves with speech frequencies.

In 1908, H.J. Round of Marconi's Wireless Telegraph Company (many decades later to be known as The Marconi Company) was able to transmit intelligible speech over a distance of 50 miles. But the quality left much to be

Raising the kite aerial at Signal Hill, Newfoundland, for the first transatlantic tests in December, 1901. Marconi is the figure at the extreme left.

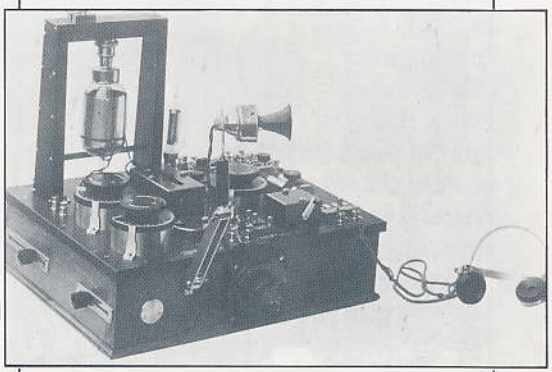
At the outbreak of World War I, wireless was still in its infancy, though significant advances had been made since the historic occasion on 12 December, 1901, when Guglielmo Marconi spanned the Atlantic with three faint dots of the Morse Code. Moreover, desired and it took a fundamental new discovery in connexion with the triode valve in 1913, followed by an encouraging nudge in the form of wartime imperatives, to bring wireless telephony out of the laboratory and into the cut-and-thrust of everyday life.

During the war, massive improvements were made in the clarity and range of transmission. Indeed, so



Morse key.

significant were the advances that in 1916 the Contracts Manager of the American Marconi Company proposed to his General Manager that transmitting stations should be built for broad-



Wireless telephone set used in experiments between vessels at anchor. March 1914.

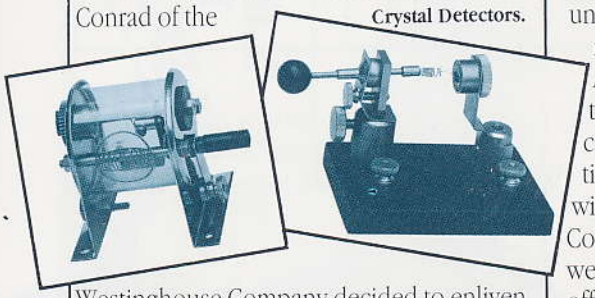
casting speech and music, and that a 'radio music box' should be manufactured for sale to the general public. 'This,' he said, 'must be arranged to receive on several wavelengths with the throw of a switch or the pressing of a button. The radio music box can be supplied with amplifying tubes and a loud-speaking telephone, all of which can be neatly mounted in a box . . .' Revolutionary ideas, indeed! The name of the visionary was David Sarnoff, who later became Chairman of the mighty Radio Corporation of America.

It was not, however, until after the end of the 1914-18 war that the vision became reality.

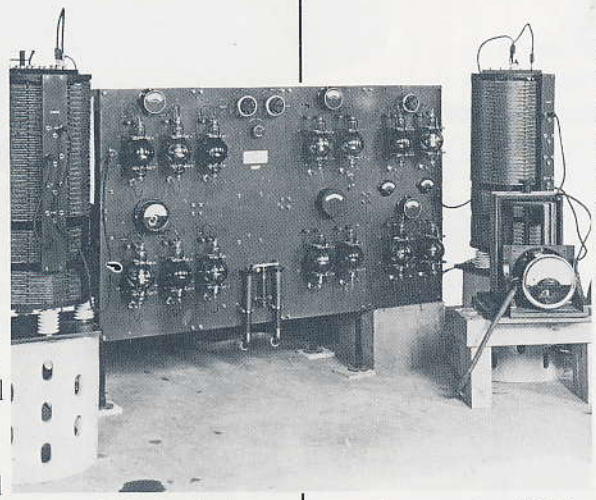
THE BIRTH

The launch of broadcasting as an entertainment medium owed much to chance. It took place on both sides of the Atlantic in 1919 in circumstances that were almost identical.

In the United States, Dr Frank Conrad of the Westinghouse Company decided to enliven his somewhat monotonous transmission range tests with a few phonograph records. Many ex-Servicemen who had been associated with wireless during the war were now building crystal receivers to keep in touch with commercial transmissions. The sound of music electrified the listeners, who promptly demanded more. Conrad obliged and, moreover, because an election was in the offing, Westinghouse set up another transmitter ready for the night. The election results were broadcast to an audience that now numbered several hundreds. From then on, regular programmes went out on the air in the hope of creating a new market for components and receivers – a hope that was amply fulfilled. Broadcasting had begun in earnest in America.

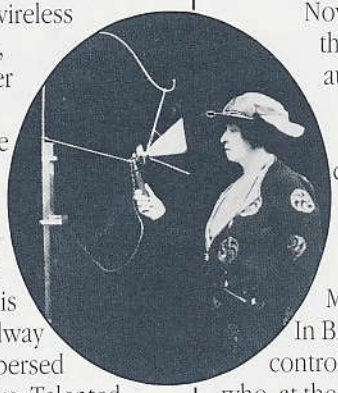


Crystal Detectors.



The experimental wireless telephony transmitter at the Chelmsford works of Marconi's which inaugurated the world's first broadcast news service in February 1920.

In Britain, the story was much the same. H.J. Round, who had so successfully experimented with wireless telephony before the war, returned to Marconi's after serving in the army. The transmitters that were built under his direction underwent the usual range tests and, as in America, the tedium of the speech tests – in this case readings from a railway timetable – were interspersed with somewhat livelier fare. Talented Company employees and local celebrities were pressed into service and their musical offerings were picked up with enormous enthusiasm, sometimes as far away as 1450 miles.

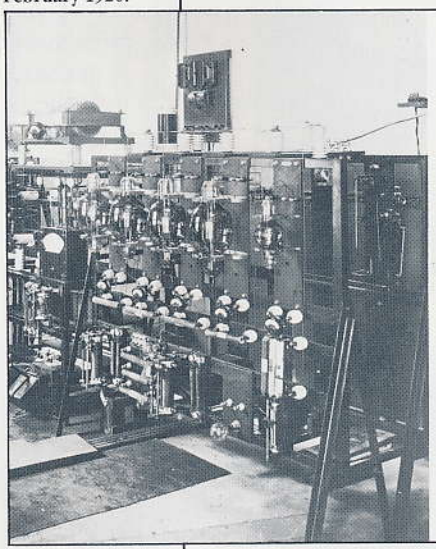


Even so, the official Marconi view was that the future of wireless telephony lay in commercial speech transmissions, and in February 1920, the Company introduced the world's first spoken news service. The appetite for entertainment, however, could not be ignored and, on 15 June, 1920, in Britain's first advertised entertainment programme, Dame Nellie Melba broadcast a recital of songs from Marconi's Chelmsford 'studio'.

Now, in the United States, because there was no single controlling authority over wireless transmission, the 'ether' was becoming jammed by an anarchy of competing stations. At the same time, a mighty new market was being created for transmitters and receivers: a market that Marconi's wished to share.

In Britain, all wireless stations were controlled by the Postmaster General who, at the very point when Marconi's most needed to demonstrate its expertise to the growing army of prospective customers, withdrew the Company's licence on the grounds of 'interference with legitimate services.'

Not until 1922, after considerable pressure from aggrieved amateurs, was permission granted for Marconi's to establish a station: but with what conditions! Power was limited to 250 watts, and transmissions to half-an-hour a week, with a three-minute close-down period in every ten to ensure that other services were not experiencing interference.

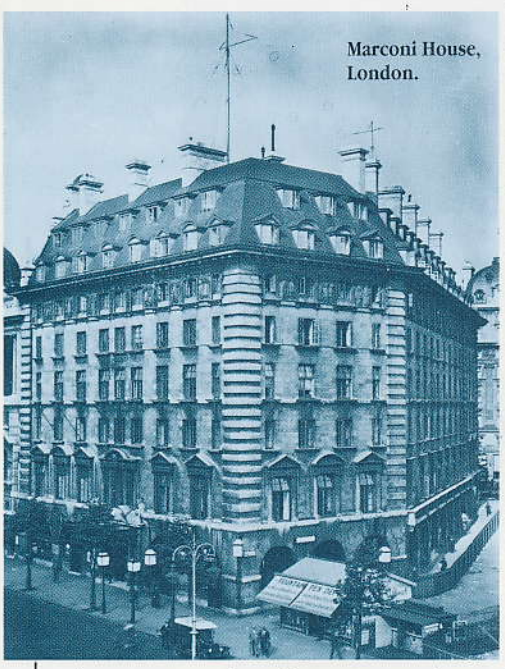


The first transmitter of 2 LO at Marconi House, London, in 1922. Marconi commenced broadcasts with this station in May 1922 and it was the first station to be taken over by the BBC when it was formed in November of that year.

Undaunted, on Tuesday 14 February, 1922, at 8 p.m., 2 MT, or Two-Emma-Tock, went on the air from a wooden hut in Writtle, near Chelmsford. In the hands of Marconi engineer, Captain P.P. Eckersley, who turned out to be a natural entertainer, the weekly half-hour-less-close-downs was not only an invaluable checking reference for the amateurs but was also a source of delight.

Shortly after 2 MT transmissions began, the GPO authorized Marconi's to establish another experimental station.

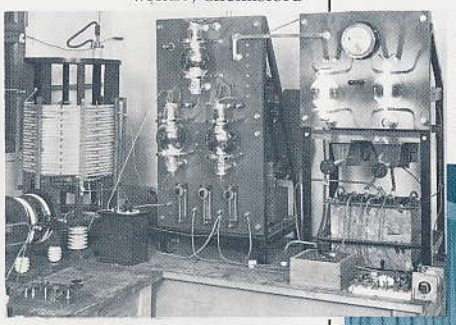
Ex-army hut used as laboratories at Writtle.



Marconi House, London.

This was given the call-sign 2 LO and was sited in a room at the top of Marconi House in London. The programmes were not allowed to be publicly advertised, were much more sober than those sent out from 2 MT and were limited to an hour a day. Even so, they were warmly welcomed by the entertainment-hungry wireless amateurs.

The 2 MT transmitter at Writtle, Chelmsford



Not surprisingly, other manfacturing companies were by now inundating the PMG with applications for similar permits. In order to avoid the chaos of interference that was bedevilling the other side of the Atlantic, he decided to create a single broadcasting authority from a consortium of interested parties. The founder members of what was known as the British Broadcasting Company Limited were the British Thomson-Houston Co, the General Electric Co, Marconi's Wireless Telegraph Co, the Metropolitan-Vickers Co, the Radio Communications Co and the Western Electric Co. Its first broadcast took place from 2 LO on Two-Emma-Tock, 14 November, 1922. Two months later, its mission accomplished, Tock made its final bow to a sorrowful circle of enthusiasts.

Loudspeaker reception with V2, 1922.

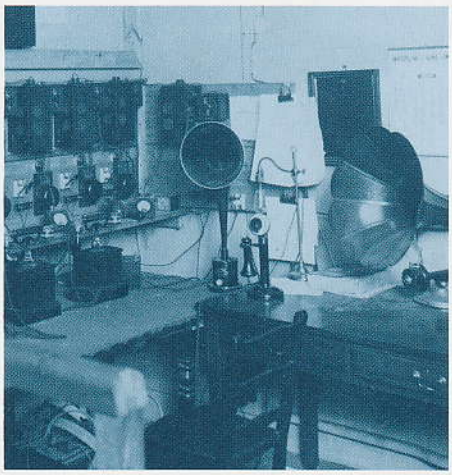
Broadcasting in Britain flourished under the aegis of 'The Big Six' until the end of 1926, when, on the expiry of the licence and with Government approval, the British Broadcasting Company was reconstituted and, with the granting of a Royal Charter, became the British Broadcasting Corporation.

CREATING A NETWORK

On the day following the formation of the British Broadcasting Company's first transmission Marconi's 2 LO station was joined by Western Electric's Birmingham station, 5 IT, and Metropolitan-Vickers Manchester station, 2 ZY. By 1924, a planned network of nine 'main' stations was completed, each with its own studio, which initially originated its own programmes. Obviously, however, there were advantages in sharing programmes, and experiments had already been carried out linking transmitters by means of telephone lines. In those days, the trunk network was not ideal for the job, consisting as it did of a mixture of underground cables, which suffered high-frequency loss, and overhead lines, which were sensitive to weather conditions.

Broadcasting studio, London, 1923.

Notwithstanding, 'simultaneous broadcasting' went ahead, the first major applications being during 1923 to 1924, when 11 'relay' transmitters were set up to service the larger towns not covered by the 'main' stations. It was intended that each station should take the majority of its programmes from its nearest 'main' station. Local people had other ideas, however, and the British Broadcasting Company was obliged to supply all the relay stations with the London programme, regardless of the loss of quality over long land-lines.



Simultaneous broadcast room, 2 LO, London 1924.

By now, all but the predominantly rural areas of Britain were able to enjoy a wireless service, and in July 1925, the first step was taken to bring even these areas into the net. A 25 kW transmitter, 5XX, was opened in Daventry, relaying the London programme. It was the most powerful broadcasting transmitter in the world, and the first to use long waves. Daventry alone, through its great power and good propagation properties, covered 55 per cent of the population of Great Britain and brought 80 per cent within 'crystal range' of at least one transmitter.

Transmitter 5XX at Daventry, 1925.

THE WIRELESS SET

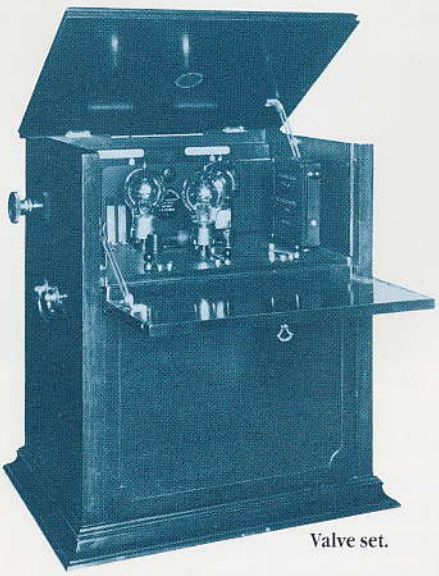
In a letter to Guglielmo Marconi in 1904, the phrase appeared, 'I have not mentioned this to anyone yet as it may become useful.' The writer was John Ambrose Fleming; 'this' was the thermionic valve, or diode as it is known today, which he had just patented. Two years later, Dr Lee de Forest in America announced his amplifying triode. From 1910 onwards, tremendous strides were made in valve development; Marconi's Captain Round demonstrated valved wireless telephony in 1913, and the war spurred on efforts to contrive more and more powerful and efficient valves.

Thus, from the beginning of broadcasting, valve receivers were available. Nevertheless, it was the crystal set that was most widely used: it was cheaper and it was simpler. It had no batteries, the power delivered to its headphones coming from the transmitter. Most sets used a wire 'cat's whisker', which was twiddled until it touched a favourable spot on the crystal at just the right pressure. Selectivity was poor and amplification non-existent – but the valve set could cost anything from three to twenty-five times as much. Furthermore, it needed batteries and, in some cases, the expertise of a wireless engineer to operate. Even then, in the days before the introduction of the 'screened grid' valve, which was not until 1927, feedback could maintain the valve in a state of oscillation, effectively turning it into a transmitter, which could introduce appalling howling noises in the real station.

Experimental Fleming diode, 1904.

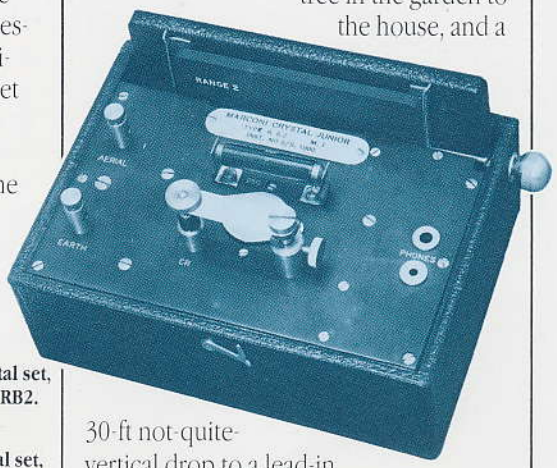
Crystal set, type RB2.

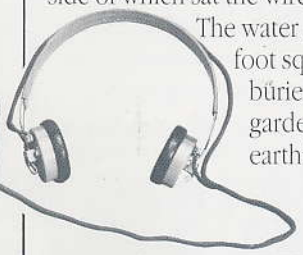
Crystal set, type RB10.



Valve set.

Listeners' licences allowed them to use 100 feet of wire to construct aerials. Most of them found it necessary, rigging 70 horizontal feet of wire from a pole or tree in the garden to the house, and a 30-ft not-quite-vertical drop to a lead-in tube in the window frame, on the other side of which sat the wireless set. The water pipes or a three-foot square metal plate buried vertically in the garden provided earthing facilities.





Marconiphone V2 set, 1922.

Although the 'twenties were DIY days *par excellence*, when even those without experience built their own receivers from well documented kits, demand grew for more professional equipment and, as had been foreseen by the manufacturers, a huge, world-wide market developed.

Marconi
Communication Systems

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Marconi

1981

Milestones in Broadcasting

No 2

THE BIRTH OF TELEVISION. ROOTS.

As far back as the 1850s, it had been possible to send pictures over wires. Certainly those pictures were only stills of two-dimensional subjects, but they were achieved by

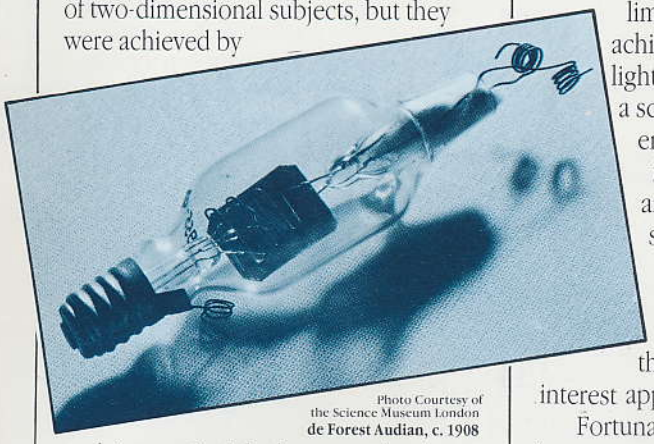
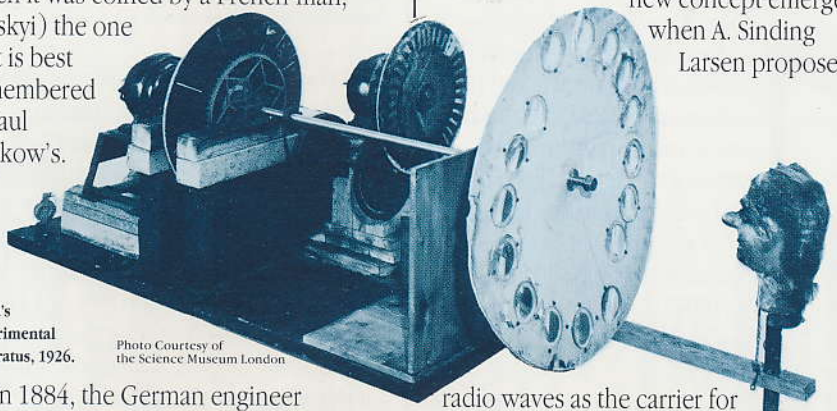


Photo Courtesy of the Science Museum London
de Forest Audian, c. 1908

applying a principle that proved to be the root of all television – that of scanning: of dissecting the picture into elements, and reconstructing it at the receiving end.

Some 20 years on, in 1873, it was discovered that the electrical conductivity of selenium increased with exposure to light, making it possible, in principle at least, to derive a signal from a real, three-dimensional subject. Of all the proposed systems that ensued for 'seeing by electricity' (the word 'television' did not come into use until 1900, when it was coined by a French-man, Perskyi) the one that is best remembered is Paul Nipkow's.



Baird's experimental apparatus, 1926.
Photo Courtesy of the Science Museum London

In 1884, the German engineer Nipkow patented a spirally perforated scanning disc, which was to lie in a state of suspended animation for the next 40 years. In 1889, Professor Weiller, also a German, proposed a form of scanning by means of a mirror drum, but this too was destined to languish for 40 years on the laboratory shelf. The trouble was that ideas far outstripped the technology of the time, and there were severe limitations as to what could be achieved: selenium's response to light was too sluggish to enable a scene to be scanned rapidly enough to portray movement; furthermore, no form of amplification existed to intensify the very weak currents produced by the apparatus. Indeed, so daunting were the problems that interest appeared to wane.

Fortunately, however, work in apparently unrelated fields was busily, albeit unwittingly, strengthening television's root structure; in 1897, the cathode ray oscilloscope came on the scene; a much faster light-sensitive cell than selenium was produced; Ambrose Fleming's thermionic valve of 1904, and the introduction of a third electrode by Dr Lee de Forest in 1907 provided the essential amplifying devices that had formerly been lacking. And in 1911 a new concept emerged when A. Sinding Larsen proposed radio waves as the carrier for picture signals. Until then, no one had visualized anything other than wires as the medium for transmission.

The root structure was now firmly established and the emergence of the sapling that became so mighty an entertainment medium was halted only by the First World War.

DOWN THE NIPKOW TRAIL

With the end of hostilities, both time and technology were on hand for serious efforts to be made to produce an actual television picture – something that no one had as yet succeeded in doing, in spite of all the well-founded ideas that had flourished for decades.

There were two possible lines of development. One stemmed from

A 30 line mechanical scanner and photo-electric cell pick up Type TT1.

Nipkow and his mechanical scanning device, the other from Russia's Professor Boris Rosing and Great Britain's A.A. Campbell Swinton, who, independently of each other, had proclaimed the potential of the cathode ray tube *vis-à-vis* television. Indeed, in 1911, Campbell Swinton had described a transmitter tube in which an electric beam scanned a mosaic of light-sensitive photo-emitting elements – an almost clairvoyant peep at the way television was achieved some 20 years later by all-electric means. Immediately after the war, however, the technological imponderables associated with electrical scanning were doubtless responsible for encouraging most of the

army of experimenters to pursue the Nipkow path.

In 1926, John Logie Baird of Great Britain became the first man in the world to demonstrate pictures embodying a degree of light and shade, and having movement. Shortly after his demonstration which was given to members of the Royal Institution, Baird offered his patents to Marconi's. However, as they were not of a fundamental nature, the apparatus being, in essence, the Nipkow device, his overtures were rejected.

In 1929, Baird's low-definition system – 30 scanning lines and 12½ frames a second – was considered to be of sufficient importance for the BBC to make the 2LO transmitter available outside normal broadcasting hours for experimental, vision-only transmission. In 1930, when 2LO was moved from its site over Selfridges to Brookman's Park, transmission continued from there, with the addition of sound. And in 1932, the BBC equipped a studio in Broadcasting House with Baird equipment. There was no intention, however, of launching a public service based on a 30-line system, and Baird was asked to issue a warning with the 'Televisor' receivers and kits that he had designed, stating that his experimental transmissions might cease after March, 1934. As the fundamental design of television receivers depends on the technical standards at the transmitting end, this was a clear indication that the BBC was anticipating other, undoubtedly higher, standards to be set.

A Cathode Ray television receiver, for a 50 line horizontal scan or a tape scan of 15 lines. This receiver was taken by Mr. Dowsett to Australia where television signals were picked up from England.

THE PURSUIT OF ALL-ELECTRIC SCANNING

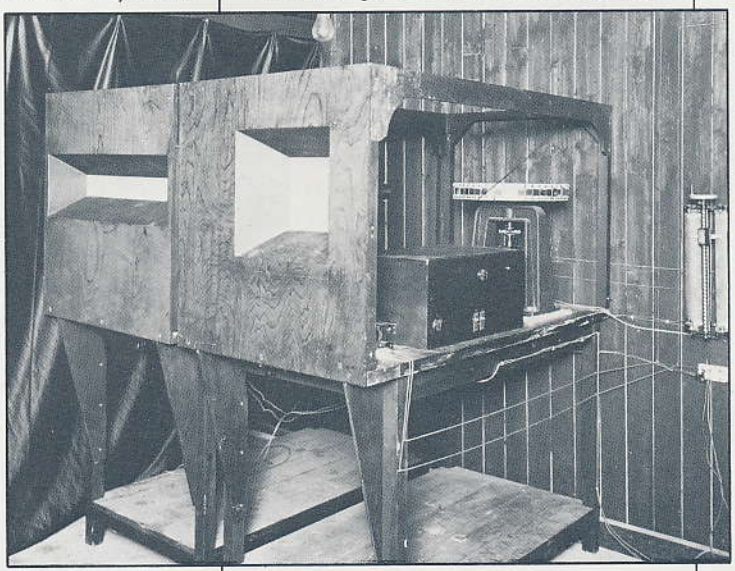
While in the years immediately following the First World War, most engineers concentrated on mechanical scanning methods, electrical scanning was also being investigated. The weakness that held back the use of the cathode ray tube was its inability to build up and store the picture information in the form of electric charges in the interval between successive scannings. In 1926, however, the year that Baird hit the headlines, there was another breakthrough, when Vladimir Zworykin demonstrated his iconoscope. Zworykin, who was a former part-time assistant to Rosing in St Petersburg, had emigrated to the USA in 1919 and, in 1923, had filed a patent application for a pick-up tube capable of charge storage – the iconoscope in embryo.

Marconi Television Apparatus. 1932. Transmitter Type TT3a designed to transmit images of a moving tape on which characters are printed by a special typewriter.

In Britain, an EMI team of engineers under the leadership of ex-Marconi man, Isaac Shoenberg, was developing both mechanical and electrical methods of scanning. Arriving eventually at the conviction that the future lay in the latter, it produced in 1933–34 the Emitron camera. This, while being based on Zworykin's inconoscope, incorporated significant differences in manufacturing techniques.

THE MARCONI INPUT

Marconi's were among the many firms engaged in television development. The Company was in no doubt that the 30 line standard with which Baird was experimenting through the BBC would never provide the basis for an acceptable public entertainment service, but it conceded that there were certain commercial possibilities inherent in low-definition television. It, therefore, decided to exploit such state-of-the-art know-how as was then available and, in 1930, set up a television research group.

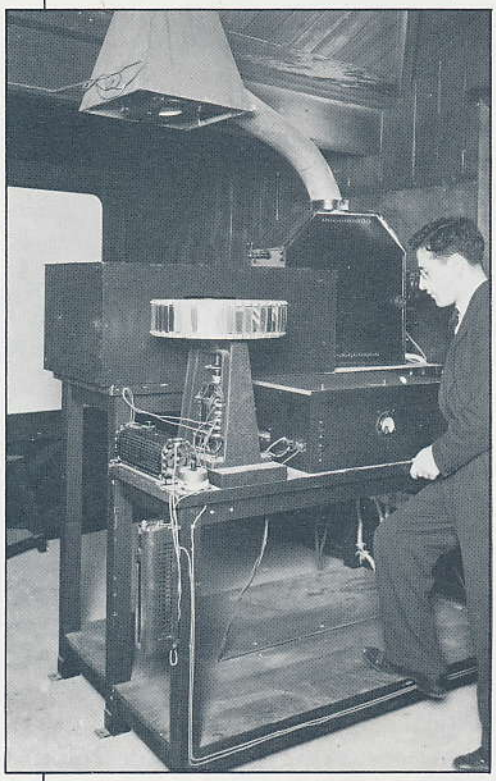


Television Receivers, TT.4c15 and TR.5c. demonstrated at British Association Meeting, York, 1932, for reception of news message on screen 25" × 3" and of head and shoulders picture 8" × 8".

The first practical result was evident in July 1932, when low-definition signals were transmitted from Chelmsford on a wavelength of 25 metres and received in Australia. The demonstration consisted of a 'news' message borne on a travelling tape, scanned in 10 lines with a repetition rate of 12½ frames a second. A 50-line head-and-shoulders picture was also transmitted, at the same repetition rate.

Later that year, the Company transmitted a 'news' message from Chelmsford to York on a wavelength of 760 metres, using a modulation bandwidth

of 18kHz. The scanning was in 15 lines a frame at a repetition rate of 20 a second. At that same demonstration,



Television Receiver, Type TR5d. Kerr Cell Projection apparatus for use with 50 line 'broadcast' transmitter Type TT.5 to give projected picture 4' × 4'. October 1932.

the viewers also saw the head and shoulders of a speaker scanned by a light beam and Nipkow disc, with 50 lines and a repetition frequency of 15 a second.

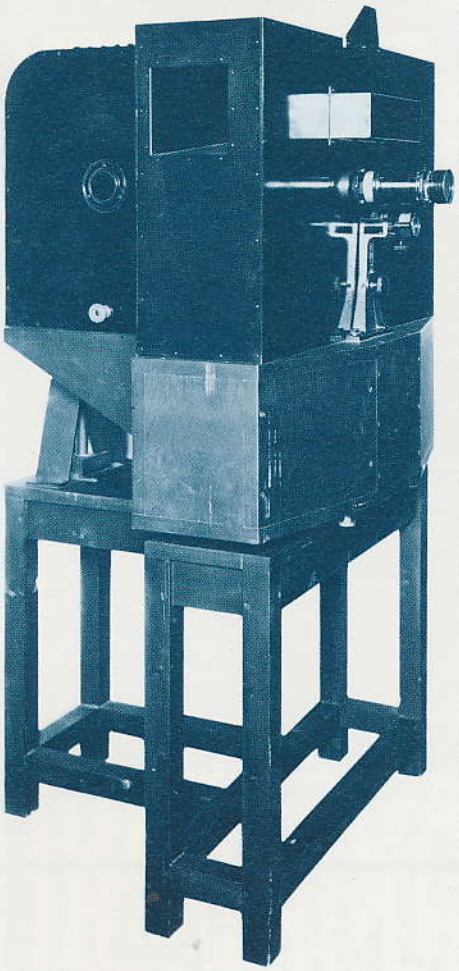
In Leicester, a year later, a display was projected a distance of 20 feet onto a screen five feet square – an achievement that encouraged the view that the system was a potential winner for public address work.

Meanwhile, in anticipation of the day when a much higher definition system would be adopted for a public entertainment service, Marconi's investigated the many problems involved in cathode ray scanning, certain that only by such means would the requisite standards be achieved. But, of greater moment for the future of the Company, it had, by 1932, produced a v.h.f. transmitter (6.7 metres) suitable for 250 kHz modulation and covering all the existing requirements of what was regarded as high-definition television.

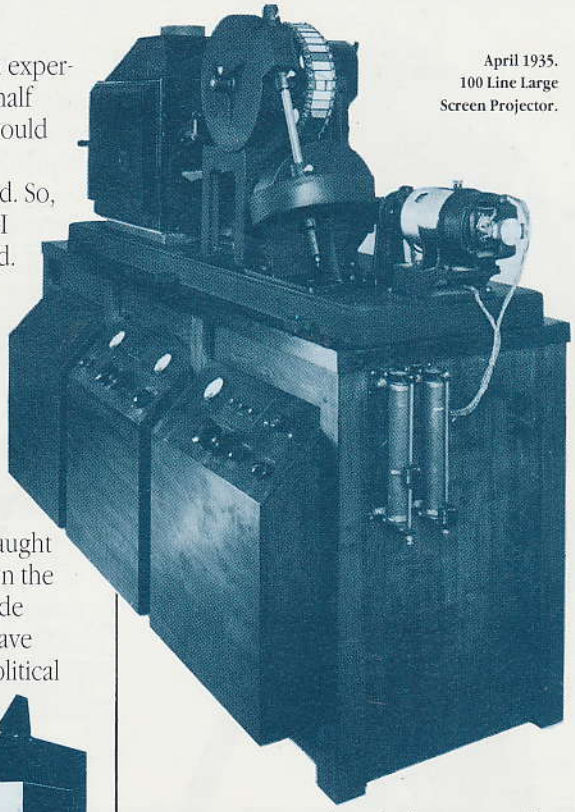
THE MARRIAGE

It was becoming clear by the mid-thirties that the interests of EMI and Marconi's were converging. EMI now possessed the knowledge of camera tube manufacture, while Marconi possessed the vital transmission expertise. Divided, each could boast half of a viable system; united they could provide a complete system in advance of any other that existed. So, in March, 1934, the Marconi-EMI Television Company was formed. It was a timely marriage. In that year, the trial period that the BBC had allocated to Baird ended, and technological achievement had reached a stage when it seemed prudent to make a decision regarding a public service.

The choice of system was fraught with difficulty. Whatever decision the GPO or the BBC might have made would almost unquestionably have been met with accusations of political bias and prejudice. In 1934, therefore, the Postmaster General set up an independent committee under the chairmanship of Lord Selsdon, which was to report on the relative merits of the several systems available, although, in practice this meant the Baird and the Marconi-EMI systems.

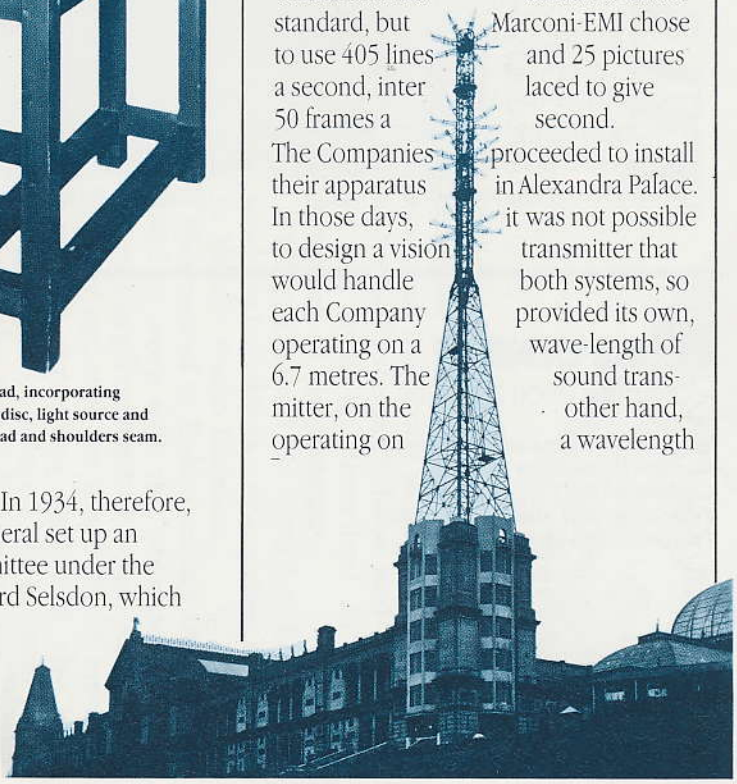


T.T.5. Television scanning head, incorporating transmitting and monitoring disc, light source and projection lenses for ½ and head and shoulders seam. August 1933.

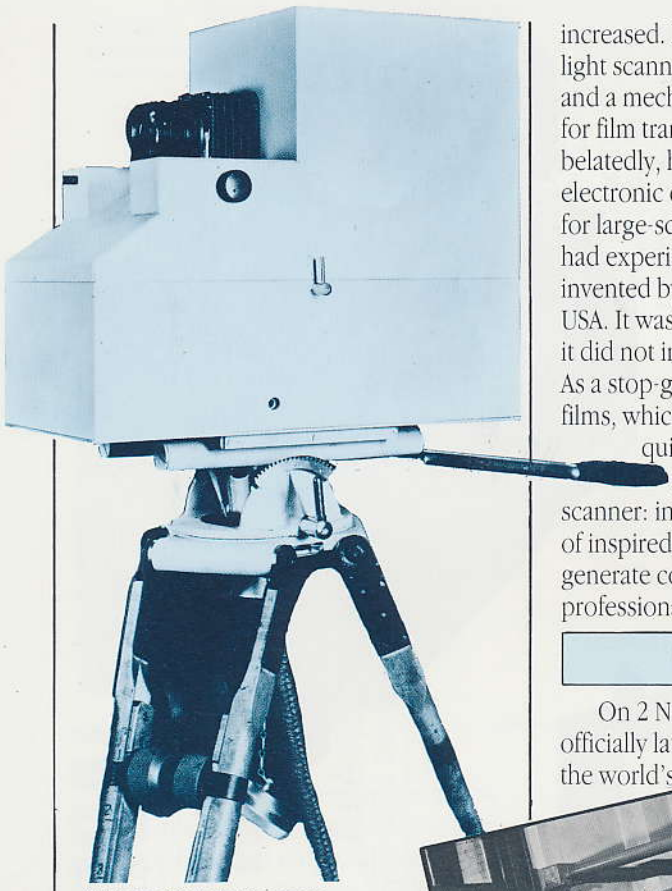


April 1935. 100 Line Large Screen Projector.

In January 1935, the Committee proposed that a service be instituted by the BBC, using Baird and Marconi-EMI equipment alternately for a trial period, and that an Advisory Committee be appointed to assess the results of the trial and to make the final recommendation. It was decreed that the definition should not be inferior to a standard of 240 lines and 25 pictures a second. This accommodated the Baird standard, but Marconi-EMI chose to use 405 lines and 25 pictures a second, interlaced to give 50 frames a second. The Companies proceeded to install their apparatus in Alexandra Palace. In those days, it was not possible to design a vision transmitter that would handle both systems, so each Company provided its own, operating on a wave-length of 6.7 metres. The sound transmitter, on the other hand, operating on a wavelength



Alexandra Palace television aerial designed for the worlds first public, high-definition TV service.



The Marconi-EMI television camera. (Emitron) as used at the commencement of the world's first public high-definition television service from Alexandra Palace, London 1936.

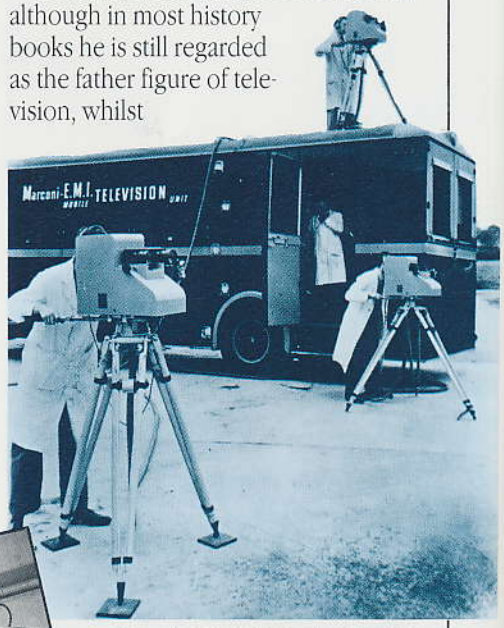
of 7.2 metres, was common to both, and was built by Marconi's who also designed the antenna system. The radiation bandwidth was 4MHz.

The rival studio equipments differed radically. Marconi-EMI used the small, mobile Emitron camera for studio work, film transmission and, linked to the studio by cable, for outside programmes. Baird's equipment had become progressively bulkier and less manageable as the scanning frequency demanded by higher definition had increased. He used a mirror drum spot-light scanner for close-ups and interiors, and a mechanical flying-spot scanner for film transmission. Somewhat belatedly, he had realized that only an electronic camera would be satisfactory for large-scale studio productions, and had experimented with a camera tube invented by Philo T. Farnsworth of the USA. It was unsatisfactory, however, as it did not incorporate charge storage. As a stop-gap, he made intermediate films, which were developed very quickly and, while still wet, were scanned by the flying-spot scanner: ingenious but having an aura of inspired amateurism that did not generate confidence in the overall professionalism of the system.

WORLD LEADER

On 2 November, 1936, the BBC officially launched the world's first public television service, transmitting for two hours daily, using the respective systems on alternate weeks. It soon became evident that not only was the Marconi-EMI system more flexible, and not only did it provide better quality pictures but it also had greater potential for improvement. On 5 February, therefore, the Postmaster General announced the exclusive adoption of the Marconi-EMI system.

Overnight, Baird's influence waned, although in most history books he is still regarded as the father figure of television, whilst the names of those who were truly responsible for the system we know today are only known in electronic engineering circles. Captain P.P. Eckersley, the Marconi man who became the BBC's first Chief Engineer, nevertheless underlined Baird's right to the place in history when he remarked that Baird was the aphrodisiac that stimulated others to research, and ultimately to produce, a more rewarding system than his own.



Marconi - EMI Outside Broadcast Van 1937.

Alexandra Palace TV TX

At the outbreak of war in 1939, the television service closed down and was not resumed until 1946. Thus was Britain diverted from the opportunity to maintain the lead that it had established.

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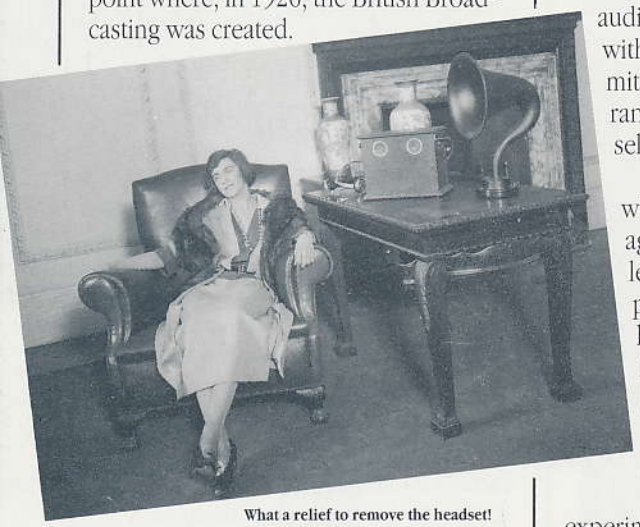
Milestones in Broadcasting

No 3

THE GROWTH OF SOUND BROADCASTING

At the beginning of the century, 'wireless' was taking its first faltering steps as a medium of point-to-point communication. In that role it was magic to the multitudes: as a possible basis for fireside entertainment it was undreamed of. Nevertheless, the idea evolved and became reality. In an earlier article, we outlined the genesis stage of radio broadcasting, leaving the story at the point where, in 1926, the British Broadcasting was created.



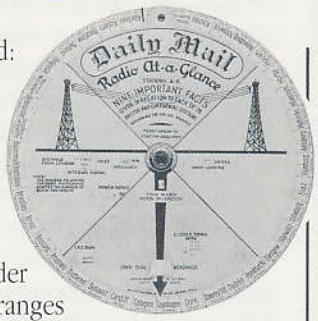
What a relief to remove the headset!

An early domestic loudspeaker threatens the Ming vases.

Since those days, when 'listening in' was the part-time past-time of a handful of knob-twiddlers, radio has become a taken-for-granted part of virtually every man's life, and has made an immeasureable contribution to his understanding of the world about him, its cultures and its peoples. It is probably true to say that in this country the growth of radio has occurred in three quite distinct stages.

THE EARLY DAYS

The first stage covered the 'Twenties and 'Thirties, when the novelty of wireless aroused intense public interest and curiosity, and when scientists and engineers were eager to investigate and harness the huge, unexplored potential of the radio wave miracle. The two factors interacted: technology provided better and better standards of reception and wider and wider transmission ranges to satisfy an expanding army of listeners, while the programmes became increasingly professional and varied, thus attracting larger and larger audiences, who expected to be served with by more and improved transmitters, better receivers and a wider range of programmes. Growth was self-perpetuating and inevitable.



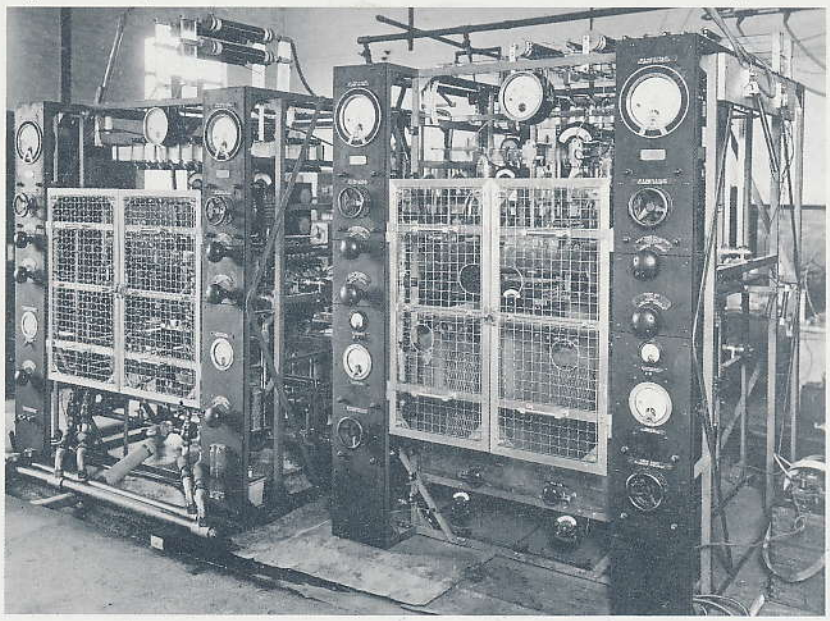
A Daily Mail giveaway, showing 'nine important facts' about stations all over Europe.

By the mid-'Twenties, Britain, which enjoyed almost total coverage through five twin-wave wireless stations, equipped with high-power Marconi transmitters, was keen to spread its radio services further afield. Thus, following Marconi's pioneering use of shortwaves in an Empire-wide communications network, the BBC decided in 1927 to start experimental mental shortwave broadcasting to the Empire from a 25 kW transmitter at Marconi's Chelmsford Works.

So successful was the outcome that, though delayed by the economic depression, the Empire Service opened in 1932, radiating from two Marconi-built transmitters in Daventry.

Those were the days when the sun never set on the British Empire– a fact that brought its own problems in the form of time differences. There was little merit in broadcasting programmes from Britain if they were going to be received in the small hours. It was necessary, therefore,

An early advertisement for EKCO radio receivers, 1940's.



25k transmitter at Station 5SW Chelmsford, 1927 – the forerunner of Empire Broadcasting Transmitters.

to devise a means of recording so that the programmes could be transmitted at suitable times. The gramophone discs of the period had only a short playing time, so an alternative was sought and found in the Marconi-Stille apparatus, a forerunner of the modern tape recorder.

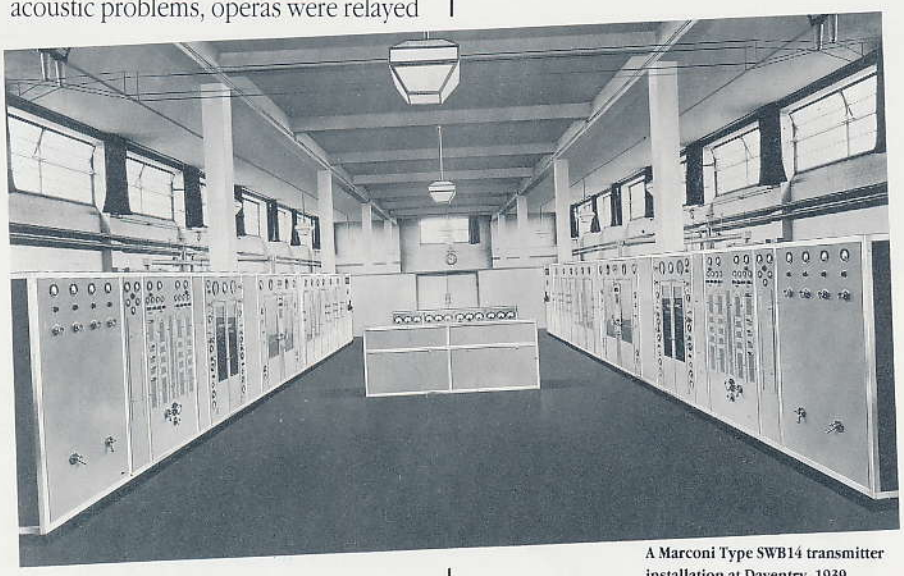
The Marconi-Stille MSR3 Recorder/Reproducer.

Once programmes were taken out of the hands of industry's test engineers and became the responsibility of the emergent breed of programme organisers, they gained in breadth, variety and professionalism, though some would say that they lost a certain spontaneity and gaiety in the process.

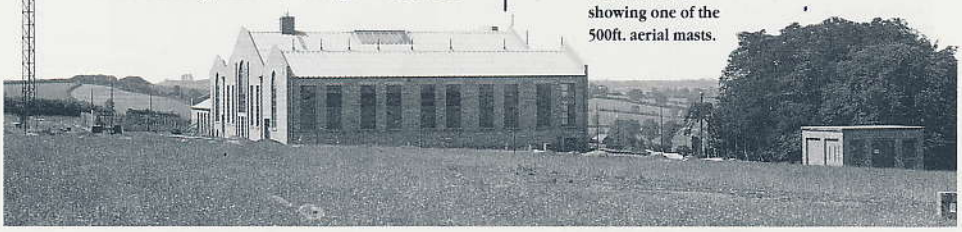
Soon, studio programmes were augmented by outside events and, engineers having successfully overcome the acoustic problems, operas were relayed from Covent Garden, dance bands from the Savoy Hotel, religious services from St Martin-in-the-Fields and even, for the aesthete, a nightingale accompanied by a cellist, playing in the bosky twilight of her garden. And in 1924, for the first time in history, the Sovereign was able to speak, at least in theory, to all his people. In practice, he spoke to some 10 million who were within earshot of wirelesses and loudspeaker relays. His speech was delivered from the British Empire Exhibition at Wembley.

As broadcasting spread, so too did the problem of interference between the forest of stations that was springing up throughout the world. One way of maintaining order was for each station to remain stable on its allotted wavelength, a difficult feat made possible by Marconi's, which had pioneered the piezo-electric quartz crystal. This controlled the frequency of h.f. oscillators and, in 1931, perfected to the point where it had a zero temperature coefficient, was fitted to a v.h.f. transmitter, which proved so successful that at least 22 European broadcasting stations followed suit.

In the years immediately preceding the Second World War, outside broadcasting had taken to wheels and portable equipment had been designed to take the place of the earlier bus-size mobile units; Daventry had become an eight-transmitter station; a modest start had been made in foreign-language broadcasting, and wireless receivers had reached a new standard of perfection with the introduction of the U.S.A.-inspired all-mains superhet – built-in moving coil loudspeakers, automatic volume-control and single-knob tuning allowing wireless owners to be mere listeners instead of requiring them to be instant engineers.



A Marconi Type SWB14 transmitter installation at Daventry, 1939.



Daventry, 1925, showing one of the 500ft. aerial masts.

THE WAR YEARS

At the outbreak of war in 1939, broadcasting entered its second stage of growth. This was due to the fact that it acquired a new status: it ceased to be predominantly a toy and became a tool. On the one hand, the authorities realized that they had an unprecedented means of informing, exhorting and instructing the public at home, and also a no-frontiers weapon which they could use to spread news abroad. And they did not ignore the importance of entertainment as a morale booster.

On the other hand, unless counter-measures could be found, it would be possible for enemy bombers to use the transmitters' radiated energy as a guide to their targets. Two hours after the declaration of war, counter-measures were put into effect.

A number of high-power transmitters in widely separated parts of Britain were switched to a common frequency, so that aircraft could not identify and home onto any given station. By February 1940, three such groups of transmitters were broadcasting, respectively, the Home Service, a multi-lingual service and a Forces Programme. The problem of achieving an exact phase relationship between the various transmitters was solved by Marconi's.

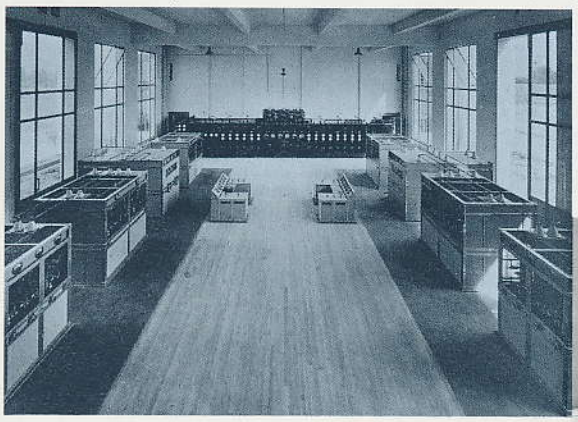
During the bleak war years there could have been few whose resolve was not stiffened by Churchill's broadcasts, few who were not glued to the set each night to hear the Nine o'Clock News, few factories that were not enlivened by the strains of Music While You Work and few whose tensions could not be eased by the rollicking ITMA programmes. In enemy-occupied Europe, agents, equipped with small transmitter-receivers would send and receive coded messages via the BBC, news was broadcast in foreign languages, and day after

day four relentless notes from Beethoven's Fifth Symphony brought hope and promise of ultimate victory.

So great was the strategic importance of Britain's overseas broadcasting activities to the allied cause that it was feared that the hub of the network, which was in Daventry, might become the object of a concentrated bombing attack. Therefore, a 'shadow' Daventry was built in Dorset, the work being completed by Marconi's in six months.

The growth of broadcasting during the war years resulted in the installation of more high-power medium frequency transmitters to augment the BBC's Home Service; the setting up of a network of 60 low-power transmitters to provide a service during air raids: and the addition of 28 shortwave transmitters to complement the eight that were serving distant parts. The London studio facilities were decentralized, a separate emergency network of studio and control centres was set up; many of the elaborate pre-war studio systems benefited from being simplified to meet austere wartime conditions; greatly improved recorders met the need for more pre-recorded programmes both to satisfy world time differences and to ease censorship problems. It reflects well on Marconi's that it was called on to meet more than half of the massive requirement for new capital equipment.

Winston Churchill addresses the nation, June 1942. (BBC copyright.)



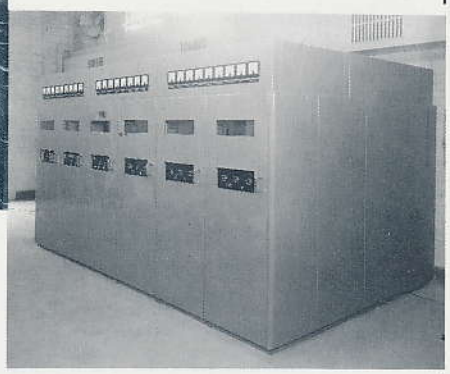
The transmitter hall at Brookman's Park.

It's that man again! Tommy Handley and the team, September 1946. (BBC copyright.)

Après la Guerre

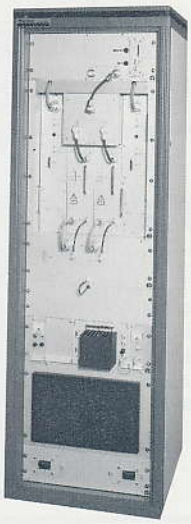
The end of the war heralded a new stage in almost every branch of human endeavour. The war itself had helped to create a seemingly unshakable listening habit. Now was the time to ensure that broadcasting did not lose the allegience it had earned.

The opening of the 'Third Programme' for minority audiences was a major step. Further expansion, however, was threatened by both a shortage of skilled engineers and the overcrowding of the frequency bands. The first threat was countered by small, low-power stations, designed by Marconi's for unattended operation and used to fill in the 'black spots' in the m.f. services. Remote control techniques were later applied to medium- and high-power transmission, greatly benefitting new nations, anxious to set up radio networks but short of time and resources to train many broadcasting engineers. The second was overcome by exploiting the little-used v.h.f. band, and inaugurating – very much in the wake of the U.S.A. – a.v.h.f./f.m. service, which initially used 26, and shortly afterwards 38, Marconi transmitters.

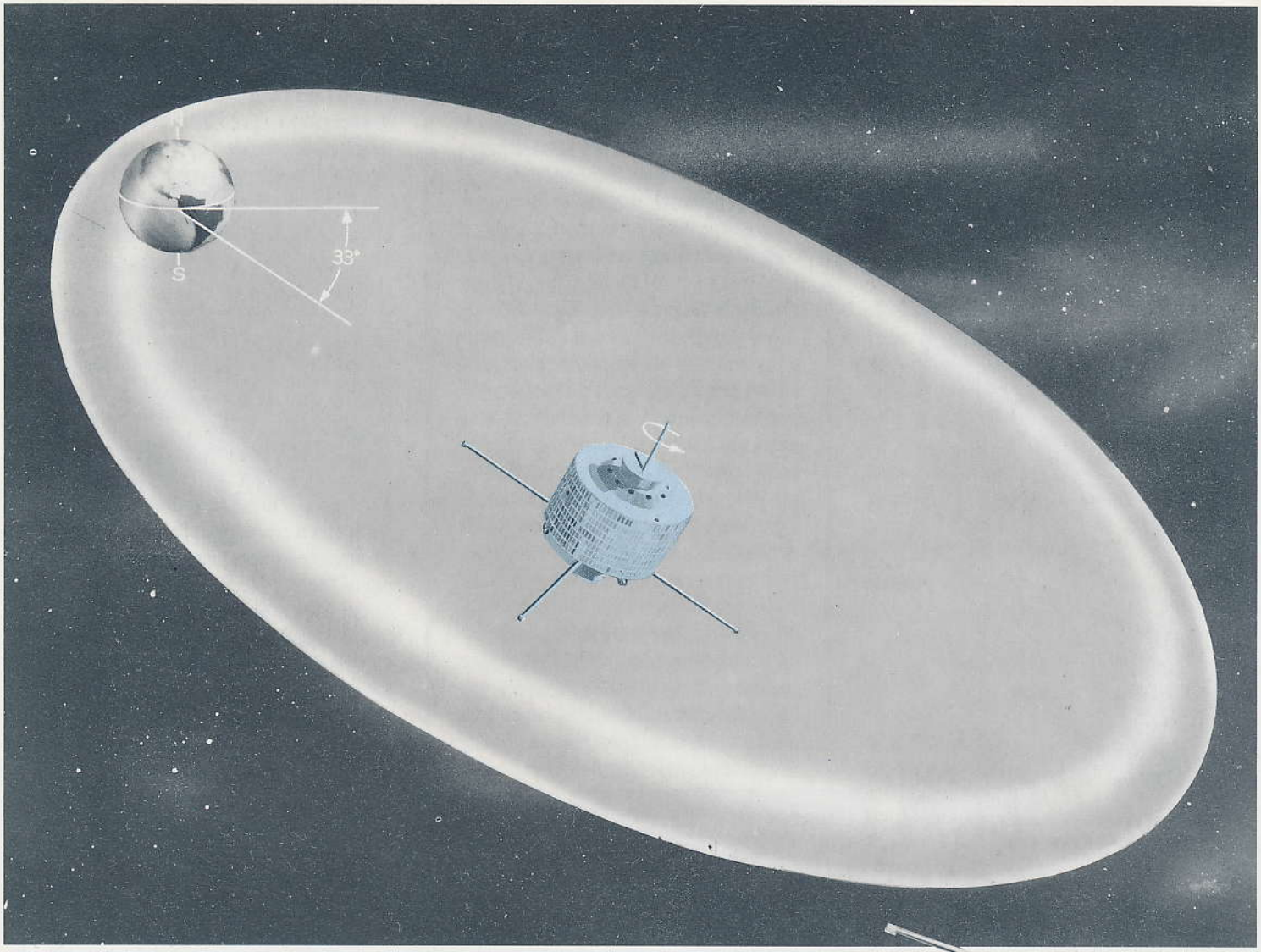


BD307 FM Broadcast Transmitter.

V.H.F. waves weaken rapidly beyond the service area, and f.m. is more tolerant than a.m. of same-frequency signals from other stations



A modern 1kw VHF FM TX



'Early Bird' satellite. (Courtesy of Hughes Aircraft Corporation.)

two factors that made it possible to plan local broadcasting stations with a considerable degree of frequency sharing. These days, in addition to the BBC's Overseas Service and four national services, Britain is served by a network of local stations, started by the BBC in 1967 and joined later by commercial stations under the control of the Independent Broadcasting Authority.

The advent of man-made satellites did not, of course, go unremarked by the broadcasters, who, when Early Bird went into orbit, seized the opportunity to use it to relay the Queen's Christmas message to the Commonwealth – a far cry from the day when George V broadcast to his subjects in Britain, and proof, if any were needed, that as broadcasting has grown so the world has contracted.

Undoubtedly the growth of radio made a quantum jump when the transistor came on the scene. It was not just that solid-state techniques, by reducing the size, increasing the simplicity and reliability and, therefore, the whole-life-cost of transmitters, encouraged the worldwide spread of broadcasting, even among the poorer nations, it was also that transisters sparked off a revolution in radio receivers.

The transistor radio. 1984. The public, at a time when it appeared to be transferring its loyalty to television, fell under the spell of the 'tranny' – the ubiquitous 'tranny' that is nowadays rarely absent from homes, streets, countryside and beaches throughout the world.

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1981

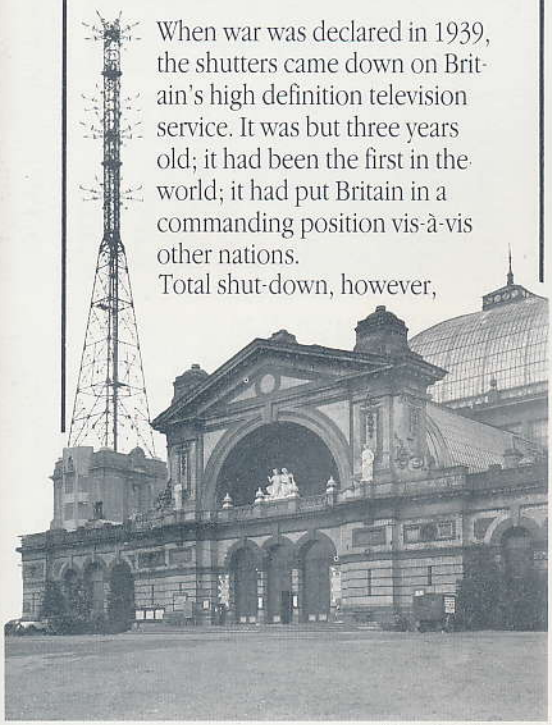
Milestones in Broadcasting

No 4

Television After the War

When war was declared in 1939, the shutters came down on Britain's high definition television service. It was but three years old; it had been the first in the world; it had put Britain in a commanding position vis-à-vis other nations.

Total shut-down, however, was the only way that the Alexandra Palace transmitter – a monument to Marconi's creative skills – could be prevented from acting as a guide to enemy aircraft. The final programme was a Mickey Mouse cartoon, in which the closing words were, appropriately, 'I t'ank I go 'ome' – a phrase immortalized by the Great Garbo. For seven years the screen remained blank. The transmitter was, however, pressed into active service on one notable occasion in 1941. An advanced German system had been designed to guide bombers to a target in England by radio beam transmitted from France. It had the misfortune, though, to operate in the same frequency band as the Ally Pally transmitter, which was so organized as to respond powerfully to one of the enemy system's signals, throwing it into total confusion!



Alexandra Palace.

Television returned to life in June, 1946, with more of a whimper than a bang, and public interest was slow to gain momentum. There was nothing slow, however, about the behind-scenes engineering activity of both the BBC and industry, who were united in their determination to regain the world lead that Britain had lost to US in the years before the latter entered the 1939–1945 fray. For television to catch on with the public, many improvements were needed – in coverage, picture quality, receivers and programme content.

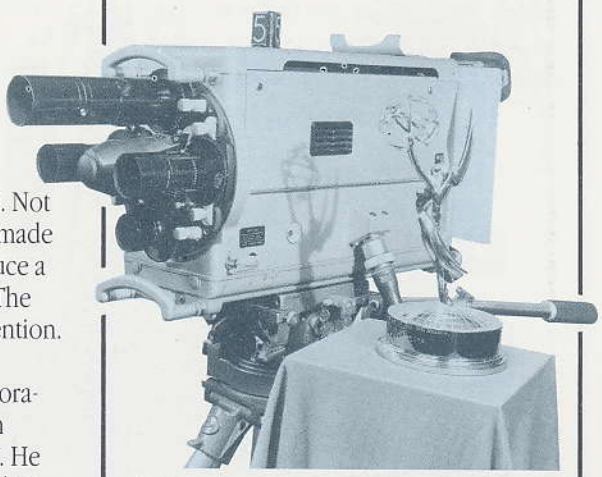
Cameras

The two types of camera used after the war by the BBC were of US design: the CPS Emitron behaved better in controlled studio conditions than out-of-doors; the reverse was true of the 3-inch image orthicon. And neither was perfect, even in its preferred role. Not until the 4½-inch image orthicon made its debut was it possible to produce a completely satisfactory camera. The manner of its arrival deserves mention.

The Marconi-EMI television camera. (Emitron) as used at the commencement of the world's first public high-definition television service from Alexandra Palace, London in 1936.

In 1947, G.E. Partington of Marconi's visited the Radio Corporation of America, where he saw an experimental version of the tube. He returned later, when RCA had all but abandoned interest in it, leaving development in the hands of one man, O. Schade. Demonstrations convinced Partington of its worth. There followed a long period, fraught with technical difficulties, during which Marconi's sister company, English Electric Valve, continued the development of the tube, while Marconi's designed a camera around it. Success came in 1957, when the BBC standardized on the 4½-inch image orthicon for both studio and outside broadcast. In 1961, it won for EEV, Marconi's and RCA the coveted US *Emmy* award for outstanding electronic technology. It became the world standard for black-and-white pictures and it reversed an all-too-common situation: the US was importing a British development of an American invention!

Marconi Mk IV cameras in Studio set.



4½ inch image orthicon together with the Emmy award.

Line Standards

Although by popular accord a world standard had emerged for cameras, there was no such international unanimity regarding line standards. The US had adopted 525, most European countries 625, while Britain retained the pre-war, pioneering 405, line standard, and thus lost an excellent opportunity to effect a change at the re-start of the service, when only a relative handful of television receivers existed in the London area (all at least seven years old).

In spite of the variation in standards, programmes could be exchanged between countries without difficulty provided they were telerecorded. This was because the line structure of the picture was eliminated in the process, which involved filming directly from the screen of a special, high-quality monitor. However, 'live' programmes exchanged between Britain and the continent (the US was out of range anyway) had to be displayed on a high quality monitor, eliminating alternate lines electronically, and picking off the picture with a camera operating on the line standard of the 'user'. Thus were pictures relayed from Paris in 1952, while in 1954, a systematic exchange was established through Eurovision – a network of microwave links and co-axial cables.

Britain was more or less forced to reappraise its decision on line standards by a plan agreed at Stockholm in 1961, when countries in the European Broadcasting Area were allocated frequencies in the u.h.f. band for exclusive use of the 625 standard. Clearly it was to Britain's advantage to loosen the shackles that bound it to the overcrowded v.h.f. band, and if this meant adopting a 625-line standard, then so be it. Consequently, the BBC's second channel, which opened in 1964, transmitted exclusively on 625 lines u.h.f.

Crystal Palace.

Transmitters

The immediate post-war requirement to improve coverage led to a surge of activity during the first decade of peace. By 1956, the veteran Ally Pally had been superseded by an immensely more powerful Marconi-equipped station at Crystal Palace. This was an excellent example of the rapid technological progress that took place after the war. With an effective (vision) radiated power of 200 kW – twice that of any other BBC station – it served a population of 13,000,000, and was the world's most powerful Band I transmitter, though by the standards of the day it was of dwarf proportions. Marconi engineers had achieved this feat through the parallel operation of two 15 kW vision transmitters, feeding into a high-gain antenna system.

I.T.A.'s first station at Croydon.

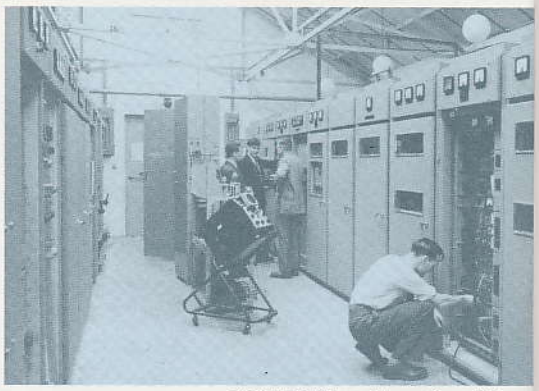
These transmitters are at last due for honourable retirement with the ending of the 405 line TV service in Jan. '85.

By now, 97% of the population was being reached through a network of new and high- and medium-power transmitters. These, linked by co-axial cable and microwave radio links provided for the national distribution of outside broadcasts from all parts of the UK, and of programmes produced in regional studios. By 1966, 85 relay stations had been installed to satisfy the so-far unserved areas and to ensure virtually total coverage of Great Britain.

In the 60s, the opening up in Europe of u.h.f. band of frequencies resulted in the building of so many new transmitters that unattended operation of both main and relay stations became imperative. So another stride was taken along the road of technology, making it possible to monitor a station's performance remotely and automatically to redeploy the remaining resources to the best advantage, if a fault were detected.

Independent Television

The most important single event in British television in the '50s was the formation of the Independent Television Authority (in the '70s, when it also assumed responsibility for commercial radio, it became the Independent Broadcasting Authority). Its purpose was to provide an alternative television service to that of the BBC. Its constitution laid down that it should own the transmitting stations, have jurisdiction over the programmes and advertising content, and should appoint programme contractors, from who it would derive its revenue. The contractors, in turn, would derive their revenue from advertisers. The ITA does not allow the contractors to accept direct sponsorship of their programmes and decreed that advertising may be inserted only in natural breaks in the programme and be of limited duration. Such arrangements differ radically from those in the US and other countries, and has unquestionably resulted in a far higher standard of programme content and presentation.



BD631 15kW Transmitters at Crystal Palace.

ITA's first station, situated in Croydon, came on the air in September, 1955. Operating in the hitherto little-used, and consequently little-known, Band III, it had been built (as had the

BBC's first station) by Marconi's. The Company completed the task in seven months and went on to provide six out of the first eight ITA stations, also supplying cameras in quantity to the programme contractors. In fulfulling its plans for national coverage, which were well advanced even before the service opened, ITA placed numerous further orders for Marconi stations.

Colour

The US introduced colour television as early as 1954. Britain was less precipitate, for two good reasons. One was an unwillingness to tie so important a new service to the 405-line standard, which was patently obsolescent. The other was a prudent decision to assess thoroughly the comparative merits of the three colour systems that were available before making a commitment. These were the American NTSC, German PAL and French Secam. NTSC had been adopted in the States largely because of lobbying on the part of the American receiver manufacturers, who held closely guarded patents, which they thought would protect them from foreign competitors penetrating their home market. In the event, the Japanese circumvented the patents and produced sets that could not only receive NTSC signals but that also arguably gave a better picture.

The European countries hoped that agreement could be reached to adopt a common standard but when it became evident that unanimity was impossible, Britain, and many other continental nations, opted for the PAL system.

So far as the vexed question of 405-versus 625-line standards was concerned, the Stockholm Plan, referred to earlier, had hastened Britain's leap off the fence. Already, BBC 2 was radiating an exclusively 625-line monochrome service, and now Britain decided to commit itself irrevocably to that standard. In July 1967, Europe's first colour transmissions were officially launched by BBC 2, using the 625-line standard, the PAL system and radiating in the u.h.f. band. In November 1969, the BBC 1 and ITA networks also started 625-line, u.h.f. colour services, although, in accordance with a decision reached in the early '50s, when discussions on colour were taking place, the programmes were capable of being received in monochrome on a conventional set – a feature known as compatibility.

The Mk VIII, the worlds first fully automatic colour TV camera.

Britain's first demonstration of compatible television was given in 1954 by Marconi's, who showed three different approaches and used two types of colour camera. And although 13 years elapsed before the inauguration of a scheduled colour service in this country, these early activities bore more immediate fruit in overseas markets, and also provided a sound foundation of knowledge on which to build future cameras – the Mark VIII, for instance, which was not only the world's first fully automatic colour camera but also weighed only 139 lb compared to the 400 lb of earlier cameras.

Satellites

Much could be written of the developments that have taken place since television became a part of our daily lives: the subject is vast and many-faceted. Studio building complexes, programmes, outside broadcasting, telecine, standards conversion, video recording are but a few of the subjects that merit more than a passing word. But space is running out, and what remains must be devoted to that most significant factor, the factor most likely to affect the future of television as a whole – the satellite.

Shortly after the war, the idea was floated that the moon might be used as a reflector. It seemed a far-fetched

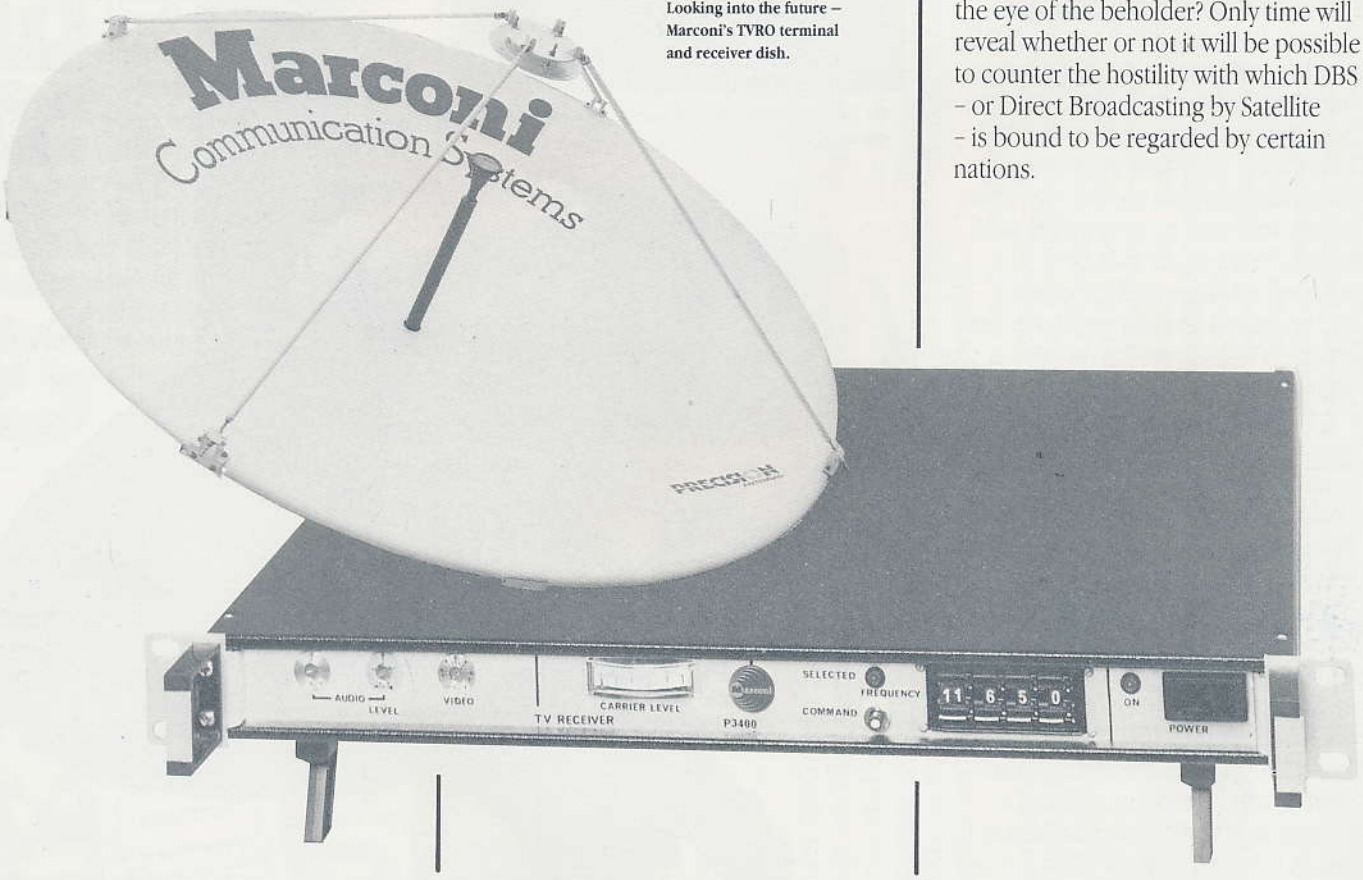
Marconi Goonhilly Satcom Aerial 2.

A typical outside Broadcast vehicle.

notion at the time, but in 1962, a surrogate moon, the *Telstar I* satellite, went into orbit, and signalled the first practical step towards achieving worldwide television coverage. Operating in conjunction with earth stations in America, England and France, its passage across the sky was followed by huge dish antennas. From the viewers' angle, *Telstar* was only of academic interest, for it orbited the earth every two-and-a-half hours and was visible from both sides of the Atlantic for only a few minutes during each orbit.

A new phase was entered with the advent of the geo-stationary satellite, that is, one that remains in the same position relative to a fixed point on the earth's surface. In 1965, such a satellite was launched for use by the communications media, including television, and subsequently, audiences have become used to seeing events televised 'live' from all parts of the world.

The most recent satellite application in the television field is that of direct broadcasting. Two ways of exploiting this development are immediately apparent. First, remote parts of the globe might follow the example of the Canadian Arctic, where signals from the satellite are picked up by a large antenna and relayed by cable or low-powered terrestrial transmitter to the sparse and widely scattered audience. Second, small antennas, mounted on private dwellings could bring signals directly to the domestic hearthside. This, however, could raise highly contentious political issues. Antennas can be made to point at any satellite, and who knows what propaganda-laden programmes might meet the eye of the beholder? Only time will reveal whether or not it will be possible to counter the hostility with which DBS – or Direct Broadcasting by Satellite – is bound to be regarded by certain nations.



Looking into the future – Marconi's TVRO terminal and receiver dish.

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1981

Milestones in Broadcasting

No 5

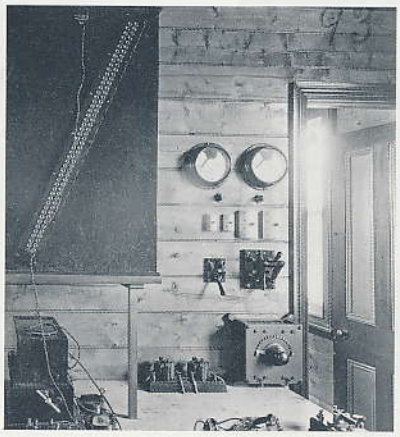
SOUND RADIO PROGRAMMES

It's not too difficult for engineers associated with the hardware side of broadcasting to lose sight of the fact that all the clever transmitters, receivers, antenna systems and studio equipment into which they have poured so much research, development, design, manufacturing and operating skills, are not ends in themselves. They are the media through which the ultimate aim of broadcasting is achieved – the presentation of programmes to the public. There is no denying, then, the programme its position at the summit of the pyramid. If programmes failed to satisfy the customer, the pyramid would crumble.

Mrs W. Collins, nee Winifred Sayer.

Having accorded the programme its rightful place in the hierarchy, one must hasten to point out that without the enormous advances in technology both programme presentation and content would have been subject to so many constraints that it is unlikely that broadcasting would have captured the interest of any but a few dedicated amateurs.

The very first 'programmes' that went out over the air were no more than range testing routines, initiated by manufacturers who were busy developing the new technique of radio telephony. Readings from the railway timetable, while perfectly adequate for this purpose, made pretty dull listening for the handful of enthusiasts, engrossed in twiddling knobs and tuning in their home-made receivers. It was also pretty monotonous for the test engineers.



Inside the Hut at Writtle.

So, ever-enterprising, Marconi's switched to music and pressed into service a number of talented Chelmsfordians: Mr White (piano), Mr E. Cooper (tenor), Miss Winifred Sayer (soprano), Mr V. Beeton (oboe) and Mr W. Higby (cornet) became the first artists to take part in what were, despite their status as tests, Britain's first broadcast programmes of entertainment. Notwithstanding the enormous enthusiasm of the listeners, the Postmaster General, who had absolute authority over the country's radio stations, resolutely set himself against using wireless telephony for public entertainment. The constraints, and even embargoes, that he placed on Marconi's test programmes failed, however, to prevent the Company from keeping the growing band of wireless amateurs happy. In 1920, for instance, sponsored by the Daily Mail, it presented Britain's first publicly advertised broadcast programme. The date was 15 June, the artist was Dame Nellie Melba, internationally acclaimed prima donna. Before the concert, she was conducted around the Chelmsford Works by a young engineer who, stopping to point out the towering antenna masts, told her that it was from the wires at the top that her voice would be carried far and wide. 'Young man,' she is reputed to have replied, 'if you think I am going to climb up there, you are greatly mistaken.'

In 1922, the Postmaster General loosened the stranglehold to the extent that he authorized Marconi's to establish a transmitting station from which it could broadcast for half-an-hour a week. Thus, on February 14 of that year, the country received a belated valentine at 8 p.m. in the form of the first radio entertainment to be broadcast from that new station, 2 MT – a wooden hut at Writtle. Captain P.P. Eckersley, the engineer who had directed the building of the station, now doubled as entertainer. To his own astonishment he proved to be a natural broadcaster, completely underawed by that sinister device, the microphone.

Captain Eckersley explains – *Courtesy BBC.*

Children's Hour – reading the Birthday list. *Courtesy BBC.*

Compère, actor-manager, soloist – he took all roles in his stride and brought to them spontaneity and humour. 'To er' is human, to forgive divine' and 'It is more blessed to transmit than to receive' are but two of the off-the-cuff dicta that have survived.

But 2MT meant more than a weekly half-hour of frivolity. It contained in embryo certain patterns that were followed later when broadcast entertainment was 'ligitimized'. For example, the first radio play, Cyrano de Bergerac, was produced – the single microphone handset being passed from player to player – and a rudimentary 'Children's Hour' was evolved.

Ring out the old year at 2LO London 1922, with Mr A. Burrows at the Chimes!

Marconi's second experimental station, 2-LO, came into being shortly after the birth of 2MT. Its programmes, transmitted from London, were far more sober and more carefully planned than 2MT's, and were, ironically, less popular. Nevertheless they scored some notable hits, including at least three outside broadcasts in 1922 – a running commentary from Olympia on the Lewis-Carpentier boxing match, reports on the King's Cup air race and a speech by the Prince of Wales to Britain's Boy Scouts.

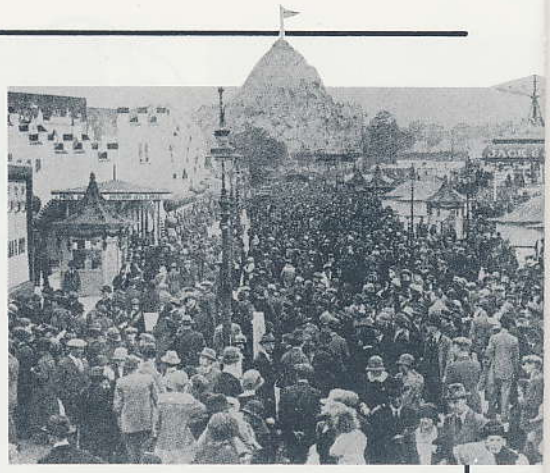
Lack of experience inevitably led to problems. In the early 2LO studio, for instance, the microphone and switches were so arranged that broadcasters often tripped over the leads, and frequently made unscripted remarks before the off-switch could be thrown. The first General News Bulletin transmitted from London, for instance, concluded with an audible cri de coeur, 'What the devil do I do next?'

With the formation in 1922 of the British Broadcasting Company, which in 1926 became the British Broadcasting Corporation, nine main stations became almost immediately available for transmitting officially recognized entertainment. Each had its own studio or studios, although they were primitive by any standard. In Manchester, for example, engineers, artists and programme staff reached the contiguous studio and transmitter via a goods hoist, decorously draped in the evenings with curtains.

Outside broadcasting, with its virtually limitless range of programme material, expanded dramatically, and inevitably brought further problems. How could the instant conflagration of a transmitter coil choke have been avoided when a pistol was fired during a theatre performance? Where, at the opera, could the microphone be placed so as not to distract an audience that would need to concentrate all its faculties in order to visualize the principal soprano as a fairy?

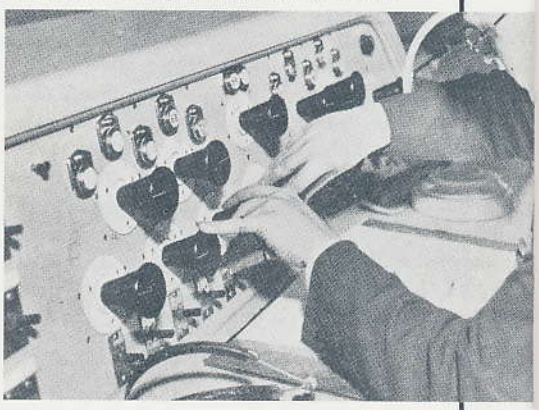
One of the notable outside broadcasts of that time was King George V's speech when he opened the British Empire Exhibition at Wembley. In passing, it is interesting to note that the equerry remarked to P.P. Eckersley, who had become Chief Engineer of the British Broadcasting Company, that one day the King might command him to kneel, tap him on the shoulder and say, 'Arise, Sir Peter'. As Captain Round had produced the microphone that the King was to use, Eckersley replied, 'It would be better if he commanded Round to kneel and said 'Arise Sir Cumference' – high office had not blunted his ready wit.

The 'Evening News' for May 12th, 1922, annoucing the first outside broadcast, of the Lewis-Carpentier fight. *Courtesy BBC.*



Part of the Great Exhibition at Wembley.

In the pre-war years, a programme pattern emerged that was to be followed and developed to the present day; school broadcasting, internal and external news services, sports commentaries, drama, vaudeville, discussions, interviews, religious services – a rich kaleidoscope. What also emerged was an awareness of the interdependence of engineers and programmers. A balance had always to be struck between what the programme staff would like to have and what the engineers could provide. So the continuing improvement in the quality and variety of the programmes owed as much to the efforts of the latter as to the initiative of the former – efforts that resulted in the switch from disc to tape for recording purposes; improvements in microphones, acoustics and amplifiers; the introduction of mixers, mobile recording units, control panels for multi-source programmes, a means of centrally controlling any programme so that such constantly reitereated gaffes as Woodrooff's 'The Fleet's all lit up' would never again electrify the listeners, the means of securing the right balance among performers in relation to the microphone and the control of volume output. In all such matters and many others, the co-operation of the programme staff and engineers, though not always as close as it might have been, had been and is the envy of many overseas broadcasting authorities.



The 'Dramatic' control panel. *Courtesy BBC.*

In 1929, five years after the formation of the British Broadcasting Corporation, the Regional Scheme came into operation, giving every listener the choice of two programmes, one of national interest, the other reflecting regional interests. Freedom of choice, though on a much wider scale, is still central to the structure of British broadcasting.

It has to be conceded that, great though the advances had been, broadcasting had its critics. Listeners' letters between 1929 and 1934 included such observations as:

'My mother spends all her time saying silly things down the loudspeaker. I am 12... I have one summer frock and four partly made because she spends so much time over the wireless. I have written this, so please do not let her know or she will hit me.'

'I have a licence since four years and have not yet heard nothink.'

'Since the change in wavelength, there has been fading which, I think, must be due to the engine not running level.'

Of what importance are programmes in the light of such comments?

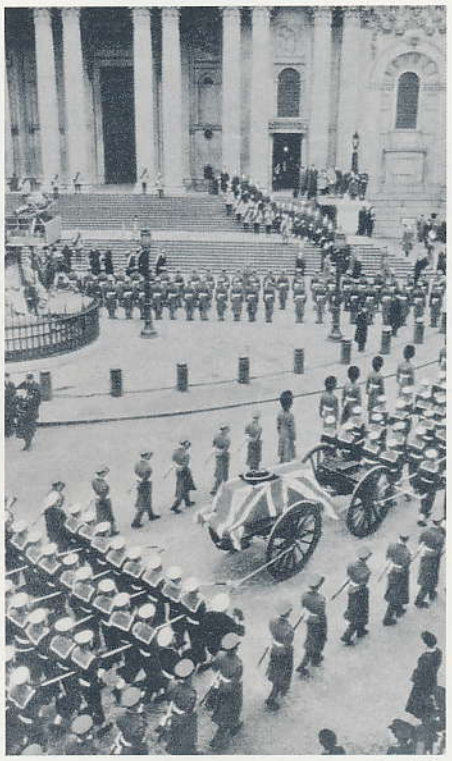
In a previous issue of Milestones in Broadcasting, mention is made of the wartime programmes that did so much to further the allied cause by boosting morale through lively entertainment and by promulgating news both to the allies overseas and to enemy territories. Let us pass then to the immediate post-war period. There was unquestionably a continued, and in some directions, sharpened interest in radio, marked by the launching of the v.h.f./f.m. service in 1955 and the beginning of regular stereophonic transmissions in 1966.

There was, however, a change in listening habits, due mainly to the growing popularity of television. Radio audiences were largest in the early morning and midday periods, and much reduced in the evening. Also, there was a tendency for each programme service to take on a more clearly defined character. By the end of the 60s, Radio 1 was established as the pop music channel,

Tony Blackburn in action circa 1967. *Courtesy BBC.*

Radio 2 had taken on light music, Radio 3 was devoted to classical music and Radio 4 dealt with news, current affairs, plays, discussions and light entertainment – a pattern that is observed to this day. Likewise, changes that took place in the techniques of programme presentation, while continuously reflecting advances in technology, are still the basis of much of today's practice: more microphones were used to separate out sounds from different musical instruments, which were then individually balanced; special techniques were

The start of the 50 km. walk at the 1948 British Olympics.



State funeral of Sir Winston Churchill.

developed to make possible the now widely popular 'phone-in' programmes; advances were made in the methods of achieving special effects for drama productions and in the control and mixing facilities for outside broadcasts. In this matter, progress was hastened because the broadcasting authorities of host countries for such international events as the Olympic Games and World Cup Football were determined to provide their visitors with the best-ever facilities. One of the most complex outside broadcasts of the period, and one calling for the highest degree of control and mixing expertise was the State Funeral of Sir Winston Churchill, which had been planned over a period of 10 years! To cope with pop music, studios were insulated against hitherto unimagined noise levels. These days the majority of pop programmes are originated in the continuity suite rather than a studio, disc jockeys being for the most part skilled in manipulating much of the technical apparatus themselves, including compressors, cartridge recorders and artificial reverberation.

Experiments in stereo broadcasting began in the late '50s, one such transmission being the Carol Service from King's College, Cambridge, in 1958. In 1966, when the problems of ensuring compatibility with conventional mono transmission had been solved, the first regular service started on Radio 3, and a new dimension, literally, was added to the quality of sound broadcasting.

Radio made amazing progress between 1922, when 2LO began its first broadcasts, and 1933 when Broadcasting House became the permanent home of the BBC.

The future of radio cannot be foretold. History shows that in some respects it has progressed in circles. Take the matter of studios. In 1932, Broadcasting House was opened and many of its studios were designed for specific purposes. The 'vaudeville' studio was provided with spotlights for the artists and tiny 'pit' and 'gallery' seating for a studio audience. A 're-ligious service' studio was set aside, equipped with an altar, while one of the talks studios was made to look like a library for the reassurance of nervous speakers. A drama suite included an elaborate effects studio. During the war, the 'general purpose', self-contained studio was found to be more practical, involving as it did less space, simplified operation and consequently less manpower. Since the 50s, however, the trend has to some extent been reversed, and studios have been constructed specially for music and drama.

The 'Effects' studio, Broadcasting House, 1935.

Outside Broadcast Van presenting live broadcast. Courtesy: Essex Radio.

But if policy in that instance travelled a somewhat circular path, sound broadcasting in general has not, and no one can say for sure what lies ahead. At any time another brilliant programme innovation might be unveiled, as it was when the Open University went on the air in 1971. There is little doubt that radio's niche in the future is assured and that it will continue to enjoy the affection and support of a public to whom it has already and so recently given so much – more and more outlets for regional interests and sub-cultures, a whole new spectrum of programmes through commercial broadcasting and a service that, through its programmes and facilities, is capable of meeting the latest and most exacting demands.

'On-Air' production studio, Courtesy MBI Broadcast Systems Ltd.

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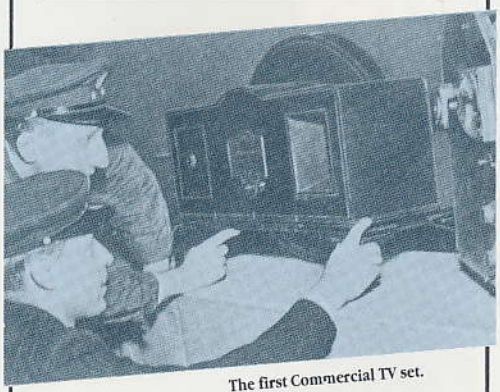
Milestones in Broadcasting

No 6

TELEVISION PROGRAMMES



The first Commercial TV set.

There are 657 million TV sets, bringing programmes to 2,500 million viewers in 162 countries throughout the world. Like it or not, it is an irrefutable fact that before the advent of television, no single factor, whether a discovery, a religion, a political creed, a philosophy or a technical development, had ever achieved universal dominion. Now, only 50 years on from its public debut, television is as universal as the sun and is affecting the lives of men and women of every race, colour and creed in every part of the globe. Furthermore, the exchange of programmes between countries and the fact that satellites can bring live events into the home of Everyman are nibbling at the roots of national cultures and life styles. Does this make for the greater unity of mankind or does it provide a means for the strong to influence the weak? Is it a medium of domination or persuasion? These are contentious questions to which there is as yet no answer.

In the previous article, we saw how radio broadcasting stemmed from communication test transmissions. The notion of radio as a purveyor of entertainment rather took the pioneers by surprise. By contrast, television was seen from the start as almost exclusively an entertainment medium. Possibly for this reason, the interplay between producers and engineers has been more marked than it was for radio.

DRAMA

The mainstream of all TV programmes has always been drama in one or other of its many guises. In television's infant days, it was transmitted live. This caused headaches. Both performers and equipment were unpredictable, and also the cost of mounting a show which, in the absence of video recorders, would be seen only once, was frequently prohibitive. There were other problems too. Those with skill in staging live entertainment were the theatre directors and stage managers, but to co-opt their services was not really practicable because they did not necessarily understand the capabilities and limitations of the TV camera.

It became evident that those best qualified to cope with the new technologies were the movie industry's film directors. Not only that, but in the USA at least, the film industry very often had a financial stake in the TV networks. So, in America, TV moved into Hollywood, setting an example that was followed by all countries having a powerful movie industry, and benefiting not only from technical expertise but also from the vast archives of feature film on which it could draw.

Both the archive film stock and the new productions were, of course, on ciné film, which had to be projected onto a cinema screen and viewed by a TV camera. In the old monochrome days, the only technical problem that arose was the need to eliminate an irritating flicker. But when colour came on the scene, the differing colour characteristics of the ciné film and the vision tubes led to a noticeable colour cast in the transmitted picture – a fault that was overcome by applying an electrical correction within the TV camera.

Even with the advent of telecine and the video tape recorder, which allows programmes to be produced directly onto video tape, directors still use ciné film for the overwhelming proportion of all productions. Certainly it has the advantages of familiarity and of being independent of the various TV systems and standards – important to the sale of programmes abroad. In Europe, where there was not such a wholesale move towards centralized TV drama production, and where to some extent live productions still survive, it is likely that greater progress will be made towards working onto tape.

George Bernard Shaw's TV play, 'Widowers Houses.'

Early Telecine.

A Telecine machine mixing TV camera and cinema projector-turning films into television.

'The Amazing Doctor Clitterhouse' - TV thriller.

And what of the programmes themselves? They are held by some to affect the modes of the viewing public. Crime drama, for instance, has grown in violence in its effort to revitalize a sated audience, and is widely regarded as a major contributory factor to the escalation of violence in the world at large. Such directives as 'Please see that the lady is raped with decorum' and 'Please murder the baby tastefully' are generally short-lived. But not all influences are bad, and Britain in particular has a reputation for producing long-running TV classics of the calibre of **The Forsyte Saga, Upstairs Downstairs** and **Brideshead Revisited**, which have been sold most successfully all over the world, with dubbing and sub-titles in the appropriate language.

NEWS

First TV Newsreel cameraman

In the genesis days, it soon became evident that television was in for a tough time if it was to compete with radio in the matter of news coverage. Radio could offer real-time, eye-witness commentary merely by connecting a reporter's phone call into a transmitter. Television, on the other hand, could do no more than show an image of a news presenter, reading from a prepared script about events that had already taken place. This led, in the USA, to a certain trivialization of the news, simply to hold the viewers' attention; indeed show-biz moved in to the extent that a chimpanzee was engaged to assist one of the newscasters!

There were occasions, however, when TV could score over radio. In the long-running situation such as a workers' strike or even a war, it made sense to deploy equipment on the scene. In the early days, this would consist of ciné cameras, and would involve tremendous logistic back-up, as the films would have to be rushed back, often through various customs and across borders, to be processed and edited in time for the news programmes. A newspaper could often present the news as quickly. But TV, with its moving pictures, could claim a big bonus point.

In many ways the technology of news reporting progressed very slowly because, great as were the logistic problems of handling cine film, the technical problems associated with deploying TV cameras was even greater. Those ranged from the sheer bulk and fragility of the equipment itself to the difficulties of engineering, high-grade wide-bandwidth signal links back to the studio. Perhaps the greatest problem of all, though, in the early days was the lack of any means of storing the video signal. Without video tape recorders, there was no point in deploying TV Cameras and Crews unless it could be guaranteed that the incident to be reported would coincide precisely with a scheduled news broadcast!

It was not until the advent of truly portable ENG (Electronic News Gathering) cameras and high-grade portable video tape recorder in the 70's that the dominance of ciné film began to be seriously challenged. Even with these developments, however, there is still today the problem of getting the filmed material back to the studio.

Perhaps what is now needed to make the total transfer to TV techniques complete is a truly portable satellite station, enabling instant links to be set up between news scenes anywhere in the world and the studio.

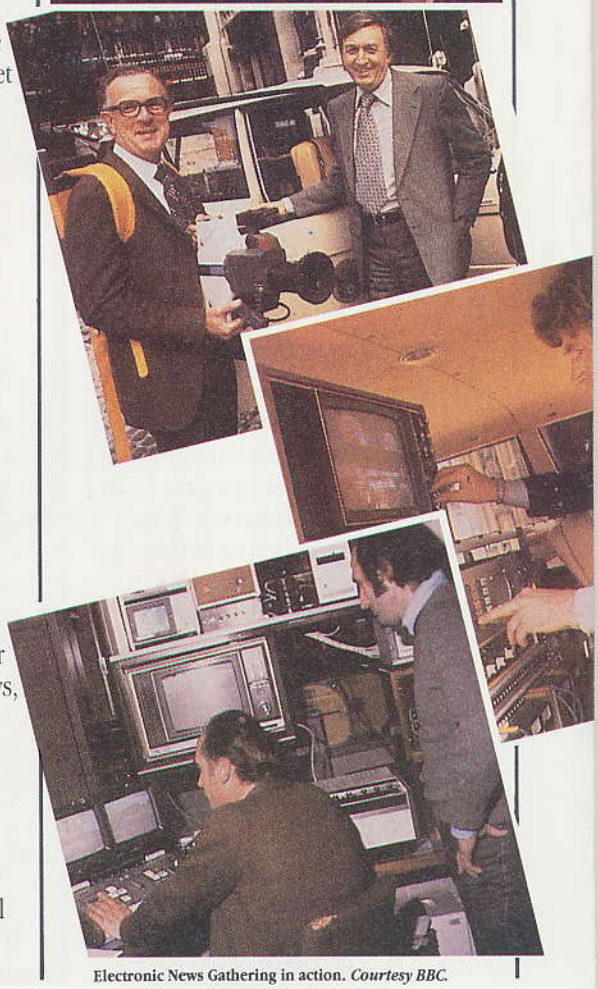
One should not forget that in the early days, news programmes, though lacking impact, provided a background against which issues could be debated. This gave rise to the various current affairs programmes, in which TV in the free world now excels, and which produced such authoritative personalities as Richard Dimbleby in Britain and Edward R. Murrow in the USA.

'In-depth' treatment of national and international affairs led to investigative journalism, and in this country, programmes such as **Tonight** and, later, **World in Action** have proved that politicians need not be treated with awe nor workers with condescension. These days, the man in the street is given as much opportunity to be seen and heard on the box as the self-styled expert. Some would have it that governments can stand or fall by the quality of their television images. For this reason, fear of television's potency has been evident all over the world.

One reason why Russia invaded Czechoslovakia in 1968 was to quell the rising tide of liberalism that was apparent in such things as the increasing candour of the Czech news programmes. These were strictly censored once the invasion was completed. In France, the government has always exercised tight control over television, and newscasters are still expected to represent the voice of their country and their government.

Portable camera and VTR, late 1970's.

BBC interview with Mrs. Thatcher, using E.N.G. for the first time. *Courtesy BBC.*



Electronic News Gathering in action. *Courtesy BBC.*

Xth British Commonwealth Games, New Zealand 1974 using a Marconi colour camera.

Live action at TV AM.

Outside Broadcast Vehicle.

In contrast, freedom in the USA enabled one of TV's current affairs supremos to voice the opinion that America could never win the war in Vietnam. This, coupled with the demoralizing effect of live coverage from the battle-front, is held by many to have been the cause of America's 'losing' the war. Perhaps the handling of the news by Britain during the Falklands crisis and by the USA during the landings in Grenada indicated that the lesson has been well learned.

THE BIG OCCASION

Given that TV was regarded from the start principally as a means of entertainment, and given that the large sporting events have always been regarded as prime entertainment, it was inevitable that TV producers should exert tremendous pressure of the engineers to overcome the technological limitations that made presentation difficult.

Early on, the only feasible technique was the use of the ubiquitous ciné camera, with its attendant problem of getting the film to the TV Studio. Later, it was realized that stadia and similar buildings could incorporate TV studios, completely wired and awaiting only the connexion of the cameras, mixers, microphones, and so on, when an event was to be broadcast. This brought the thrill of live action to the small screen.

The real solution, however, lay in the Outside Broadcast Vehicle, the development of which has brought a new dimension and immediacy not only to sporting events but also to any important occasions such as Royal Weddings and State Ceremonies, in which the viewers now have a sense of participation. It is a staggering fact that no fewer than 750 million people saw the wedding of Prince Charles and Lady Diana Spencer in 1982. The OB Vehicle has also widened the scope of live drama, enabling the action to take place both in the studio and on location. It is even possible to produce a live transmission from the theatre itself.

H.R.H. The Prince & Princess of Wales.

TRANSFER OF PROGRAMMES BETWEEN COUNTRIES

There has always been considerable international traffic in TV programme material. At first, this was really an extension of the existing traffic in films for the cinema, with no great problem raised by standards, which were more or less common worldwide.

The exchange of live programmes was another matter. This involved the transmission of TV signals and, unlike ciné film, TV standards were, and are, not universal. Consequently, programmes had to be received and displayed on equipment conforming to the standard of the originators' country, and then viewed and retransmitted on the standard of the receivers' country.

This clumsy procedure was not really replaced until the 70's when digital signal processing techniques had progressed to the stage where it was possible to overcome the problem electronically.

The transfer of humour between countries sometimes presents unexpected difficulties. A situation comedy series recently produced in Britain had as one of the major supporting characters a Spanish Waiter called Manuel. Much of the humour derived from the fact that, as the situation he was involved in, grew more desperate, his command of the English language deteriorated to the point of speechlessness. When the series was sold to Spain, Manuel had to be dubbed as an Italian!

LEARNING

No article on programmes should omit mention of televisions role as instructor. In one way it discharges its obligations as mentor through documentaries, which almost without our being aware of it, are adding daily to our knowledge of ourselves and the world we inhabit. In another, they provide formal structured educational programmes that can be viewed in schools and are of inestimable value in countries of the Third World.

BBC Documentary 'World About Us'. *Courtesy BBC.*

'Manuel' *Courtesy BBC.*

Fun and games on 'Blankety Blank'. *Courtesy BBC.*

And in this country we are fortunate in that TV has been granted the unique and remarkable status of University of the Air. Inaugurated in 1971, the Open University, as it is known, provides the means for men and women, mostly of mature years and unable or unqualified to enter conventional universities, to obtain fully recognized degrees. In 10 years, it produced 30,000 graduates, and had 65,000 registered students who were enrolled for more than 100 courses.

WHERE WILL THE FUN END?

TV Producers are great ones for fun and games – and practical jokes. You can see it all happening in such programmes as **Candid Camera, People are Funny** and **Game for a Laugh**. But the underlying object is the humiliation of the victim, and because of this they are regarded by many as being in questionable taste. Not so in Japan, however, where the programmes reflect such a huge appetite for humiliation that it has been said that 'the audience is becoming a monster beyond our control,' and that in time viewers might demand to see someone killed on a game show!

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Milestones in Broadcasting

No 7

A FIRESIDE STORY

It was a chance visit to Barnstable in North Devon that caused us to wonder if we have perhaps been guilty of introducing a slight bias into *Milestones*. Tucked away in Silver Street in this charming centre for holidaymakers is the small, privately-owned Bygones and Broadcasting Museum. The all-absorbing hobby of Robert Brain and his wife, Pauline, the museum boasts a remarkable collection of early wireless and television receivers and associated equipment. The realization that these are objects of very considerable interest to a great many people made us aware that we have tended to ignore the fireside aspect of the broadcasting story. So in this issue we shall do our best to redress the balance. We will confine ourselves to the period so abundantly represented in the museum - that is to say, from the earliest days of both sound radio and television to the late 50s.

THE HOBBY ERA

Inevitably, the first wireless receivers were 'hobby sets'. Programmes being what they were - range tests from transmitters that it was assumed would be used for communications purposes - no businessman in his senses was likely to embark on the production of receivers for domestic use. So the enthusiasts were forced to build their own if they wished to listen to readings from railway timetables!

Pauline Brain in a room setting of the 30s is at home with the Revophone 'cat's whisker' as she is with today's push-buttons.

MANUFACTURERS STEP IN

The advent of the British Broadcasting Company in 1922 changed the attitude of the manufacturing industry, and while the do-it-yourself habit continued to flourish throughout the decade, readymade sets started to appear in the shops.

Visitors may browse over television sets that range from Baird's Televisor through monster-size sets combining television, radio and gramophone to the more compact receivers of the late 50s.

EARLY DEVELOPMENTS

It goes almost without saying that for many years before 'listening in' became popular, the backroom engineers and scientists had been busily engaged propounding and applying principles that eventually benefited the High Street customer.

As early as 1902, Fessenden had proposed that a local oscillator could be used to produce a beat note at an audible frequency. In 1913, H.J. Round of Marconi had patented, and introduced, the use of positive feedback, or reaction, to increase amplification. In 1915, stability was improved by using 'hard' vacuum, as in the 'R' valve. Inter-electrode capacitance was reduced by bringing out the leads at different points in the envelope, as in the French horned valve and the Marconi 'Q' valve of 1916. Valves were further improved by the use in 1918 of dull-emitter filaments. In 1919, Armstrong described the super-heterodyne principle.

CRYSTALS v VALVES

Although valve sets were available from the start, they were hard put to it to establish a hold on the market. The crystal set was cheaper and simpler. It consisted essentially of a tuned circuit and a crystal detector. It had no batteries, as all the power delivered to its headphones came from the transmitter. Most designs used a 'cat's whisker', and the performance of the set depended on making the 'whisker' touch a favourable spot on the crystal with just the right pressure. Lacking any means of amplification, the crystal set was insensitive, and the sound was further weakened if more than one pair of headphones were used. Furthermore, it could not separate transmissions of comparable strength unless the wavelengths differed widely.

For all its disadvantages, a crystal set at a pound or two had the edge on a two-valve set at £7, and a very thick edge indeed on sets with four or more valves, which cost well over £50 (1926 prices). Moreover, valved sets needed batteries, and the low-tension accumulators used for heating the valve filaments were extremely inconvenient, necessitating frequent trips to the local radio shop or garage for recharging. Even operating such a receiver could be a daunting task, often accomplished only after studying two or three closely-printed pages of complex instructions. The results, however, could be rewarding: '...within 50 miles or so of a high-power broadcast station, music on the loudspeaker is so loud that it can be heard 500 yards away.' Such was the carrot that one manufacturer dangled before his prospective customers.

LOUDSPEAKERS

The use of valves had made it possible to employ the loudspeaker. One of the first practicable types had a conical metal diaphragm connected to an electromagnetically operated reed. It was introduced in 1920 by S.G. Brown, whose headphones were already well-known, and was followed shortly afterwards by the horn loudspeaker.

AN UN-NEIGHBOURLY REACTION

Sensitivity and selectivity in those early valve receivers depended on reaction, i.e. feeding part of the valve output back to its input. If the reaction control were tuned a little too far, the feedback caused the valve to oscillate, and the receiver effectively became a transmitter on a wavelength close to that of the station it was tuned to. This, in turn, caused howling noises that ruined the station for everyone else in the neighbourhood. Only with the introduction of the screened grid in 1927 was stable amplification of the r.f. signal achieved, and neighbourly love restored.

WIRED FOR SOUND

In those days a listener's licence entitled him to use 100 ft of wire to construct his aerial, and in most instances this was needed for satisfactory reception. Ideally, some 70ft of wire, secured by a porcelain insulator, ran horizontally from a tree or pole in the garden to the chimney stack, from which a stay wire and another insulator enabled the remaining 30ft to run down to a 'lead-in' tube let into the window-frame. The receiver was installed immediately inside the window and the headphones or separate loudspeaker were wired up to it. A waterpipe or a metal plate, buried vertically in the ground, served as an earth. Frame aerials were also used and, while less efficient, they enjoyed the twin benefits of convenience and directionality, which allowed discrimination against interference.

A variety of loudspeakers reflects the taste of the times.

Side rooms off the main areas of the museum yield specialist treasures to delight the wireless enthusiast.

MARCONI RECEIVERS

Marconi's had foreseen the likely market trend following the creation of the British Broadcasting Company, and in 1922 set up the Marconiphone Department, whose task was to design, manufacture and sell domestic receivers that complied with the Post Office specifications and tests, thus qualifying for the British Broadcasting Company's authorization stamp.

First out of the stable was the 'Crystal Junior', which was followed by the V1 single valve detector, with positive feedback from anode to control grid providing reaction. The third in the series was the V2 which, in its final form, incorporated an h.f. stage and detector in a reflex circuit with reaction applied. The V2 was for a long time the most sensitive receiver on the market and the first to incorporate automatic bias.

In 1923, the Marconiphone Company was formed to take over the activities of the Department, and because of lack of space in the Marconi factory, mass production was started at the Sterling Telephone Company's works in Dagenham, with research and design continuing to be carried out in Chelmsford.

By entering the consumer market, Marconi's had departed from its traditional role, and in 1929 decided to sell the thriving new firm to RCA.

General view of Robert Brain's collection of receivers, which cover both sound and television from the early days to the late 50s.

Together with with the Company, it also sold the copyright signature, G. Marconi, on domestic receivers, a step that was perhaps ill-considered and that caused confusion which exists even to this day. In this context it is interesting to note that Marconi's have recently re-purchased the Marconiphone name, and it is now being applied to products for the new cellular radio system in the UK.

THE ALL-MAINS SET

Between about 1927 and 1934, wireless sets developed rapidly. The battery-powered receiver, connected to an outdoor aerial and tuned by manipulating two tuning controls and a reaction control, was superseded by the all-mains superhet, with built-in moving coil and single-knob tuning. Its sensitivity was such that a few feet of wire in the room were sufficient to serve as an aerial. This form of receiver changed little during the next 20 years.

THE SUPERHET PRINCIPLE

The superhet (originally supersonic heterodyne, then superheterodyne) principle has remained the basis of all subsequent receivers. In the so-called 'straight set', the tuning knob had to vary all the tuned circuits simultaneously, and could not easily achieve the selectivity demanded by the growing congestion of broadcasting wavebands. In the superhet, this disadvantage is overcome by mixing the signal from the aerial with the output of a tunable oscillator to form a signal at their 'difference' frequency. All the circuits that follow are permanently tuned to accept only one narrow range of 'difference' frequencies. This technique enables the tuned circuits that give the receiver its selectivity to be designed for optimal performance at a single frequency, and to be precisely adjusted for all time during manufacture.

A special little bit of Memory Lane is reserved for Stuart Hibberd, who was Chief Announcer at the BBC for 25 years. His personal wireless set, photographs and one of his spats are on display.

Part of the section that is devoted to early tape recorders and portable wireless sets.

THE WAR YEARS

In the years immediately before World War II, a short-wave band became an essential selling point for all but the cheapest sets, and push-button tuning was also greatly in demand.

By 1939, there were 9 million licence holders in Britain, most of them in possession of extremely stylish sets. Wartime priorities, however, meant a dramatic falling off of domestic receiver production. New sets were hard to come by, and spares and skilled engineers were in short supply to repair old sets that were wearing out. In 1944, to ease the situation, an unbranded receiver came on the market. It was stark in appearance and was known as the Utility Set: over $\frac{1}{4}$ million were sold.

AFTER THE WAR

In 1947, the Radio Exhibition high-lighted the improvements in design and manufacture that had taken place in the short space of time since the end of the war. Miniaturization had resulted in a marked reduction in the size of the sets, and there were an increasing number of refinements to satisfy the 'hi-fi' enthusiasts.

By 1954, printed circuits were widely used in receivers and ferrite rod aerials in portable sets. By the end of 1955, transistors had replaced valves in the audio-frequency stages and were beginning to be used also in the r.f. and i.f. stages.

In spite of the advent of television,

sound radio was booming, and between 1945 and 1955 the number of licences increased from 9.71 million to 13.08 million.

EARLY TELEVISION

The honour of transmitting the first recognizable moving picture over radio waves belongs to John Logie Baird. The 30-line images were rudimentary and tinged with the reddish orange colour of the neon lamp used as a light source. They were received on a set that used mechanical scanning, as did the apparatus that originated the pictures. Baird designed and built these receivers, which were known as Televisors, and which were also available in kit form for home construction.

The content of the programmes which, in 1932, Baird was permitted to broadcast from a BBC studio in Broadcasting House, and the quality of the pictures did not encourage many people to invest in Televisors. Only a few thousand kits and fewer than a thousand readymade sets had been sold when, in 1935, transmissions ceased in order to make way for a higher definition service.

THE CATHODE RAY TUBE

By this time it was evident that such a service depended as much on the availability of the cathode ray tube to produce the display in the receiver as on the camera pick-up tube to originate the picture. Cathode ray tubes had, therefore, already been incorporated in receivers when the BBC Television Service was officially inaugurated in 1936.

Because of its narrow deflection angle, the tube had to be very long to produce a picture of acceptable size, and this fact, together with the large number of bulky components that had to be accommodated on a number of separate chassis, made the television set a very substantial piece of furniture. Some had the tube mounted vertically so that the picture could be viewed through a mirror, housed in the lid of the receiver, which was tilted at an angle of 45°.

SLOW STARTER

In spite of the improvements in transmission and reception that accompanied the high definition service, the pre-war attitude of the public towards television was still only luke-warm - a fact attributable perhaps to the limited transmission hours, a high percentage of repeat programmes and the cost of the receiver. The typical 1937 set was a luxury model with a 12-inch (305 mm) screen, which cost half as much as a small car, and occupied almost as much space.

There was also a fear that rapid technological advances would render the receivers obsolete. An assurance from the Postmaster General that transmission standards would remain substantially unchanged for at least three years, and a reduction in the average price of a receiver, due to the use of smaller tubes, pushed up the sales figures, and by September 1939, when war pulled down the shutters on television, about 20,000 sets were in use.

THE POST-WAR RECEIVER

While post-war television receivers benefited from war-time work on radar, they still employed long, thin picture tubes with circular screens, reduced to a rectangle by a rubber mask. This made for small pictures and large cabinets. The size and weight of a receiver were partly due to its massive mains transformer, which supplied a low voltage for heating the valves and a very high voltage for the picture tube. In about 1950, the transformer bowed out: the valve heaters were connected in series across the mains supply, while the high voltage was derived from the line scanning circuit.

Pre-World War II wireless sets

MULTI-CHANNEL SETS

When the first regional transmitters opened in Britain, some manufacturers produced separate London and Birmingham models, tuned to the appropriate frequencies, but soon receivers were produced that could be pre-set by the dealer to any one of the five BBC channels. When the alternative ITA programme became available in the London areas, however, means were provided for the viewer to change channels.

Our nostalgic glance at the past stops at this point, for Robert Brain's exhibits, which illustrate so many of the points we have mentioned, do not, for the moment at least, go further.

Robert Brain, right, and his son, Richard, examine an extension speaker of the mid-40s.

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1981

Milestones in Broadcasting

No 8

ANTENNAS

We feel it is time to take a look at an aspect of broadcasting that all too often receives Cinderella treatment in historical surveys of this sort. We refer to the antennas that actually transmit the broadcast signal. It is easy to regard these as mere adjuncts of the transmitter. Nothing could be further from reality. While it is probably true that antenna development in such matters as power handling, directivity and gain has been in response to advances in antenna transmitter technology, there have been times when advances in antenna technology or in the understanding of propagation theory have been the spur to innovation on the transmitter side. This was certainly so in the genesis days of radio.

THE PRE-BROADCAST ERA

Missing Link - In the mid-nineties of the last century, all the ingredients but one were to hand for assembling a practical system of wireless telegraphy: the spark gap for generating Hertzian waves, the sensitive coherer for detecting their presence, and the elevated antenna, which had often been used to collect static electricity. The idea of putting together these components to make a signalling system would probably have been obvious to investigators of the Hertzian phenomenon had they not been exclusively concerned with the pure physics of the subject. Furthermore, there was one link missing - the elevated antenna in its role of radiator. Although it had been used in connexion with static electricity since Benjamin Franklin's day, it had never been thought of in terms of collecting man-made electromagnetic waves.

Just when it seemed that the practical limits of range had been reached at a hundred yards or so, Guglielmo Marconi was inspired to combine an elevated antenna, which he had used to detect electric storms, with his Hertzian wave apparatus.

Disconnecting the Hertzian dipoles at both transmitter and receiver, he attached one output terminal of his induction coil via a wire to a metal cylinder, erected at the top of a pole. The other output terminal he connected to a metal plate in contact with the ground. At the receiver end, one side of the coherer was connected to a similar elevated cylinder, and the other side to earth.

The improvement in range was dramatic, and by systematic experiment Marconi established that the distance over which the waves could travel was directly related to the dimension of the cylinders and their height above ground.

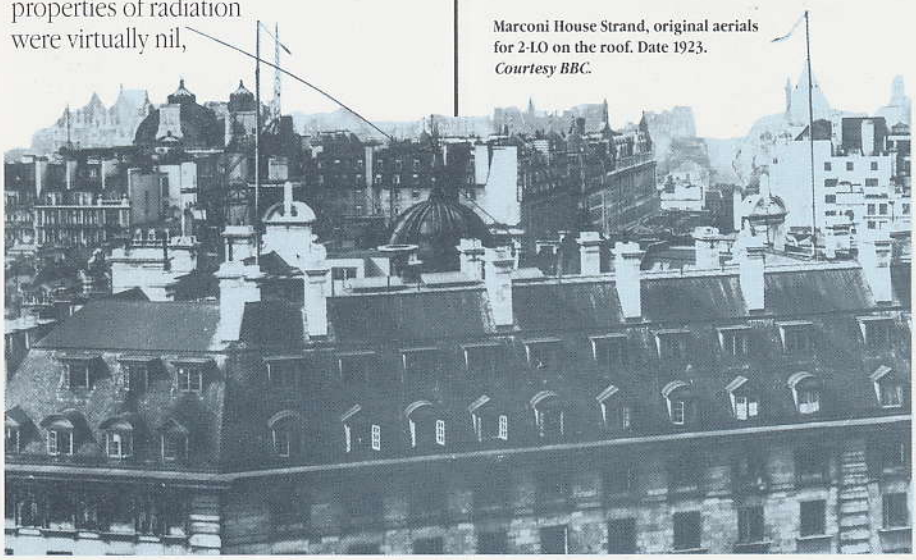
That antennas were central to the success of wireless transmission was now fully recognized, and there followed a period of intensive study and experimentation into the subject - a practice that is still observed.

Selectivity - The part played by the antenna in helping to overcome the vexed problem of that time - interference between stations - is revealed in Marconi's famous Patent No 7777, granted in 1900. In this, Lodge's syntonic (or resonant) jars circuit, whose properties of radiation were virtually nil, was transformed by coupling it to an antenna via an h.f. transformer, and tapping the antenna inductance to enable the periodicity of the oscillations to be adjusted. Also, the fixed capacitor (or Leydon jar) was replaced by a variable capacitor.

Thus, Marconi created a resonant circuit capable of being precisely tuned to a given frequency, and of radiating that frequency.

Birth of Diplex - The new circuit did more than eliminate inter-station interference, it also increased the range, the radiated power no longer being dissipated over a very broad band. Even more importantly, it opened up new dimensions in that it enabled two differently tuned transmitters to be connected to a common antenna, allowing a number of messages to be received simultaneously on an antenna connected to differently tuned receivers. Diplex working had arrived.

Directional Properties - In July 1905, Marconi registered another important patent, which concerned his discovery of the directional properties of antennas. He had found that an antenna wire laid on the ground had the strongest powers when its free end pointed away from the transmitting station. 'Inverted L' antennas behaved in the same way. Furthermore, the direc-



Marconi House Strand, original aerials for 2-LO on the roof. Date 1923. *Courtesy BBC.*

tional effect was equally evident with the transmitting antenna of that type.

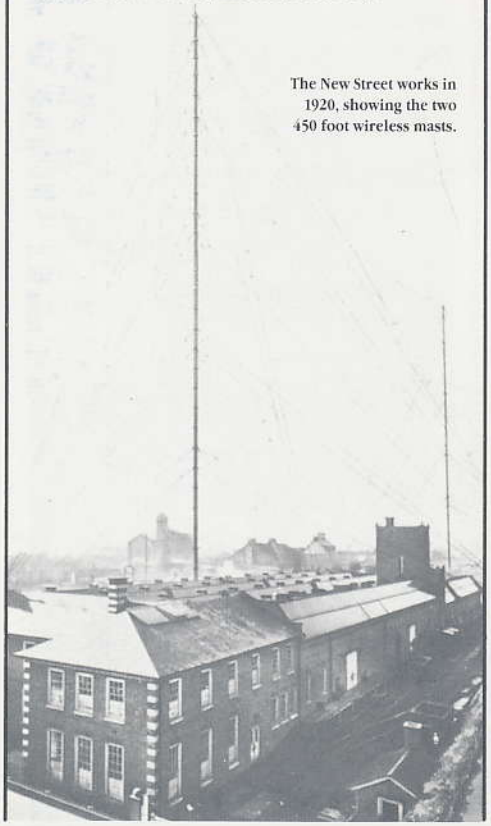
Support Structures - No less important than the antennas were the mast and towers that supported them. Early on, mast design was a matter of empiricism and expediency, resulting, inevitably in such spectacular disasters as those at Poldhu and Newfoundland where, in 1901, the destruction by gales of the masts on both sides of the Atlantic all but killed off the historic communication experiment.

However, in 1909 Marconi set in train a systematic series of investigations into the effects of wind-loading on support structures. The continuous pursuance of such studies has made it possible these days to construct masts reaching a height of 2120 ft, and single masts able to support a number of curtain antennas, with all the stresses and strains calculated to balance each other.

BROADCASTING

Clearly, the early advances in antenna technology had a profound bearing on the quality of wireless telephony, when this mode of communication took its place alongside that of telegraphy.

In Marconi's first broadcast experiments, the transmitter used an antenna suspended between two 450-ft masts, while later, the famous Two Emma Toc station at Writtle, mentioned in a previous issue of Milestones in Broadcasting, had a four-wire antenna, about 200 ft long, suspended by 110-ft masts. When 2LO came on the air, it used antennas that consisted of two cages, each of four wires, supported by 50-ft masts, about 100 ft apart on the roof of Marconi House in London.



The New Street works in 1920, showing the two 450 foot wireless masts.

Younger readers, used to 'trannies' with highly efficient, built-in ferrite antennas, may not realize the lengths to which early listeners had to go in order to capture the signals at maximum strength. Usually, an 'inverted L' antenna was slung, as high as practicable, between a chimney and a pole or tree, with a string of insulators at each end, and with an insulated lead-in tube passed through the window frame.

Long Wave Broadcasting (30 to 300 kHz) - In 1923, the world's first long wave transmitter dedicated exclusively to broadcasting was built at Daventry, a location in the centre of England from which it was hoped to achieve 'universal coverage' of the United Kingdom. Its signals were radiated by a T-antenna, suspended between two stayed masts of triangular section, 500 ft in height and 800 ft apart. National coverage of the UK nowadays is from Droitwich, with two smaller 'repeater' stations in the north.

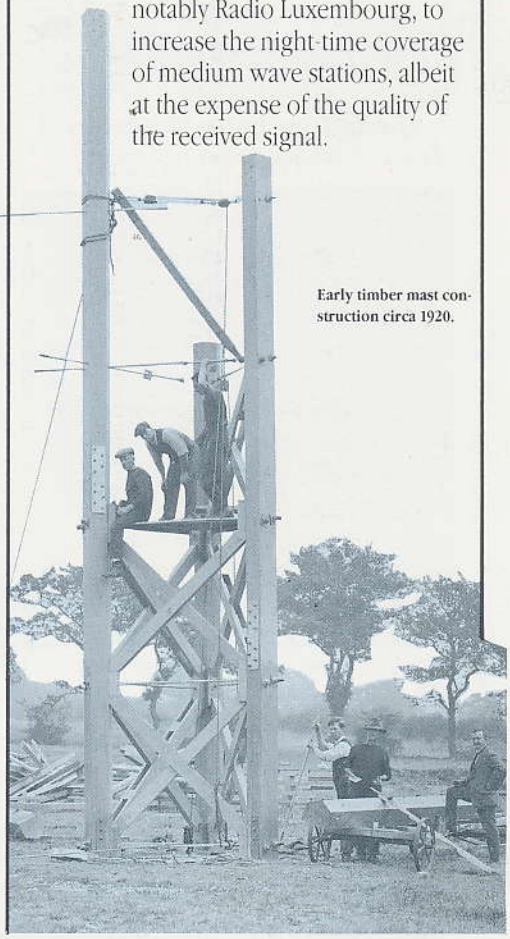
In view of the fact that all the world's earliest stations broadcast on long wave, it is ironic that Droitwich is now one of only a handful still to do so. There are a number of reasons, the principal one being the difficulty of constructing efficient antennas to radiate at these frequencies.

Medium Wave Broadcasting (300 to 3000 kHz) - Medium wave transmission was the first to benefit from the application of the 1905 discovery regarding the directional properties of antennas, which were exploited to reduce interference between stations in a wave band that was, and still is, becoming increasingly over-crowded.

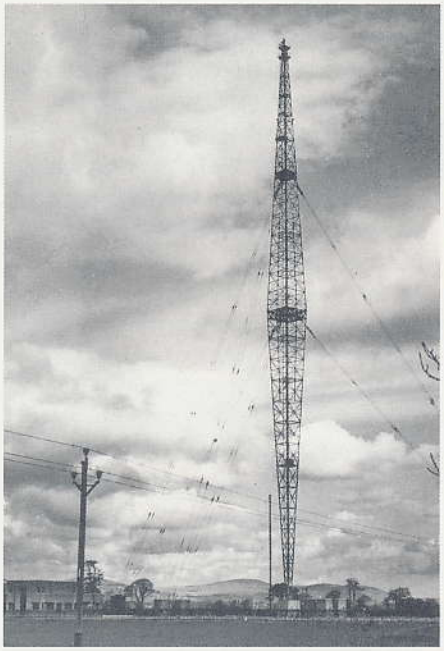
A much later m.f. development was the multiplexing, in 1970, of several different services into a single antenna, without loss of isolation. This practice resulted in a considerable saving in ground space.

At the beginning of the century, it was postulated, and later confirmed, that there were layers of gas in the upper atmosphere having refractive properties that could 'bend' radio waves back towards earth, and thus act as reflectors. This ionospheric phenomenon begins to affect broadcasting at medium wave. In this band, the sky wave propagated via the ionosphere gives rise to the 'night fading zone', in which ground wave and sky wave signals interfere with each other, giving poor reception for listeners within the zone.

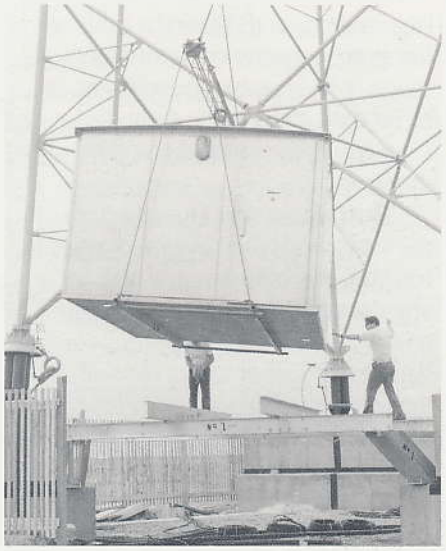
The fact that the height and density of the layers varies according to, among other things, the time of day, has been exploited by some broadcasters, notably Radio Luxembourg, to increase the night-time coverage of medium wave stations, albeit at the expense of the quality of the received signal.



Early timber mast construction circa 1920.



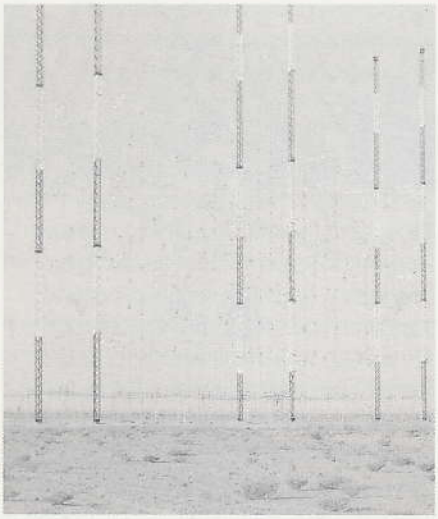
475 foot mast Radiator at Lisnagarvey. Mid thirties. *Courtesy BBC.*



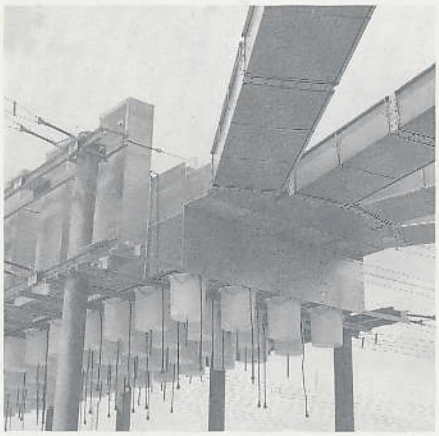
Orfordness Antenna Matching Unit 600 kW BBC European Service.

Short Wave Broadcasting (3 to 30MHz) - Unlike medium wave propagation, short wave propagation is effected exclusively in the sky wave mode.

Towards the end of the 1920s, the short wave Empire Service went on the air from Daventry. By 1933, it had become evident that the quality of reception was unacceptable to the listeners. It seemed likely that the antennas lay at the root of the trouble. Experiments followed from which it was concluded that increased gain and better directional performance were obtained using horizontal rather than the existing low vertical antennas, that no more than four horizontal radiators stacked vertically at 0.5 λ were needed, and that the lowest antenna element should be no less than 1.0 λ above ground.



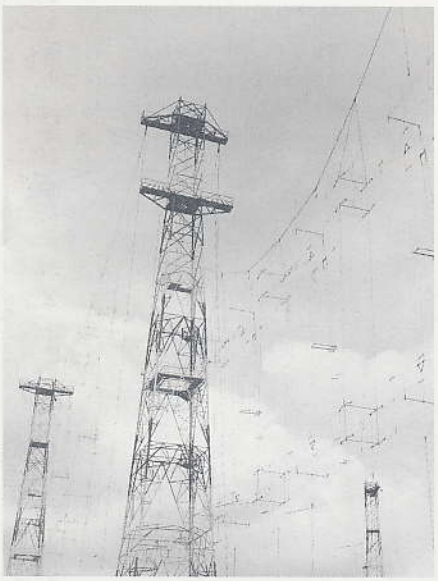
Modern Shortwave Antenna 500 kW in the Middle East.



Modern Shortwave RF Switching Station 300 ohm, 300 kW in the Middle East.

The first horizontal dipole arrays operated on single bands, but in due course these were superseded by dual-band short wave antennas – a development that provided the basis for today's technology, which makes it possible to transmit four or five bands.

By 1937, in order to compete with short wave stations used by Hitler for propaganda purposes, the Daventry station was extended. The new antenna



4 Band wideslew HF Antennas at BBC station Singapore.

curtains, for which Marconi's supplied the working drawings, were composed of either two or four vertical stacks of half-wave horizontal elements, with four elements in each stack. An innovation was the use of stayed masts rather than towers as the supporting structures.

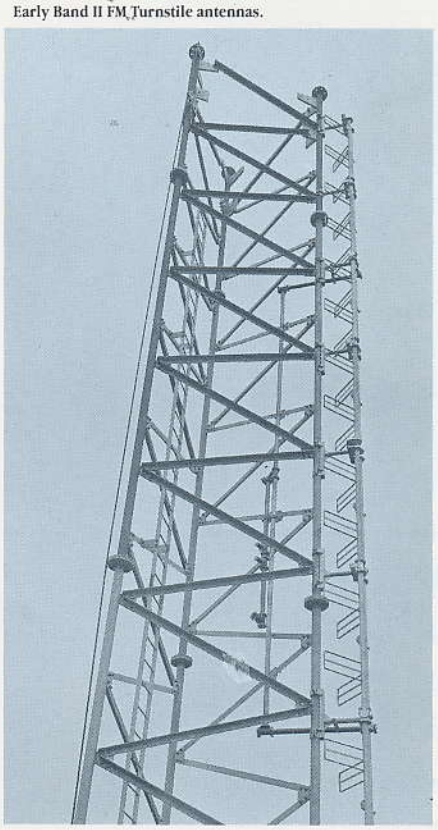
The original short wave arrays simply radiated in the direction in which they were orientated. However, in time, increased coverage using fewer arrays was obtained by electronic azimuth-slewing, effected by phasing the currents to the dipole bays. The most modern development is, arguably, the rotating curtain, where a complete multi-band antenna array is suspended from a structure which itself can rotate through 360°, enabling the antenna to be precisely aimed in any direction.

Very High Frequency/Frequency Modulation (30 to 300 MHz) - Any milestone in the history of broadcasting must of necessity be accompanied by an antenna milestone. The introduction of VHF/FM is no exception.

In early tests, two 20 kW transmitters were used, the effective radiated power of each being increased to 120kW by a slotted cylindrical antenna, which was common to both and which was horizontally polarized.

These days, it is usual to operate several high power VHF/FM transmitters into a multi-channel combiner, feeding a single directional wideband antenna system.

Early Band II FM Turnstile antennas.

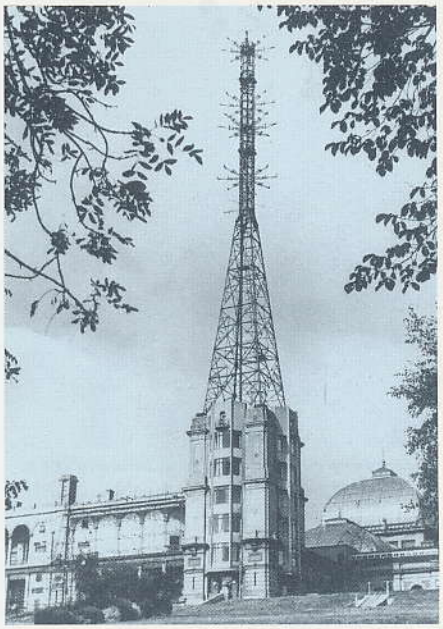


Band II high power multi-channel combining unit.

Television (300 to 3000 MHz) - In 1936, the BBC inaugurated the world's first high definition television service. The station was located at Alexandra Palace in North London. It used separate antennas for vision and sound. These were mounted on a common mast, the upper part of which was octagonal. Each antenna consisted of eight end-fed dipoles, uniformly spaced around the mast. An energized dipole was mounted behind each of the radiating dipoles to act as a reflector. The sound antenna was similar to the vision antenna except that its dimensions were appropriate to the lower frequency, and it did not require the complex arrangements for keeping the impedance constant over a wide band. In time, vision/sound combiners were developed, enabling a single antenna to be used for each service. Later, multi-channel combiners enabled several services to be transmitted on a single antenna.

Modern wideband VHF FM Band II Antenna.

In 1956, the Crystal Palace station took over from Alexandra Palace. It immediately uncovered a hitherto unknown problem. As originally designed, the station had two transmitters operating in parallel on the same frequency. Each was fed to a separate antenna. Local reception was affected by a sharp null in the vertical radiation pattern because, in certain directions, the radiation paths from the upper and lower antennas could arrive in anti-phase. In BBC parlance this was the 'Penge effect', Penge being the London suburb worst affected. The problem was overcome by combining the outputs of both transmitters in a diplexer and subsequently splitting the combined output to the two antennas.



Alexandra Palace North London, Television Antenna, 1946.

In 1955, the first ITA station came on the air from Croydon. Stations have proliferated over the years, but instead of a forest of masts and towers springing up over the country, the landscape is little changed, because the BBC and ITA (now known as the IBA) joined forces in so far as, where possible, they use common structures to support their antennas.

Television via Satellite - Many developments have taken place since the early days of television but none, perhaps, of greater significance than those relating to satellites.

The launch of the Telstar I satellite in 1962 heralded the first practical step towards achieving world-wide television coverage. Its passage around the earth was followed by huge dish antennas operating from stations in the USA, the UK and France. In those days, the satellite was visible from both sides of the Atlantic for only a few minutes on each 2½-hour orbit. With the advent of the geo-stationary satellite, which remains in the same position relative to a fixed point on the earth's surface, viewers have become accustomed to 'live' television from all quarters of the globe.

Fresh developments concern direct broadcasting, whereby signals from the satellite can either be picked up by a large antenna and relayed by cable or low-powered terrestrial transmitter to sparse, widely-scattered audiences, or be brought direct to the domestic set via small antennas mounted on private dwellings.

The Connecting Thread - Each of the wave bands used by broadcasters has presented its own particular antenna problems. But one that is common to all is that of power handling. It says much for the skill of the engineers that, since the days of the 1 kW transmitter, they have progressed to the point where antennas are capable of coping with as much as 2 MW e.r.p.

Goonhilly 4 Antenna.

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1981

Milestones in Broadcasting

No 9

TELEVISION'S GOLDEN JUBILEE

1986 is the Golden Year of television - not just in Britain but throughout the world. On November 2, 1936, the first ever public television service was launched: the Age of the Box was upon us. No one man, no one nation can claim to have 'sired' the magic new medium but to Britain goes the distinction of being the first to lead it out of the rarefied atmosphere of the laboratory and into the lives of the people. And within Britain, the honours are shared by the BBC, who initiated the service, and Marconi, EMI and John Logie Baird, who provided the systems that enabled the pioneer step to be taken.

Behind this memorable date lie over 80 years of theorizing and experimentation.

As far back as the 1850s, two-dimensional pictures were dissected into elements that were transmitted over wires and reassembled at the receiving end; thus was the principle of scanning established - a principle that was to become the root of television.

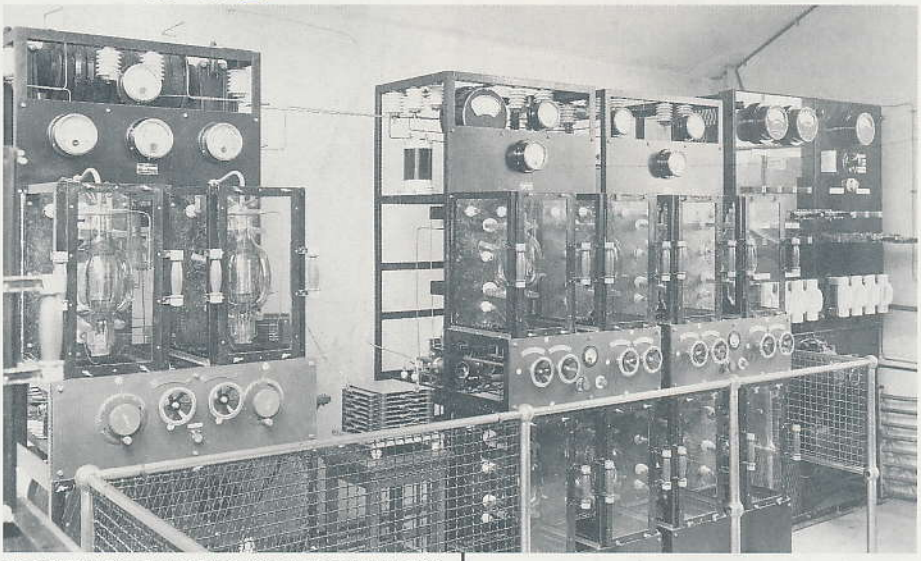
In the 1870s, it became possible, in theory, to apply the principle to three-dimensional subjects.

In the 1880s, Nipkow patented a spirally perforated scanning disc, and Weiller thought up a form of scanning by mirror drum.

In the 1890s, the cathode ray oscilloscope made its debut.

In the first decade of the twentieth century, Ambrose Fleming devised the thermionic valve, and Lee de Forest provided the means to make it an amplifier by introducing a third electrode.

Prof. Ambrose Fleming, inventor of the thermionic valve.



The 2LO Transmitter installed in Selfridges, London March 1925

In the second decade, A. Sinding Larsen proposed radio waves as the carrier of picture signals.

It can be seen that by now many strands existed which, if brought together, might form the fabric of television. World War I put a stop to any such progress, but when hostilities ceased, intensive efforts were made to produce an actual television picture.

Two lines of experiment were pursued, one based on mechanical scanning, and the other on the idea of electrical scanning, which had been propounded, almost simultaneously, by Russia's Boris Rosing and Britain's A.A. Campbell Swinton.

In the race that ensued to produce a working system, the laurels went to Britain. The man behind the breakthrough was John Logie Baird. The method he employed was that of mechanical scanning. The year was 1926. The picture that he demonstrated was not good but it had movement and a degree of light and shade.

In 1929, acknowledging the importance of Baird's work, the BBC made the 2LO transmitter available to him after normal broadcasting hours for experimental purposes, and in 1932, it fitted a studio with Baird equipment. It did not, however, propose to introduce a public service based on this low-definition system whose standards were clearly inadequate - 30 scanning lines and 12½ frames a second.

Meanwhile, advances were being made in electrical scanning. In 1926, the year of Baird's triumph, Vladimir Zworykin, an émigre from Russia to the USA, demonstrated his iconoscope - a pick-up tube that cracked the problem of charge storage.

In Britain, the electrical scanning cause was being supported by, among others, Marconi's and EMI. By the mid-thirties, it was becoming clear that the interests of the two companies were converging. EMI had produced the Emitron camera, which incorporated the iconoscope's principles, while Marconi's possessed the transmission expertise vital to the production of a complete system.

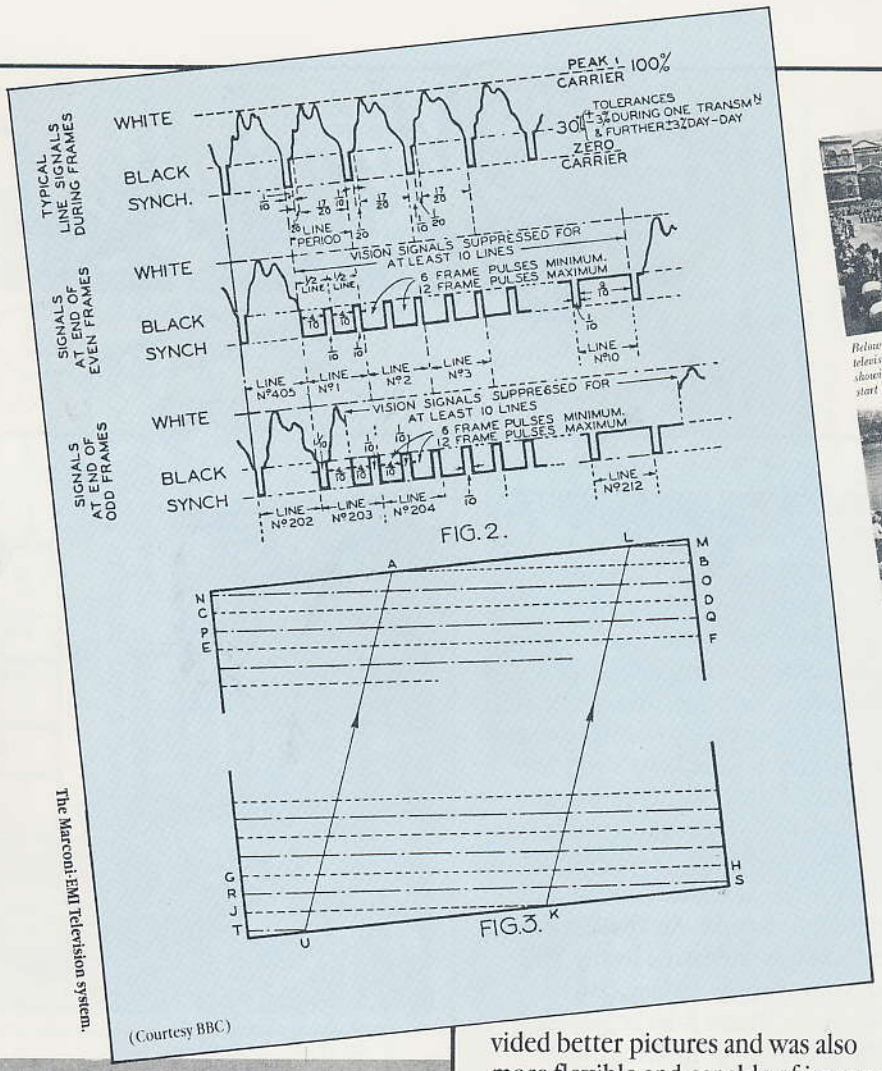
So, in March 1934, the Marconi-EMI Television Company was formed. It so happened that in the same year, the trial period that the BBC had allocated to Baird expired. The time, therefore, seemed right to come to a decision about a public service.

An independent committee under the chairmanship of Lord Selsdon was to report on the relative merits of the several systems available, although to all intents and purposes this meant the Baird and the Marconi-EMI systems.

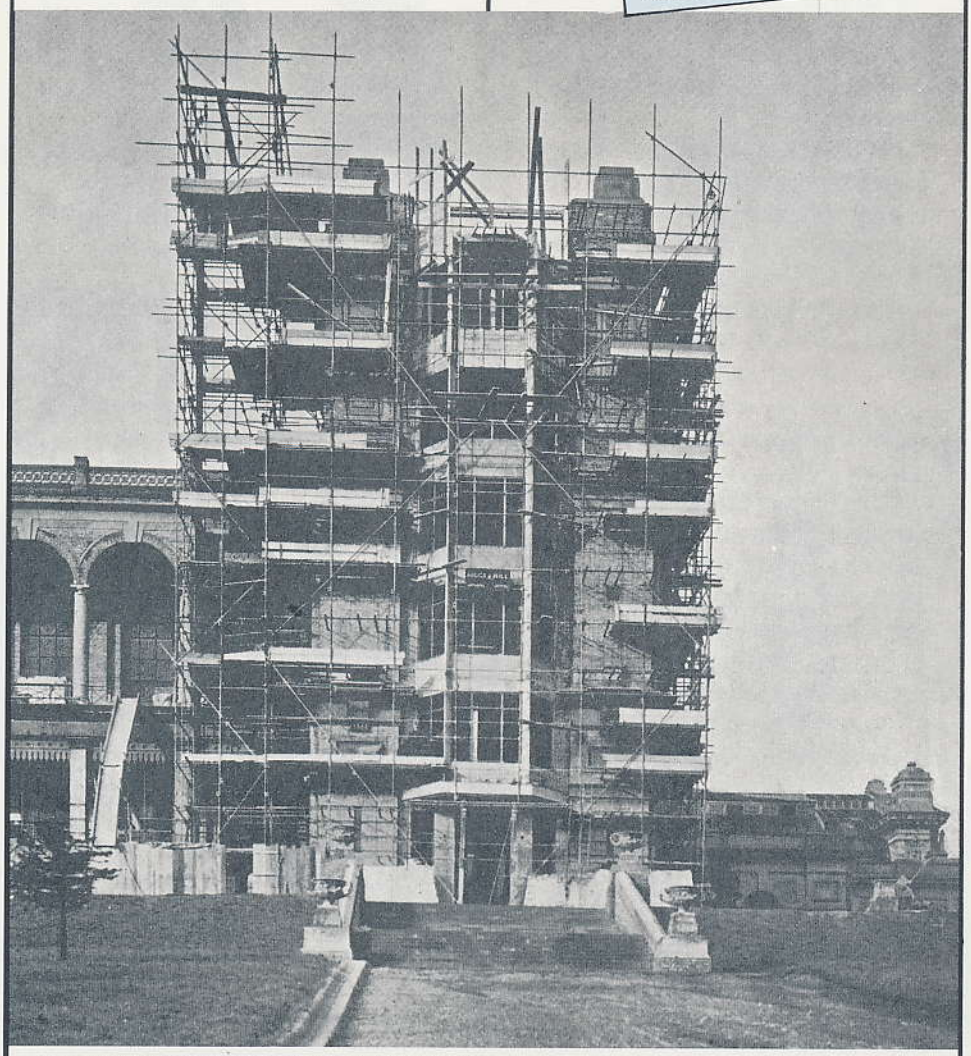
In January 1935 it was proposed that a BBC service be started, using Baird and Marconi-EMI equipment alternately for a trial period. The companies, therefore, installed their apparatus in Alexandra Palace. Each provided its own vision transmitter and shared the sound transmitter, built by Marconi's, who also designed the antenna system.

THE WORLD'S FIRST PUBLIC TV SERVICE

On that historic day, November 2, 1936, the world's first public television service went on air, transmitting for two hours daily. In due course, the Postmaster General announced the exclusive adoption of the Marconi-EMI system which, using 405 lines and 50 frames a second, provided better pictures and was also more flexible and capable of improvement than Baird's system.



Below—A launch carrying a mid television station made history showing the 1949 Boat Race start to finish



Tower under construction at Alexandra Palace. (Courtesy BBC)

CAMERAS

Two types of camera were used by the BBC after the war, both of US design, and neither perfect. Marconi's decided that it was time to step into a wider market than that of transmitters and to turn its electronics expertise to studio equipment. The marriage with EMI was, therefore, dissolved.

In the late '40s, G.E. Partington of Marconi's saw an experimental version of an RCA tube, in which RCA itself had all but abandoned interest. But Partington and his fellow engineers took up the cause, and after overcoming almost insuperable obstacles, they and the English Electric Valve Company produced the 4½-inch image orthicon camera, which was adopted by the BBC in 1957 as standard for both studio and outside broadcast, which became the world standard for black-and-white pictures, and which won the coveted Emmy award for outstanding electronic technology.

Outside Telecasts.

LINE STANDARDS

After the war, Britain retained the pre-war 405 line standard of the Marconi-EMI system. But the USA adopted 525, and most European countries 625, line standards.

While the interchange between countries of telerecorded programmes presented no difficulty, the telerecording process having eliminated the line structure, the exchange of 'live' programmes involved complex electronic processes. Even so, a systematic exchange was established through Eurovision in 1954.

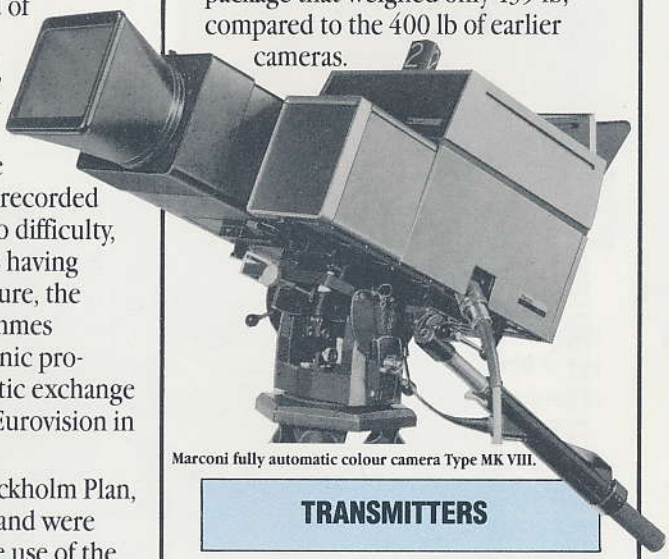
When, in the 1961 Stockholm Plan, frequencies in the u.h.f. band were allocated for the exclusive use of the 625 line standard, Britain decided to loosen the shackles that bound it to the overcrowded v.h.f. band. The BBC's second channel, which came on air in 1964, therefore transmitted exclusively on 625-line u.h.f.

'The Emmy Award.'

COLOUR

The question of colour was approached with caution in Britain, but in 1967 BBC2 launched Europe's first colour service, opting for the German PAL system in preference to the USA NTSC and the French Secam. It radiated in the u.h.f. band and used 625-line standards, setting the pattern for the BBC1 and ITA networks when they introduced colour services in 1969.

A notable Marconi contribution to the colour story was the world's first fully automatic colour television camera, the Mk VIII, which wrapped up the most advanced technology in a package that weighed only 139 lb, compared to the 400 lb of earlier cameras.



Marconi fully automatic colour camera Type MK VIII.

TRANSMITTERS

In 1956, the veteran Marconi Ally Pally transmitting station was superseded by an immensely more powerful one (also Marconi's) at Crystal Palace, It had an effective (vision) radiated power of 200 kW, served a population of 13 million, and was the most powerful Band I station in the world.

The two 15 kW transmitters that worked in parallel and fed into a high-gain antenna system to achieve this distinction went into well-deserved retirement in January last year. From that moment it was no longer possible to receive the colour programmes on 405-line, monochrome sets.

By 1966, virtually total coverage of Great Britain had been achieved through a network of new high- and medium-power transmitters and relay stations.

Also in the 60s, the opening up of the u.h.f. band led to the building of so many new transmitters that unattended operation and remote control became imperative in order to counter the shortage of skilled engineers. Once more technology took a step forward in order to meet the need.

ANTENNAS

In 1936, the Alexandra Palace station used separate antennas for vision and sound. They were mounted on a common mast and each consisted of eight end-fed dipoles, behind each of which was an energized dipole to act as a reflector. The wound antenna was similar but its dimensions were appropriate to the lower frequency.

At Crystal Palace, the antenna design led to interference which became known as the 'Penge effect', and which was overcome by combining the outputs of both transmitters in a diplexer, and subsequently splitting the combined outputs to the two antennas.

Many developments have taken place since those early days. While each wave band has presented its own antenna problems, the one that has been common to all is that of power handling. It says much for the skill of the engineers that they have progressed to the point where antennas are capable of coping with as much as 2 MW e.r.p.

SATELLITES

Much could be written of the developments that have taken place during half-a-century of television: studio building complexes, outside broadcasting, telecine, standards conversion, video recording and many other subjects line up for honourable mention but in limited space, preference must be given to space itself, for by far the most significant factor to affect the future of the medium is the satellite.

The idea that the moon might be used as a reflector was mooted shortly after the war. It seemed far-fetched, but in 1962, a surrogate moon, *Telstar I*, went into orbit, and signalled the first practical step towards world-wide television coverage.

Telstar was of academic interest only to most people. It orbited the earth every two-and-a-half hours, and was visible from both sides of the Atlantic for only a few minutes during each orbit.

'Bermuda Standard A Earth Station.'

In 1965, however, a geo-stationary satellite was launched for the communications media, including television, and subsequently audiences have become used to seeing events televised 'live' from all parts of the world.

These days, the idea of direct broadcast into the home via satellite is engaging the attention of engineers, authorities and governments. The issue is politically contentious, for the small domestic antennas that are envisaged could be made to point in any direction, and who knows what propaganda-laden programmes might meet the eye of the beholder?

PROGRAMMES

Programming is a subject that must surely claim a place in any resume of television's first fifty years.

'Early Drama.'

Drama in one form or another was a 'natural' from the start, and has always been the mainstream of TV programmes. In the early days it was transmitted 'live' - a practice that is attended, even now, by all manner of hazards. The use of film stock as an alternative, and, later, the advent of telecine and the video tape recorder took the pressure off actors and producers alike, although in Britain and Europe at large, 'live' performances still survive to some extent.

Reporter at Work. (Courtesy IBA)

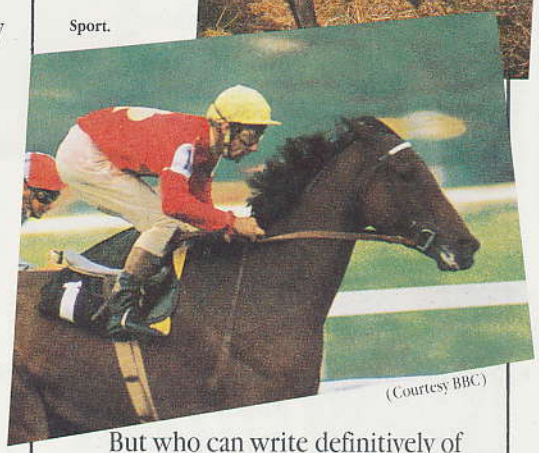
In the broad category of drama, it is probably true to say that no country in the world has equalled the quality of programme put out by Britain.

Television as a news purveyor started off with problems. Where radio could offer real-time eye-witness commentary simply by connecting a reporter's phone call into a transmitter, television could only show an image of a news presenter reading from a script about events that had already taken place.

These days, a compromise mixture of technologies is used to provide the reporter with the tools of his trade: television cameras are becoming widely used, especially with the advent of built-in recorders, while cine film is popular for major international events. Perhaps the ultimate, (for the time being at least) is a truly portable satellite station, enabling an instant link to be set up between the studio and a news scene anywhere in the world.

Against the background of early news programmes, others evolved that have become part of our way of life - current affairs and investigations, for example, which provide the opportunity for men and women of all levels of experience, intellect and education, and of all races and creeds, to express their views in a way never before dreamed of, even by radio; sports, which have reached the public through the good offices of cine cameras, built-in television studios in stadia and like buildings and, now, through outside broadcast vehicles, which bring immediacy to many important occasions other than sporting events, and also enable 'live' drama to go on location.

'Live Drama.' (Courtesy IBA)



Sport. (Courtesy BBC)

But who can write definitively of programming? Like everything else in television, it is an on-going story. In Marconi's we are proud of the part we played in the gestation period of television; of the part we played at its birth; of the part we have played during the fifty years that have followed. We are confident that we shall be making contributions of similar magnitude for the next fifty years ... and beyond.

Marconi

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1981

Milestones in Broadcasting

No 10

This series, which is now drawing to a close, has thrown up many names associated with advances in broadcasting, and we now present, in slightly greater detail, the achievements of a selected few - space, unhappily, preventing due honour being paid to all.

But what has happened? All these men are dead. Where are today's names? Is technology standing still? Are there no more inventions, no more milestones in broadcasting?

These questions are patently absurd. It is simply that milestones these days are reached by teams of scientists and engineers. Certainly there are still inspired individuals but their identity tends to be concealed within the team. If for no other reason than that of cost, the era of the 'garret inventor' is over.

George E. Partington

George E. Partington 1916 - 1963

Partington's contribution to the history of broadcasting lay in his dogged search for perfection in the early days of television camera design.

In 1947, as a senior engineer of Marconi's Wireless Telegraph Company he visited the USA. At RCA's Lancaster plant, he saw an experimental image orthicon, which had originally been developed for the US Navy. The tube incorporated a light-sensitive mosaic of 4½-inch cross section instead of the standard 3-inch. It had many disadvantages: it was physically unwieldy, requiring a long camera housing and long lenses, while its sensitivity was considerably lower than that of a 3-inch tube. Its sole merit was its low noise performance.

As RCA had just developed the successful Vidicon photo-conductive camera tube, it all but abandoned work on the 4½-inch image orthicon, leaving only one man, O. Schade, to continue with its development.

Later that year, Partington returned to RCA, where Schade gave a demonstration of the tube. It was microphonic and had poor target but Partington reported that it was the finest picture he had ever seen - at least in areas where the target was good.

He succeeded in persuading his chief to authorize development of the tube but, owing to company reorganisation, and its resultant upheavals, action was delayed until 1951.

There followed a nightmare period in which the English Electric Valve Company, who were developing and manufacturing the tube, and Marconi's, who were designing and manufacturing the overall camera, ran into countless problems.

Not until July 1955 did the BBC put the camera into studio use. In 1957, it bestowed the ultimate seal of approval by standardising on the 4½-inch image orthicon for both studio and outside broadcasting use - a step that was followed by countries throughout the world. In 1961 it won the USA's coveted Emmy award for Marconi, EEV and RCA.

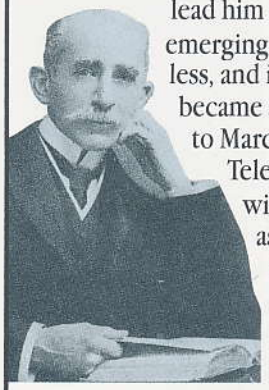
In 1956, Partington was appointed deputy chief television engineer, and in 1959 became chief engineer of Marconi's Broadcasting Division - a position he held until his death.

John Ambrose Fleming 1849 - 1945

Fleming graduated with a BSc degree from the University of London in 1870. He taught science at Rossall School; worked at the Royal College of Chemistry; became science master at Cheltenham College; worked at Cambridge under Professor James Clerk Maxwell; was the first professor of mathematics and physics at University College, Nottingham, and in 1881, when electric lighting began to attract public attention, was appointed electrician to the Edison Electric Light Company of London. He held this position for the next ten years, while at the same time advising many city corporations on electric lighting matters.

In 1885, he was appointed the first professor of electrical engineering at University College, London - a chair that he occupied for more than 40 years.

It was natural that his work should lead him towards the emerging science of wireless, and in 1899 he became scientific adviser to Marconi's Wireless Telegraph Company, with whom he was associated for more than 25 years.



John Ambrose Fleming

He was soon made aware of the capricious nature of a coherer as a detector of wireless waves, so decided to apply his knowledge of the physical phenomena of the incandescent lamp in an attempt to find an alternative. The result was the most memorable achievement of his life - the 'oscillation valve', which was patented in 1904.

It derived from experiments in which he set up an oscillating circuit with two Leydon jars, a wired wooden frame and an induction coil. A second circuit included in incandescent lamp and a galvanometer. Both circuits were tuned to the same frequency, oscillations were started in the primary circuit and a steady d.c. current passed through.

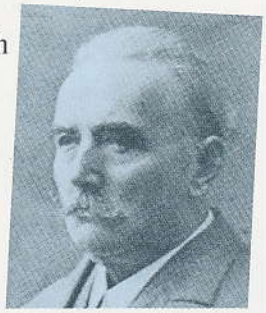
Fleming was knighted in 1929.

Paul Nipkow 1860 – 1940

Nipkow, who was educated at local schools in Lauenburg and Neustadt, became interested, early in life, in telescopes, optics and the telephone. This led him to think about the possibility of sending pictures over wire.

On Christmas Eve, 1883, he hit on the idea of a perforated spiral distributing disc or scanner. The Nipkow disc, which was patented in January 1894, was the basis of all scanning systems up to the time that electronic scanning was introduced in the late 20s. It is remembered as the device that literally spun television into being.

In 1884, however, there was no wireless. Hertz had not yet propounded his great theory; Marconi had not yet realised it in practice. Nipkow's television could be transmitted only over wire. 'How' he asked many years later, 'could such an outlandish idea as pictures through the air have come to a modest student of philosophy?'



Paul Nipkow

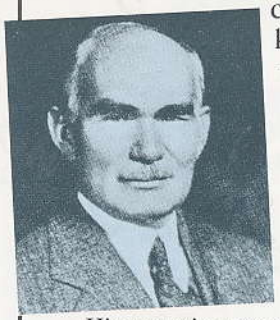
Nipkow's scanner lay in a state of suspended animation for the next 40 years, and, while wireless was being developed by Marconi and others, Nipkow turned his inventive talents to producing a practical system for making railway traffic safe.

He then chased another phantom - the use of a set of paddle wheels on an airplane. Instead of their being lined up parallel, he arranged them to swing around in various directions, enabling the flying machine to be steered in any direction - vertically straight, obliquely up, forward or backward - without shifting the rotation of the motor. In 1933, he wrote, 'They are building an airplane of this type in Berlin right now.'

Nipkow lived to see the cathode ray tube used as the television scanner, and to see his disciple, Baird, drift into comparative obscurity. Unlike many who had trodden the mechanical path which he had opened up, he was quick to concede that the c.r.t. had 'the most prospect for realisation.'

Lee de Forrest 1873 – 1961

In 1899, de Forrest, having graduated from Yale, went to Chicago to work for the Western Electric Company in the dynamo department. But his interest lay in wireless, and in particular with the problem of the coherer, which he knew was the weak link in the wireless circuit.



Lee de Forrest

His experiments took him down many avenues; he searched for the response to electrical vibrations in a gas flame; he developed a self-restoring coherer, calling it a 'sponder' or 'electrolytic anti-coherer'; he formed a company, which collapsed after some years. He then returned to his search for a new detector.

Fleming's valve detector or rectifier had been a mighty advance. But it could not relay or amplify. In seeking to make the device an amplifier, de Forrest connected a battery in circuit with the plate and filament. Amplification was undeniable but slight. He then added a zigzag piece of platinum wire, which he called the grid, between the filament and plate. The result was the audion - the three-electrode thermionic vacuum valve: a generator, a detector and an amplifier of Hertzian waves.

The effect on radio was tremendous. But there remained the challenge of finding circuits in which the valve would give its best performance. De Forrest feared that, just as his small modification had transformed Fleming's valve into a tube of unlimited potential, so it might fall to another to revolutionise the audion and its efficiency merely by altering the wire in the hook-up. Certainly hundreds of experimenters set off on the trail.

De Forrest joined the search, but it took years of litigation before, in 1934, the US Supreme Court upheld his claim as inventor of the regenerative circuit.

Vladimir Kosma Zworykin 1889 – 1982

Born in Russia, Zworykin took a course in electrical engineering in Leningrad, where he studied under Boris Rosing, professor of physics, and one of the first to recognise the possibilities of cathode rays as applied to television.

Vladimir Kosma Zworykin

During World War I, Zworykin worked on wireless in the Signal Corps of the Russian Army. After the war, he emigrated to the USA, and in 1920 went to work in the Westinghouse Electric and Manufacturing Company's research laboratory in Pittsburg. He achieved his PhD in 1926 with a thesis entitled 'The Study of Photoelectric Cells and their Improvement.'

Much preoccupied with the subject of television, and resulting from the work he had carried out during the preparation of his thesis, he perfected what he called the 'Iconoscope', the purpose of which was to observe the scene to be transmitted - *eikon* being the Greek word for image, and *skopon* meaning to watch. At the receiving end, the 'Kinescope' observed the motion - *kinema* being the Greek for movement.

Zworykin's invention enabled television scanning to be effected electronically, and was demonstrated in 1924.

In 1930, he joined the research staff of the RCA Manufacturing Company, later becoming director of the corporation's laboratories at Princeton.

After setting the new medium of television firmly on the right road, he and his staff developed an electron microscope, capable of magnification up to 100,000 diameters and opening up hitherto unseen worlds to scientists. From that he turned to the development of an electron-scanning microscope, a diffraction camera, an electronic clock and electronic calculating devices.

Of all his inventions, the Iconoscope is likely to be the one best remembered, and of it he said, 'What I have done in ten years of research is to emulate the human eye.'

Guglielmo Marconi

Guglielmo Marconi 1874 – 1937

Marconi, generally acknowledged as the Father of Wireless, first succeeded in transmitting wireless signals over a few feet of space in 1895, using two insulated plates, separated by a spark gap, consisting of two small spheres connected across the secondary of an inductance coil, the primary of which included a battery and a Morse key.

That simple circuit proved to be the seed from which a whole new era blossomed - the Electronics Age.

Marconi came to England from Italy in 1895 and the following year formed the company that is now known as The Marconi Company: the first wireless company in the world.

By harnessing Hertzian waves and using them as a medium of communication, he ended the isolation of those at sea; he spanned the Atlantic with signals in 1901, confounding those who believed that range was limited by the curvature of the earth's surface; he enabled airmen to communicate with the ground and with each other; he drew the countries of the British Empire together in a shortwave 'beam' system of communication; he opened the way for broadcasting, television, radar and the countless benefits that are now enjoyed through the application of electronics to everyday life.

There are some who claim for others the honour of 'inventing' wireless. Marconi made no such claim for himself. He was every ready to acknowledge that he used the theories and discoveries of others in his own experiments. But one thing is certain: he was the first man in the world to produce a practicable system of communication without wires.

Because it is impossible to encompass in so short a cameo the achievements of such a giant among men, let the unique gesture of his contemporaries, when his death was announced, speak of the esteem in which he was held: wireless stations throughout the world closed down for two minues. The 'ether' was as quiet as it had been before Marconi.

John Logie Baird

John Logie Baird 1888 – 1946

After graduating from Glasgow University, Baird worked as an electrical engineer and assistant superintendent of the Clyde Valley Electrical Power Company.

In 1923, he became interested in the idea of television, and in 1926 became the first man in the world to demonstrate pictures embodying some degree of light and shade, and having movement. The system he used, which was mechanical, was based on Nipkow's scanning disc, and the demonstration was given to members of the Royal Institution.

In 1928, he hit the headlines with the first television broadcast across the Atlantic. The picture was imperfect but undeniably an image.

In 1929, the BBC made its 2LO transmitter available to him out of normal broadcasting hours for vision-only experiments, and in 1935 fitted a studio in Broadcasting House with Baird equipment.

His transmissions were capable of being received only on sets of his own design - Televisors.

By 1934, it was clear to the BBC that, in due course, it would have to provide a public television service. As far as supplying a suitable system for the purpose was concerned, Baird and the Marconi-EMI Television Company were the principal contenders, the latter having developed an electronic system.

On 2 November 1936, the BBC launched the world's first public TV service, using the respective systems on alternate weeks. Three months later, the Marconi-EMI system was adopted exclusively.

Baird was once described as working '... in accordance with the best traditions of the "garrett inventor"'. And for all that he dropped out of the limelight almost overnight, his place in the history books is assured. He is almost universally acknowledged as the father of television, and if he did nothing more, he unquestionably stimulated others to research, and ultimately produce, a better system than his own.

David Sarnoff 1891 – 1971

Born in Russia, Sarnoff at first seemed destined to become a Jewish scholar of the Talmud. In 1900, he and his family emigrated to the USA, of which he eventually became a citizen and where, while still at school, he helped to swell the family coffers by selling newspapers, running errands and singing in the synagogue.

In 1906, he took a job as messenger boy for a telegraph company, and with his first earnings bought a telegraph instrument. Becoming proficient in Morse, he joined the Marconi Company of America as a radio operator. During his service with the company he also became operator of the world's most powerful radio station, established by John Wanamaker.

David Sarnoff

On April 14, 1912, Sarnoff picked up the *Titanic* distress signals, and remained at his instrument for 72 hours, receiving and passing news. He was rewarded by the Marconi Company with rapid promotion.

In 1916, he proposed the 'radio music box', or commercially marketed radio receiver. His idea went on ice for several years but in 1921, as general manager of the Radio Corporation of America (RCA), which had been created from the Marconi Company of America, he demonstrated the market potential of his idea by broadcasting the Dempsey-Carpentier fight. Within three years, RCA sold more than $80 million worth of receivers.

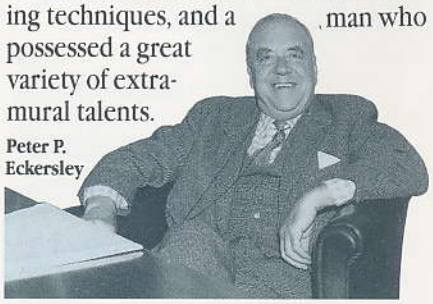
In 1926, he formed the National Broadcasting Company (NBC). At this time, he was aware of the potential of television, and in 1928 launched an experimental NBC TV station for research purposes.

Sarnoff became president of RCA in 1930. By 1939 he was able to demonstrate television successfully at the New York World's Fair. Development was delayed by World War II, during which he served on Eisenhower's staff as communications consultant, and was promoted to brigadier general.

Sarnoff was appointed chairman of the board of RCA in 1947 and retired in 1970.

Peter P. Eckersley 1889 – 1963

Eckersley was one of the main architects of early British broadcasting techniques, and a man who possessed a great variety of extra-mural talents.



Peter P. Eckersley

As a schoolboy, he was initiated into the mysteries of wireless by his elder brother, Tom, who became a brilliant physicist and mathematician.

In 1915, he enlisted in the Royal Flying Corps as a wireless equipment officer. At Brooklands, where he trained under Major C.E. Prince, he witnessed the historic 'first-ever' ground-to-air wireless telephony transmission.

After the first World War, during which he attained the rank of Captain, Eckersley joined the newly formed Aircraft Department of Marconi's Wireless Telegraph Company, and became head of the experimental section of the designs department.

When the Radio Society of Great Britain invited the company to design, build and operate an experimental wireless station for the benefit of its members, the task fell to Eckersley's group. The result was the famous 'Two Emma Tock' (Station 2MT) at Writtle, near Chelmsford, which began transmissions on February 14 1922. In Eckersley's hands, the weekly half-hour, which was all that the Postmaster General would grant, turned into more than an invaluable checking reference for the amateurs, it became a source of entertainment, for Eckersley proved to be a natural and witty broadcaster, with a talent for ad libbing.

In February 1923, he was invited to become the first Chief Engineer of the newly formed British Broadcasting Company - a position he retained when the company became a corporation, retiring for personal reasons in 1929.

With no precedent to guide him, his engineering abilities and his vision were given full scope, and station after station was rapidly put into service. Because his interest in programme content was as great as his interest in engineering, his schemes were conceived against a backcloth of understanding of the listeners' needs.

He implemented new techniques such as the simultaneous broadcasting system, and was the instigator of the first international conference called to allocate wavelengths and transmitter powers.

His major achievement, perhaps, was the 'Regional Scheme', which provided twin high-power stations radiating alternative programmes on different wavelengths.

Henry Joseph Round

Henry Joseph Round 1881 – 1966

When Round joined Marconi's Wireless Telegraph Company in 1902, he was seconded to the American Marconi Company's training school for wireless operators, where, in his spare time, he devised dust-core inductances and the elements of direction finding.

In 1907, he published findings that went into limbo until 1933, when they were resurrected and became known as the 'Lossev Effect' - later to bear fruit in the form of semi-conductor devices.

Back in England in 1908, he became Guglielmo Marconi's personal assistant. Prior to World War I, his most memorable achievement was the 3-electrode, gas-filled tube, patented in 1914, and used to demonstrate radio telephony.

During the war, seconded to Intelligence by the War Office, he did outstanding work on radio direction finding and shipborne and airborne radio telephony - work for which he was awarded the Military Cross.

Returning to Marconi's after the war, with the rank of Captain, he developed the first wireless telephony station to be heard on the other side of the Atlantic.

Three years later, in 1922, he designed the 2LO transmitter, which became the British Broadcasting Company's first station to go on the air.

As Marconi's Chief of Research, he developed the 'straight eight' receiver, a gramophone recording system, a large-audience public address system, the artificial echo techniques for studio productions, new types of microphone, gramophone pick-ups, amplifiers, sound recording systems, antenna systems and many other inventions, including the screened grid valve and the r.f. pentode.

Round resigned from Marconi's in 1931 but from 1937 until his death was the company's technical consultant - except during World War II, when he worked for the Admiralty on ASDIC.

During his life, he filed 117 patents, and during his last 16 years he invented new magneto-strictive devices; permanently magnetised nickel transducers; the first belt-recording system for echo sounding, and anti-fouling devices for ships.

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