

THE BROADCASTING YEARS

1 The 1920s

1922

THE WRITTLE STATION, 2MT

Having carefully considered the petition presented to him by the Committee of the Wireless Society of London only a few weeks before, the Post Master General announced on January 25th 1922 that he had authorised Marconi's Wireless Telegraph Co. Ltd. to arrange a short weekly programme of wireless telephony and Morse calibration signals for the benefit of the several thousand amateur wireless experimenters around the country who were eagerly waiting for something interesting to listen to. The service would be provided by Marconi's subsidiary, the Marconi Scientific Instrument Co. Ltd., from an experimental station housed in a wooden hut in the Essex village of Writtle, a few miles from Chelmsford and would have the call-sign 2MT ("TWO-EMMA-TOC"). This company had been set up by Marconi's on November 1st 1919 to repair and bring up to date all obsolete apparatus belonging to Marconi's and to manufacture and sell amateur telegraphic and telephonic equipment under licence. During the first week of January 1922, they had exhibited components, valves, batteries and receiver units including a complete set of six, at the Model Engineer Exhibition held at the Horticultural Hall in London. Also at the exhibition were stands from six other wireless manufacturers who displayed domestic wireless equipment designed solely for "amateur use in the home". The other exhibits were by G.Z. Auckland & Sons, a selection of components for the amateur to build "a domestic wireless installation"; Bower & Co., components and French 'R' valves; Burnham & Co., their Ultra-Five receiver and honeycomb tuning coils, together with the actual transmitter used to broadcast the Dutch concerts from the Hague; Economic Electric Co., various pieces of electrical and wireless apparatus; A.W. Gamage, components and unit receivers, and F.O. Read & Co., HF and LF amplifiers and other wireless apparatus. Leslie McMichael also had a stand at the exhibition, but showed almost exclusively ex-Government apparatus from the Disposal Board War Office including Townsend wavemeters, Mark III Tuners, condensers and valves.

The Writtle station began its regular Tuesday night broadcasts on February 14th at 7pm. From 7pm to 7.25pm, three five minute sections of C.W. Morse were transmitted on 1,000 metres long-wave (the same wavelength allocated to amateur transmitters) with a power of 1 kW, 500 watts and 250 watts respectively. This was followed at 7.35pm by an opening concert of songs by Robert Howe and records played on a Cliftophone gramophone, transmitted on the relatively long wavelength of 700 metres with a power of 250 watts. The wireless telephony transmissions were strictly limited to a maximum of half an hour per week and like the Morse transmissions were divided into sections. Between each section was a break during which the Writtle station closed down for a couple of minutes so that the announcers could maintain a listening watch on 2MT's wavelength for any important Government messages or "S.O.S." calls. For the benefit of wireless enthusiasts who wanted to try to tune-in to the test broadcasts, *Wireless World* had, a week before, published full details of the opening programme. Excellent reception was reported by those living within about a 15 mile radius of Writtle who were able to pick up the broadcasts on simple crystal sets while as far north as Forfar in Scotland, loud-speaker reception was obtained on a 5-valve set although signal fading was quite marked. Another, more serious problem encountered by many

of those tuning-in on valve receivers was interference, and this was especially experienced by amateurs living on the English Channel coast who were often prevented from receiving 2MT because of jamming from ship and coastal-based Naval wireless installations. Around the London area, the first three items of the opening concert were heard quite clearly, although after that, harmonic interference from the Post Office's arc transmitter at Leafield on 12,200 metres entirely wiped them out.

Interference continued to be a problem and so a few months later, on Tuesday May 30th, 2MT's 700 metre wavelength was changed to 400 metres medium-wave and the rather dreary section of Morse calibration signals on 1,000 metres long-wave was dropped altogether, with the wireless telephony section opening the programme at its new time of 8pm. 2MT's new medium wavelength meant that the circuit designs of long-wave only receivers had to be modified in order for Writtle to be received. This change would be necessary anyway as plans had been announced by the P.M.G. earlier in the month proposing the establishment of a national domestic broadcasting service which would employ a number of wireless telephony transmitting stations using allocations between 350 and 425 metres on the medium waveband: soon to become popularly known as the 'Broadcast Band'.

Until the Writtle station closed down on January 17th 1923, the 'ether' around the Essex area was filled with "first class amusement", which included on October 17th, the first ever wireless play: a short scene from *Cyrano de Bergerac* directed by a Miss Agnes Travers.

The station's Director and Chief Announcer was Captain Peter Pendleton Eckersley. An R.F.C. Wireless Equipment Officer during the war, he later joined the Experimental Section of the Marconi Company's Aircraft Department and went on to become the B.B.C.'s Chief Engineer. It was largely due to Eckersley's boyish enthusiasm and imaginative personality that these Tuesday evening programmes became compulsive listening-in and although the Writtle station operated for less than a year, it was a tremendous success and helped to convince many, including the Post Office, that broadcasting as an entertainment had great public benefit and, as a new art, had very definitely arrived.

THE BRITISH BROADCASTING COMPANY

Shortly after Writtle went on the air in January, the Post Office granted Marconi's a licence for the installation of a 100 watt wireless telephony broadcasting station at their Head Office at Marconi House in the Strand, London. Its call-sign was to be 2LO.

The transmitter and a single 20 ft. x 20 ft. studio were housed on the top floor of Marconi House in what used to be an old cinema theatre, and from here the first experimental tests began at 9.25pm on the night of Thursday May 11th with the opening message, "Hullo C.Q. 2LO calling. Please stand by." There then followed a rather ambitious outside broadcast of a boxing match between Carpentier and Lewis at Olympia in West London. The commentary was relayed live by telephone by *Daily Mail* reporters at the ringside and was sent out via the transmitter at Marconi House on 360 metres. However, there was not very much to describe as Carpentier won after only

A.J.S. 4-valve battery receiver, 1923, with an S.G. Brown Model H1 horn loud-speaker.



one minute of the first round, although the general opinion afterwards was that the broadcast had been a great success, brief as it was. 2LO was not alone in broadcasting the fight as the Radio Communication Company at Slough (call-sign 2AA) had their own commentator, Jack Dempsey, at the other end of a telephone line at Olympia.

Initially, subsequent test broadcasts from 2LO were restricted by the Post Office to hour-long studio programmes of speech, sent out in the late morning or late afternoon to a limited reception area around London. Like Writtle, periods of a few minutes silence were included which had the advantage of allowing the engineers time to smooth out any technical problems which might have (and usually had!) occurred. The station's Chief Announcer was Arthur Burrows, who in mid-November, when 2LO was inaugurated as the first station of the British Broadcasting Company, became its Director of Programmes. He was soon to become one of the famous Wireless Uncles: 'Uncle Arthur' to the thousands of children listening to him on Children's Hour every evening.

On May 18th, the first of a series of meetings was held between the Post Office and the representatives of firms interested in the Post Master General's proposed broadcasting plan, with the idea of forming a *single* licensed broadcasting company rather than having many firms operating their own separate stations, each under a different licence. In America, where controls were non-existent, the situation had become chaotic with a very large number of stations transmitting on a narrow band of wavelengths, and the Post Office naturally sought to prevent a similar situation arising in Britain. Also, any licence granted to such a joint company would only be for two years, thereby giving the Post Office the safeguard of being able to review the entire situation after a limited period. The geography of the British Isles played an important part too in this decision. Given that each station was to be of a certain power and range, it was thought impossible to operate more than eight transmitters in mainland Britain without causing interference between them.

From mid-summer, more variety was introduced into the broadcasts from 2LO with programmes of concerts and musical evenings now permitted. The original power of around 100 watts was raised to 1.5 kW and the reception range of the transmissions greatly extended to encompass many more of the 11,000 amateur 'listeners-in' who had already been issued with Experimenter's Licences.

In September, from the 2nd to the 8th, the International Radio Exhibition took place at the Central Hall, Westminster. This was the first exhibition open to the public solely devoted to wireless and was supported by over 40 British and foreign manufacturers showing complete receivers, components and accessories. At the end of the month, from September 30th to October 7th, the first All British Wireless Exhibition was held at the Horticultural Hall, London SW1. Supported by 52 British wireless manufacturers, it was then the most representative trade gathering ever to be held in Britain and was aimed primarily at the requirements of experimenters and amateur listeners-in. The general public flocked to the Hall, not to make a critical examination of the apparatus on show, but to witness the new phenomenon of broadcasting itself.

Among the exhibits on show were the first three sets from Marconi's made specifically for domestic and not for Government, marine or other official use. They were the Marconiphone V2 2-valve receiver (fig. 60), the Marconiphone Crystal A crystal set (fig. 64) and its smaller version, the Marconiphone Crystal Junior (fig. 68). 'Marconiphone' was the trade name used until the end of December 1923 by Marconi's on all their broadcast receivers produced for the domestic market. The Marconiphone Company Limited was set up on December 29th 1923 and

within a couple of days all the business in connection with the sale and distribution of Marconiphone receivers and accessories together with the Marconiphone trade name had been transferred to them (see 1923).

The original chassis of the V2, the Crystal A and the Crystal Junior were not in fact made by Marconi's but by the firm of Plessey, who up to that time, using two rooms in shared premises in Holloway, had specialised in the manufacture of tools and jigs. Early in 1922, Marconi's had been looking for firms to manufacture domestic wireless sets under contract, and in July, Plessey won an order from them for 5,500 crystal sets and 5,000 V2 valve receivers. It was worth £30,000 and transformed Plessey overnight, establishing them in the forefront of the emerging Wireless Industry, enabling them to quickly expand and, within twelve months, to move to a large permanent factory site of their own at Ilford.

On October 18th, the British Broadcasting Company was at last formed. It comprised 300 British manufacturers and dealers in wireless receivers and accessories headed by the so-called 'Big Six': British Thomson-Houston Co. Ltd., the General Electric Co. Ltd., Marconi's Wireless Telegraph Co. Ltd., Metropolitan-Vickers Electrical Co. Ltd., the Radio Communication Co. Ltd., and the Western Electric Co. Ltd. It was registered on December 15th 1922 and although its licence was not issued until January 18th 1923 it was retrospective and gave permission to broadcast for an initial period of two years as from November 1st 1922, two weeks before the actual inauguration of broadcasting.

The B.B.C. was a limited liability company licensed under the Wireless Telegraphy Acts to conduct a broadcasting service "to the reasonable satisfaction of the Postmaster General". It was constituted with a capital of £100,000, of which £60,000 was contributed in equal parts by the six main wireless manufacturing firms who each had representation on the Board of Governors. John C.W. Reith was appointed as General Manager of the Company, and in October 1923 joined the Board as Managing Director. The Chairman received an annual remuneration of £500, and each of the Governors received £200 - all payments free of income tax! Smaller firms were represented by Sir William Bull (Director of Siemens) and Walter W. Burnham (Managing Director of Burndept) and the remaining 40,000 £1 shares (limited to 10,000 to any one applicant) were made available to any bona-fide British manufacturer wishing to join the Company, whether it was a long-established firm with impressive factory premises or one of the growing number of 'back-room' concerns with just a few employees. Each shareholder had to pay an initial goodwill deposit of £50, although this clause was subsequently abolished on October 1st 1923. Dividends were limited to 7.5 per cent and revenue was derived both from a half share of the 10s.0d Broadcast Licence introduced on November 1st 1922 and from royalties levied on certain wireless equipment sold to the public.

And so, on Tuesday November 14th, the British Broadcasting Company first began broadcasting from their single studio on the top floor of Marconi House in the Strand. The London station retained its call-sign 2LO, and with the programmes being beamed on 361 metres from a cage aerial perched high on the roof, listeners in London and the Home Counties were soon tuning-in to the first evening's entertainment: two copyright news bulletins each of about a thousand words, and two weather reports, put out at 6pm and at 9pm. The announcer was the station's Director of Programmes, Arthur Burrows, and at the start of each programme he informed listeners-in that he would read the 'messages' through twice, first quickly and second slowly, asking them to write in and say which pace they considered better. With the official programmes over, he then began a little informal talk by saying, "You know, this broadcasting

is going to be jolly good fun!"

Both the news and the weather reports soon became important features of the B.B.C.'s daily programme. An agreement was reached with four British Press agencies (Reuter's, the Press Association, the Central News and the Exchange Telegraph Company), for them to supply a daily summary of the world's news, and the Meteorological Department of the Air Ministry agreed to supply the B.B.C. with two weather reports every night.

THE B.B.C.'S BROADCASTING POLICY

The B.B.C.'s broadcasting policy was primarily one of public service rather than of pure commercial interest, and headed by Reith, it strove for political independence and impartiality. The Company began by serving the most densely populated areas in each main part of the country first, to gauge the popularity of broadcasting and to test for future requirements. Compared to later broadcasting developments, the B.B.C. was, in 1922, using very low power transmitters and while the basic predicted range of reception had been calculated at about 100 miles, it was soon found in practice that the real limit of 'quality' reception was about 35 miles with a simple valve receiver and headphones, and only about 12 miles with a crystal set. Greater distances were obtainable at night and in special circumstances of weather and terrain, and for those rich enough to be able to afford multi-valve receivers, reception range was increased to well over 100 miles. Curious freaks of reception did occur of course: readable signals from 2LO were reported to have been received in the Shetland Isles on a 1-valve set, while nearly 200 miles away from London, reception was claimed on a crystal set at Bridlington, Yorkshire.

On Wednesday November 15th, the day after the opening of the first station, the B.B.C.'s second and third stations began broadcasting to listeners in the Midlands. They were Birmingham (call-sign 5IT) on 420 metres, owned by the Western Electric Company, and Manchester (call-sign 2ZY) on 384 metres, owned by Metropolitan-Vickers Electrical Company, each transmitting programmes of concerts and news from about 6pm to 10pm.

Both these companies had strong American connections and like Marconi's had been experimenting with wireless telephony for some time. The Metropolitan-Vickers Electrical Company had earlier in the year been given a licence to begin experimental broadcasts from their station in Manchester, having pooled their patents with those of the Radio Communication Company, who themselves were then operating an experimental broadcasting station from their works in Slough.

Earlier in October, the Western Electric Company, which was part of the Bell Telephone Group of America, had set up a 500 watt transmitting station (call-sign 2WP) in Norfolk Street, London. Later that month, the component parts of 2WP were transferred to Birmingham and installed in the works of the General Electric Company and given a new call-sign, 5IT.

At 6.30pm on December 23rd, the B.B.C.'s new station at Newcastle (call-sign 5NO) opened with an experimental transmission of concert music on 400 metres. By the close of 1922, the B.B.C. had four of its proposed eight main stations in operation, all transmitting within the Broadcast Band to an audience of nearly 36,000 listeners tuning-in on factory-made Broadcast Licence receivers, together with many thousands of amateur experimenters with home-constructed sets.

THE BROADCAST LICENCE

To legally tune to the B.B.C.'s programmes, listeners-in had first to purchase a licence; either the Experimenter's Licence for those building their own equipment at home, or the Broadcast Licence for the less technically minded who wanted a factory-made, 'ready-to-receive' set.

The 10s.0d Broadcast Licence had been introduced along with the B.B.C.'s royalty scheme on November 1st, two weeks before the inception of broadcasting. Although there were no restrictions as to the qualifications, experience or experimental objectives of the applicants, its terms did stipulate that the holder was only allowed to receive B.B.C. broadcasts on British-made equipment which had been manufactured by a member of the B.B.C. and registered and approved by the Post Office. All such equipment could be readily identified by a circular 'BBC/PMG' stamp of approval (see Appendix, fig. 907a) placed either on the cabinet or the panel of the receiver together with an engraved G.P.O. registration number. The stamp however, did not signify any guarantee of the quality of the receiver bearing it.

While the B.B.C. had not actually begun to broadcast until November 14th, this licensing measure was brought into force in advance with the aim of protecting the infant British Wireless Industry from foreign competition, as membership of the B.B.C. was open only to bona-fide British wireless manufacturers. As a contribution towards the expense involved in the erection and maintenance of suitable transmitting stations and studios and the maintenance of regular programmes, the B.B.C. was to receive a moderate royalty on all British factory-built BBC/PMG-stamped receivers, amplifiers and certain accessories sold to the listening public together with a 50 per cent share of the revenue from the Broadcast Licence.

Problems soon arose however, and continued to grow throughout the early part of 1923, as there was an unexpected and overwhelming public interest in the very much cheaper home-constructed type of receiver, whether assembled from odd components and work box 'bits and pieces' or from a commercially-made boxed kit of parts. Both the B.B.C. and the Post Office had miscalculated the appeal of home-construction and soon after official broadcasting began new home-constructors in their thousands applied for the 10s.0d Experimenter's Licence which gave them the legal right to build home-constructed sets which the Broadcast Licence did not. Armed with an Experimenter's Licence, listeners could also legally use non BBC/PMG-stamped factory-made receivers of either domestic or foreign origin. One British company, the Peto Scott Co. Ltd., even sold G.P.O.-registered receivers either with or without the stamp. Their 2-valve Broadcast Major cost an extra 35s.0d in royalties if sold stamped for use with the Broadcast Licence, although listeners could buy it un-stamped at the normal price if they had an Experimenter's Licence, thereby making quite a saving for themselves but otherwise depriving the B.B.C. of its royalty. The B.B.C. therefore were receiving no royalties on sales of un-stamped apparatus or kits of parts (commercially manufactured receivers in kit form were exempt from royalty payment), and no revenue either from the Experimenter's Licence.

In December 1922, in order to curb the rush for Experimenter's Licences, the Post Office re-defined the original terms of that licence by stipulating that it would be granted only for genuine home-made apparatus to bona-fide experimenters who actually *made* their own components. Mr J.W. Wissenden, Head of the Wireless Licence Department of the Post Office defined the term 'home-made' as follows: "Any set which does not contain bought parts such as transformers, inductances, condensers etc., built at home from raw materials by the amateur wireless experimenter constitutes a home-made set. Any major parts of the apparatus that have to be bought for the set (such as valves) have to be stamped with the B.B.C. stamp and therefore have to be of British manufacture. 'Home-made' does not mean sets that have been bought in a kit of parts or made up of wholly manufactured parts which only need a screwdriver or a pair of pliers to assemble them." Therefore, from December 1922, applicants for the

Experimenter's Licence were scrutinised with a lot more attention and an inevitable backlog soon built-up during the early part of 1923.

As well as the BBC/PMG stamp, all sets for use with the Broadcast Licence also bore a G.P.O. registration number, signifying that the circuitry of the set had been tested and passed by the Engineer-In-Chief at the Wireless Section of the General Post Office (North) London as conforming to the technical requirements laid down to prevent interference from oscillation. Before beginning production, a manufacturer had to submit an example of his receiver for testing and if found satisfactory, a registration number would be allotted to it and the set sealed, labelled and returned. All sets in the production run could then bear a BBC/PMG stamp and that particular G.P.O. registration number as long as they were identical to the sealed and registered set, which had to remain sealed and readily available at the factory in case of official inspection. (Post Office officials also had the authority to select sets from the production line and compare them with the standard model they had previously approved).

In December, *Popular Wireless Weekly* sent a reporter down to the Post Office's Wireless Section to see how the registration and approval systems were working. Half a dozen sets were lined up when he arrived and a vast amount of brown wrapping paper and packing provided evidence of how many sets had been there before. He tackled one of the department's officials with the question "Pretty busy?" and received the reply, "This broadcast business is a blessed nuisance!" "And," wrote the reporter, "what more satisfactory indication of the prosperity of the wireless trade could be desired?"

Valve receivers were of the 'tuned radio frequency' ("TRF") type, (also known as the 'straight' type) and used general purpose 'R' valves which could be used either as HF amplifiers, detectors or LF amplifiers. The ubiquitous 'R' valve (fig. 38), with its characteristic bulbous shape and 'top-pip' evacuation seal (a pinch of glass formed at the top of the valve during the air evacuation process in manufacture and common to practically all valves until 1925) dominated the domestic receiver market until towards the mid-1920s. It employed a 'pure' tungsten filament (a tiny trace of thoria was added to improve tensile strength) which required a high temperature to give the necessary electron emission (c.1,050 deg. C. - c.1,200 deg. C.). This consumed a large current from the accumulator and gave rise to the valve's characteristic feature of glowing like an electric light bulb when in use. For this reason it was known familiarly as a 'bright-emitter' and some frivolous people, on occasions when they weren't using their receivers for listening-in, instead merely connected the filaments to the accumulator and turned up the rheostats high enough to provide light to read by or even to light the room. *Wireless World* thought that this practice was extremely foolish and ought to be discouraged at all costs for it considerably shortened the valves' lives. With receivers of this period designed with valves mounted externally on the control panel, the valves' incandescence could prove rather trying on the eyes. To combat this, a device costing 8d placed on the market by a Mr R.F. Gordon of Weymouth provided one remedy. Rather similar in appearance and construction to a well-known family planning product, it consisted of a sleeve of black rubberised material which was rolled snugly over the valve, and being opaque, effectively shielded the listeners' eyes from the glowing filament. On the upper end of the sleeve was a protective protrusion which prevented the valve's top-pip of glass from damage if accidentally knocked.

In practice the 'R' valve was usually very unstable particularly when used as a HF amplifier due to a small but troublesome anode-grid capacity which could very easily be made to produce excessive feed-back and distortion. To obtain



fig. 38. 'R' Valve (actual size), by British Thomson-Houston Co. Ltd. Late 1922. A bright-emitter with a nickel-plated base. 4 ¼ in. high. Etched with the BBC/PMG stamp.

a degree of volume, the long-standing favoured method was to employ an adjustable reaction circuit in which part of the amplified energy from the anode of the valve in the aerial circuit was fed back by means of a swinging reaction coil to its grid and therefore further amplified. (The method of 'swinging coil reaction' was very popular until it was displaced by 'capacity controlled reaction' in 1927). The amount of reaction amplification was determined by adjusting the variable reaction control mounted on the panel which would sometimes be labelled 'VOLUME', although with the B.B.C.'s transmitters using very low power and with the relative inefficiency of receiving valves in general, there certainly wasn't much volume to control. Adjustable aerial circuit reaction generally gave better results than other types of circuit but was prone to cause severe oscillations in the receiver's aerial with only the smallest overuse of the reaction control knob by an unsuspecting or novice listener-in. This oscillation would then be radiated locally causing 'howling wails' to be heard in the headphones and loud-speakers of neighbouring receivers tuned-in to the same station for perhaps several miles around, possibly completely drowning out the programme being listened to.

Before the inauguration of the B.B.C., the use of adjustable aerial circuit reaction was universal but under the Broadcast Licence regulations, the use of adjustable reaction in the aerial circuit of all BBC/PMG-stamped valve sets was banned, although fixed reaction could be used in this stage if it was incapable of causing oscillation. Adjustable reaction could be used in a subsequent stage so long as it was not coupled to the aerial tuning circuit. The Post Office therefore only passed manufactured sets which did not oscillate but to produce an efficient receiver under these conditions was extremely difficult. Much to the annoyance of many long established and reputable firms, the home-constructor was virtually given a free hand as to the type of circuit he chose to build and any such amateur-built receiver, no matter how crude, inefficient

or liable to cause interference, could cheerfully be used with the Experimenter's Licence without being subject to any kind of Post Office test or approval. Most of these sets had adjustable aerial circuit reaction and therefore most of the problems encountered with oscillation lay squarely with the home-constructor's set. Although the Experimenter's Licence stipulated that home-made sets must not be allowed to cause oscillation, the sheer number of home-constructors made it difficult for Post Office officials to carry out checks. Mr. W. W. Burnham of Burndept Ltd., voiced the opinion that experienced firms such as his were being treated by the Post Office as "schoolboys" by being compelled to submit their sets and this general discontent continued until reaction testing was abolished altogether in October 1923.

Reaction circuit interference from "inexpert amateurs" was very common during the early years of the British Broadcasting Company and was still something of a menace when the Company became a Corporation in 1927. Common too were the sometimes desperate appeals broadcast to listeners-in to control their sets and a black list of defaulting areas was often read out over the air in the hope of "shaming the delinquents". But soon, vast improvements to high frequency amplification with the wide adoption of Neutrodyne circuits in 1925 and the introduction of the screened-grid valve in 1927, led to the development of highly stable TRF receivers which became universal until the mid-1930s when they were finally ousted by the mains superhets.

Local interference from amateur transmitters was also very noticeable within a few weeks of the inauguration of the British Broadcasting Company and their owners were politely requested not to carry out experiments during the broadcasting hours, 5pm to 11pm. The B.B.C. hoped to provide such high grade programmes that all amateurs would be listening-in instead of experimenting during the hours when the broadcasting stations were in operation.

LISTENING-IN

Two basic types of factory-built receiver were available to the public for listening-in to the B.B.C.: the crystal set and the battery-driven valve receiver. There were no plug-in mains receivers at this time and it would be another few years before the first commercial 'mains' wireless receivers began to appear (see 1925).

Crystal Sets

Crystal sets were in general designed for short-range reception of their local medium-wave broadcasting station, and could be used satisfactorily up to about 12 miles from the transmitter. They were by far the most popular type of receiver, due mainly to their sheer simplicity in use, relative cheapness and compact size: most were housed in a small polished wooden box-like cabinet, little bigger than a biscuit tin (fig. 39). They employed a mineral crystal (usually galena) in delicate contact with a tiny coil of wire known as a 'cat's whisker' to detect the transmitted high-frequency currents which were then converted into audio-frequency currents enabling the broadcast programmes to be heard through a pair of headphones. It was not a question of simply turning the set on, for the listener-in first had to carefully search the crystal with his cat's whisker in order to find a spot sensitive enough to produce a good signal in his headphones, (a process called "tickling the cat's whisker"), and this could take some considerable time. Care had to be taken too, once a good contact had been found, not to jog the detector (which was usually protected from dust by being enclosed in a glass tube) as the cat's whisker/crystal arrangement was easily upset: 'permanent detectors', which required no adjustment, were employed by some manufacturers but were never very widely used.



fig. 39. Gecophone Model No.1 Type BC 1002, by General Electric Co. Ltd. 1922. BBC/PMG Stamp, GPO Reg.No.102. Crystal set for headphone use, glass-enclosed cat's whisker/galena detector (open detector version also known), provision for plug-in coils, variometer tuning, ebonite control, nickel-plated fittings, mahogany box with lift-up lid. 6 1/4 in. x 9 in. x 6 in. (closed). £5.10s.0d.



fig. 40. Exploring the crystal with the cat's whisker in order to get a good signal could prove a time consuming task, leading in some cases to the point of frustration.

For tuning purposes, either a variometer or a cylindrical inductance coil with a slider or tappings was used - the variable condenser (then the 'straight-line capacity type' with semi-circular metal vanes) was at this time quite an expensive component and although fairly common in valve receivers, it was not usually employed to any appreciable extent in crystal sets until 1923 when cheaper examples appeared. While most crystal sets covered the medium-wave Broadcast Band only, a few were provided with interchangeable plug-in or slot-in tuning coils which enabled their basic tuning range to be extended. This was useful for those within reception range who might enjoy listening-in to the ground-to-air conversations from Croydon Aerodrome on 900 metres, or who wished to set their watches or clocks by the Paris time-signals on 2,600 metres.

In the main, the crystal set was for the solitary listener-in even though it was possible to connect up another pair of headphones without too much loss of signal strength. Family listening was generally ruled out as, without the aid of amplification, the output was not strong enough to drive a horn loud-speaker; but it was a fairly common practice to place the headphones in a china fruit bowl or pudding basin which seemed to amplify the signals a little, especially if everyone huddled around.

Unlike valve receivers, crystal sets worked without batteries as all the necessary power came directly from the energy of the transmitted waves picked up by the outdoor receiving aerial. (There were a few rare exceptions to this, with crystal sets using a carborundum crystal and a steel contact, where a small cell of about 1.5 volts was needed to polarize the crystal in order to get it to function properly, fig. 64). The most common form of outdoor receiving aerial was the horizontally mounted 'L' type: a large, cumbersome affair, strung up on poles or fixed to a tree in the garden with the down lead-in wire to the set positioned at one end giving the whole aerial its characteristic 'L' shape. The Broadcast Licence permitted the use of up to 100 ft. of aerial wire and for maximum signal strength this had to be carefully positioned so that it was in a direct line with the nearest broadcasting station.

Given that the crystal set's reception range was not very great, then with a large outdoor aerial, plus a good earth connection and a pair of headphones, plenty of entertainment could be enjoyed for the investment of an average week's wages. As *Popular Wireless Weekly* reported, listening-in soon became "Britain's most favourite hobby - afforded by everyone!"

Valve Receivers

In comparison to crystal sets, battery-driven valve receivers were very expensive. They were capable of greater receiving ranges but were larger and more complicated and generally looked as though they would be far more suitable on a science laboratory bench than in the domestic surroundings of the home. Some, *Wireless World* thought, were of "fearsome appearance" (fig. 41) with their ebonite control panels festooned with an imposing array of protruding bright-emitter valves, plug-in tuning coils for various wave-ranges, knobs, switches and dials. The panels themselves were characteristically either sloping (fig. 65), horizontal (fig. 53) or vertical (fig. 41). Receivers employing from one to as many as eight or more valves were available on the market, and listeners tended to go for the cheaper and basic models like the comparatively short-range 2-valve (DET/LF) receivers rather than the more specialised long-range multi-valve sets which were not very economic due to the heavy filament current consumption and the initial cost of each valve. Valves were not generally included in the price of the receiver and like the other accessories such as batteries, earth wire and an aerial system, they had to be purchased separately.



fig. 41. 'Cabinet Set', by W.R.H. Tingey. Early 1922. A 5-valve receiver with 3 or 5 valve switching, covering 175 to 28,000 metres in 7 stages, ebonite control panel, ebonised wood case. 16 in. x 18 in. x 7 in. Typical of the "fearsome" type of valve receiver described by *Wireless World*, with its scientific-looking panel bristling with controls.

Valve receivers were of the 'permanently installed' type, and it was not practical to move them once they had been wired-up via panel terminals to the aerial, earth, HT and LT batteries and headphones or, if capable of driving one, a horn loud-speaker. The whole assortment, with trailing wires and accessories spreading out around the receiver, constituted the 'wireless set' in its original meaning. If space for an outside aerial system was limited, for example in the case of a flat-dweller, a small indoor directional frame aerial, mounted on a stand or fitting into the top of the receiver's cabinet, was usually found to be adequate for local station reception, although the actual amount of energy it picked up was small.

A good low resistance earth connection was thought essential and there were several methods of obtaining it. The most elaborate was to bury a fan-shaped system of wires under the entire length of the aerial, or the listener could purchase a specially produced copper earth mat which was buried deep in the ground preferably in a damp part of the garden: a 7lb. biscuit tin or an old copper saucepan could give similar results. Most listeners though used a copper tube driven into the earth which they frequently watered. Wiring the receiver's earth terminal to an outside water pipe or an interior gas pipe were other favoured and perhaps more convenient methods, but with the latter, leaded joints in the pipe offered a high resistance which made the connections inefficient. To protect both the receiver and the home from lightning, (an outdoor aerial was an excellent lightning conductor), a throw-over switch was usually employed which disconnected the aerial from the receiver and connected it to the earth wire and thereby directly to earth. But there were apparent hazards with connecting the aerial system directly to a gas pipe being used as the earth which most wireless magazines and books were at pains to point out.

At this time, valve receivers in general were designed for headphone use, although some of the more powerful multi-valve models and those which were used with a separate valve amplifier were capable of driving a horn loud-speaker (a 2-valve DET/LF receiver could also drive a horn loud-speaker if used very close to a transmitter). Loud-speakers with metal, wood or ebonite horns were only being produced in small numbers, and these were usually straight-necked or curved-necked. A

few of the more 'modern' swan-necked variety were only just beginning to appear but by the following year these had become the dominant design. Most horns were made of metal (spun aluminium or copper), and these had the annoying property of vibrating at certain specific frequencies especially during passages of loud orchestral music. Some were finished in a crystalline paint which helped to overcome the problem but horns made of ebonite, like those made of wood, were thought of as being comparatively non-resonant.

The sound, intensified by the horn, was reproduced from a drive unit housed in the base of the loud-speaker and the vast majority of these used a magnet system which was very similar to that found in headphones, only with a somewhat larger soft-iron diaphragm. Arrangements were made, via a 'sensitivity control', for altering the distance between the diaphragm and the pole pieces of the magnet so that the drive unit could be adjusted according to the power output of the receiver, a feature which in some cases was used in headphones such as the Brown Type 'A'. Sensitivity controls were also used in moving-iron cone loud-speakers following their introduction in the mid-1920s. During the late autumn of 1922, the first energised moving-coil horn loud-speaker, the Magnavox R2B, was introduced into Britain from America by the Sterling Telephone & Electric Company and this was certainly the most sophisticated horn loud-speaker then on the market (fig.820). In 1926, moving-coil *cone* loud-speakers were introduced which within a few years superseded all other types and became the standard approach to loud-speaker design.



fig. 42 . Straight-necked, curved-necked and swan-necked horn loud-speakers of 1922.

In 1922, wireless receivers, accessories and components were generally bought from the relatively few specialised wireless and electrical retailers established in the cities and towns within the service area of the four B.B.C. stations, or they could be obtained by mail order direct from the manufacturer. (Valves were not generally sent through the post owing to the risk of breakage and were usually purchased locally). Quite unrelated establishments such as cycle shops, newsagents, tobacconists and chemists also sold wireless sets but within a few years, as broadcasting encompassed practically the whole of Britain, a network of specialist wireless retailers was established around the country and the wireless shop, usually with its backroom service engineering department providing repair, battery charging and valve testing facilities, became as common a sight in the High Street as the butchers' or the bakers', and was probably more frequented by men than any other shop in town.

The wireless retailer was the last link in the chain of marketing and his shop was soon to become the showroom of Britain's fastest growing industry, supplying an ever enthusiastic listening public with the latest receivers, headphones, loud-speakers, batteries, components and valves.

In 1922, valves were generally of the 4 volt bright-emitter type and to supply filament current, 6 volt accumulators were required. Known as 'low tension' ('LT') batteries, these comprised three series-connected 2 volt lead-acid cells housed in thick glass containers (fig. 43). Accumulators were very heavy and needed frequent re-charging (the charge lasted from 2 to 3 weeks with average use), and while most battery set users had to put up with the inconvenience of lugging their accumulators down to the nearest wireless retailer or garage who could provide this service, home-charging units had become available during the summer for use in homes connected to a DC mains supply. In September, the Hart Accumulator Company of London inaugurated a motorised re-charging service for the convenience of their customers in outlying districts which was soon to be copied by other battery firms and garages around the country. For 6d a time, the used accumulator would be collected and swapped for a re-charged one, the customer of course having initially to purchase an extra accumulator. Valve receivers also required a 'high tension' ('HT') battery to supply the valves with anode voltage (fig. 44). These were mostly non re-chargeable and would last about 3 to 4 months.



fig. 43 . Lead-acid accumulators, also known as 'LT' (low tension), 'secondary', 'storage' or 'wet' batteries, were re-chargeable 2 volt batteries of varying current capacity, consisting of a thick glass container in which two sets of lead plates were fitted. The plates were made up of lead grids filled with paste: a mixture of red lead, litharge and sulphuric acid for the positive plate, and a mixture of litharge and sulphuric acid for the negative plate, (the sulphuric acid in both mixtures was allowed to dry out before the cell was assembled). The plates, separated by hard wood or ebonite separators, were immersed in an electrolyte comprising a solution of pure sulphuric acid diluted with distilled water to the required specific gravity. Accumulators provided the filament current for the valves and would last about two to three weeks before they needed re-charging, depending upon the number and the type of valves used and the time spent 'listening-in'. In 1922, a 3-cell 6v accumulator of 40 ampere-hour capacity complete in a 7¼ in. x 10 in. x 5½ in. wooden carrying crate cost around £2.10s.0d, and the re-charging service, which usually took about 24 hours, cost around 6d. From the mid-1920s, 'unspillable' accumulators with a 'jelly' electrolyte and accumulators housed in lighter weight 'unbreakable' celluloid containers became popular for use with battery portable receivers. The LT batteries in the photograph date from the late 1920s.

In November at the Olympia Motor Show, Marconi's and Daimler carried out experiments intending to exploit the commercial possibilities of car radio. An experimental receiver was mounted adjacent to the back seat of a limousine to pick up programmes sent from a temporary Marconi transmitter (call-sign 2BP) set up in Olympia for the duration of the show.

However, little came of these experiments and the development programme was subsequently dropped. Over the next ten years, there were various private experiments with car radios (see 1927) but they remained little more than a novelty until the introduction of the first commercially manufactured model in 1932 (see 1932).

In 1922, a few valve sets began to be housed in neat upright wooden cabinets with a battery compartment below and double doors above which were kept closed when not in use to hide the control panel. Known as 'smoker's cabinet sets' because of their resemblance to this article, they became popular with several manufacturers and were the first real attempts to make the wireless fit in with domestic furnishings (fig. 56).

Completely 'all-enclosed' sets with both batteries and a horn loud-speaker contained within the cabinet were rare. One of these, by Wates Bros., was the Cabinet Set which was built into a writing bureau, and Anode Wireless & Scientific Instruments Ltd. offered a Table Model (literally!) with the receiver and all its accessories housed neatly within a rectangular mahogany table so as to "harmonise with the other furniture in the room".

'Unit sets' were very much in evidence too, both in factory-built and home-constructed form (fig. 65). Any number of separate add-on units (e.g. a detector or LF stage) could be purchased as and when required and linked by standard terminal connections to be assembled into anything from a simple crystal set to a multi-valve receiver depending upon the budget or the requirements of the listener-in.

A new type of circuit introduced at about this time was the reflex circuit in which one of the valves served the double purpose of acting simultaneously as an HF and an LF amplifier (fig. 60, Marconiphone Model V2).

Home-construction grew increasingly popular, for with a minimum of technical knowledge, building a receiver on the kitchen table offered a cheaper and to many, a more rewarding way of listening-in, especially if the set worked after it had all been wired together! For the even more technically minded, making some components by hand was comparatively straightforward although there were many sources of cheap ready-made components available to save both time and trouble. There were also many books on the subject and one of the most well known names in this field was that of John Scott-Taggart. A keen experimenter since before the First World War (see 1913), Scott-Taggart founded The Radio Press in 1922 which concentrated on books and magazines (notably *Modern Wireless* and *The Wireless Constructor*) published with the home-constructor's market in mind. He was a prolific writer, with innumerable wireless books and magazine articles to his credit, and amongst wireless collectors, is perhaps best known for his famous series of circuits which bear his initials 'ST' (see 1932).

The problems over the Experimenter's Licence had given the green light to some foreign component manufacturers, who took full advantage of the situation and began to flood Britain with cheap stock. There were plenty of ex-Government components around to experiment with too, as well as surplus World War One wireless receivers, much of it suitable for medium-wave reception. At least one of these receivers, the 1916 Mark III Tuner, was given its own G.P.O. registration number (Reg.No.237) when it emerged in December 1922 in a slightly modified guise as the McMichael Radiomac Crystal Mark III crystal set. This version covered "the entire broadcasting and shipping range, 150/1200 metres" and was described in McMichael's advertisements as "Brand New!", which was probably an accurate statement since the bulk of Mark III Tuners released onto the market straight from Government stores were unissued and had never seen active service.



fig.44 . High tension ('HT') batteries, which were also known as 'primary' batteries, were necessary to provide the valves with anode voltage, and comprised a large number of series-connected 1½ volt dry cells usually arranged neatly in a strong cardboard box and well sealed in with paraffin wax or pitch to form a single unit. Depending on the valves and the type of receiver used, HT batteries in sizes from 45 volts to as much as 180 volts were available, and these were provided with tappings taken from groups of cells at regular intervals so that variations in voltage could be obtained as desired. While being non re-chargeable, a good quality HT battery could, with average use, last for about three to four months and in 1922, one of 60 volts in a 3½ in. x 9 in. x 2¾ in. container cost around £1.0s.0d. HT batteries were sometimes made up of series-connected accumulators, but these were usually used only by listeners who were in a position to do their own re-charging or had a regular collection and re-charging service. The HT batteries in the photograph date from the 1930s.

With valve sets, a good percentage were capable of being adapted to tune outside the medium-wave Broadcast Band by means of interchangeable plug-in coils and this meant from below 200 metres to above 20,000 metres, encompassing both wireless telephony and Morse transmissions. With some models, tuning could be a highly complex process as there were several controls which had to be adjusted and balanced up correctly. The use of a wavemeter to measure the wavelengths of stations in order to calibrate the dials, was useful (fig.179, a later example).

While tuning in both crystal sets and valve receivers was comparatively 'coarse', there was at least one early use of an auxiliary vernier condenser to obtain finer tuning (fig. 62). This was a small unit, comprising one moving and two fixed metal vanes, connected in the circuit of the main tuning variometer making possible fine adjustments in steps of about a tenth of a degree. Although this component first appeared in a crystal set it was not long before vernier condensers were adopted in some valve receivers too and from 1925 they became generally available (see 1925).

As a more accurate indication of station tuning, some listeners-in with valve receivers employed a milliammeter placed in series with the positive HT battery lead and the anode of the output valve, which gave a visual indication of the signals received. The needle would deflect to a maximum point when the required station was fully tuned in, and an accurate reading of the strength of the signal received could then be taken. Visual tuning indicators of this type were occasionally included on the panel of some commercially manufactured valve receivers during the 1920s, but with the advent of automatic volume control and the need for far greater tuning accuracy in the 1930s, various types of visual tuning indicators became widely adopted (see 1932). Another meter sometimes seen on the panels of sets of the 1920s was the ammeter, which was used for measuring filament current.

In general though, the only visual guide to tuning in 1922 was by the two types of dial then in common use. Both had been used in military equipment during World War One and had influenced the design of domestic wireless equipment after. The first type was a rotating, circular dial in Bakelite or ebonite, with white 0-180 degree engraving on the bevelled edge of the dial itself (sometimes 0-100 degrees) and a fixed datum line engraved on the panel so that the reading was always in the most convenient position for the eye (fig. 56). Once broadcasting got under way in November 1922, this latter type of dial was universally adopted and continued practically unmodified for several more years.

The second type of dial was a rotating control knob with an attached pointer to indicate the settings on a semi-circular degree-marked Ivorine scale screwed onto the panel (fig. 53). Less commonly, these scales were also transfer printed or engraved directly onto the panel. Similar, smaller controls were also used to indicate the filament current of bright-emitter valves. Although bright-emitters were universally employed in wireless receivers of this period, they were recognised as being relatively inefficient, for they gave only a tiny power output while their filaments could consume nearly 3 watts. But about this time, interest began to be shown in a new improved class of valve known as the 'dull-emitter', the first commercial example of which, the LT1, had been produced by the M-O. Valve Company in March 1921. The dull-emitter employed a non-incandescent filament made of tungsten coated with thoria which gave the same necessary electron emission as the bright-emitter while operating at a very much cooler temperature (c.600 deg. C. - c.750 deg. C.). It therefore had a very much lower current consumption and required a smaller filament voltage (c.0.8v - 3v).

Initially costing more than an 'R' valve, early thoriated tungsten dull-emitters were too expensive for most listeners-in. But from 1923 with the introduction of the first standard ranges and the lowering of prices, they gradually became popular and soon superseded bright-emitter types, their heyday being from 1925 to about 1927 when they in turn began to be displaced by barium oxide coated types (see 1927).

1923

On May 1st 1923, the British Broadcasting Company moved its 2LO studio to new premises a few hundred yards away at the Institution of Electrical Engineers' building in Savoy Hill, while the original transmitter and aerial were kept in position at the top of Marconi House with a Post Office line connecting the two buildings. This move permitted the gradual construction of several additional studios at Savoy Hill and by the time these had been superseded by the new purpose-built Broadcasting House in May 1932, nine studios were completed, the largest of which (the concert hall) measured 45 ft. x 26 ft.

The first phase of the B.B.C.'s mainland broadcasting scheme was completed on October 17th with the opening of the eighth main station at Bournemouth (call-sign 6BM) on 385 metres. Cardiff (call-sign 5WA) on 353 metres had opened on February 13th, Glasgow (call-sign 5SC) on 415 metres on March 6th and Aberdeen (call-sign 2BD) on 495 metres on October 10th (the Broadcast Band had been extended in October 1923 following recommendations of the Sykes Committee: see THE LICENCE PROBLEM, below).

Each of the eight main stations produced its own separate programme from its own studio which meant that some eight complete programmes had to be produced every night. This proved very expensive and it soon became clear that if broadcasting became very popular and was allowed to expand, it would be essential to increase the potential number of listeners without increasing the number of separate programmes. This

led to the establishment of eleven relay stations around the country by the end of 1924, each with a transmitter output of about 120 watts serving their immediate local area for a radius of about 5 miles.

The first relay station, Sheffield (call-sign 6FL) on 303 metres, was opened on November 16th. The relay station scheme was one of the recommendations of the Sykes Committee following its investigation into broadcasting. The relay stations were to provide a few of their own productions but mainly a simultaneous broadcast programme fed by Post Office telephone lines from London, Glasgow or Cardiff: their own programme costs were therefore very much lower than in the case of the B.B.C.'s main stations.

By the mid-1930s, most of the B.B.C.'s stations were interconnected by long-distance underground cables specially designed for the purpose of simultaneous broadcasting, but when this method was first introduced (Glasgow did the first official 'SB' in the winter of 1923) ordinary Post Office telephone lines were used. By connecting the various broadcasting stations together it was possible for all, or a combination of those stations, to broadcast one single programme simultaneously.

LISTENING-IN

In the winter of 1923, just a year after broadcasting began, there were over 500,000 licensed receivers grouped around the eight main stations and one relay of the British Broadcasting Company. Unless you happened to live close to one of these stations, the type of receiver you could afford to buy did limit your listening. It would be a bad investment to purchase a cheap crystal set if you lived a hundred miles or so away from a transmitter, for the receiving range of this type of set was very limited. Of course, if money was no object, you could buy a long-range multi-valve set and be assured of hearing *something* entertaining practically anywhere in Britain, and there was often the possibility of picking up some really long-distance stations from Europe or even America, especially during long winter evenings when conditions were more favourable.



Fig. 45 . The chance of getting America or other distant stations often kept the really keen listener-in up till the early hours of the morning.

In January there had been a large increase in the purchase price of many valve receivers due to the introduction of the Marconi A1 Licence. A royalty was payable to Marconi's at the rate of 12s.6d per valve holder on receivers covered by Marconi patents and made by member firms of the British Broadcasting Company. (The 'Big Six', under the A2 Licence, paid only 7s.6d per valve holder). During the Marconi Company's existence, it had probably done more original research than any other firm, and this had resulted in an accumulation of patent rights made out in the names of various

employees of the firm. Added to this were numerous other patents which had been purchased outright from other companies. Since practically every type of valve set made for broadcast reception was likely to involve the use of various circuits patented by Marconi's, it was usual for manufacturers to work under their patent licences.

In March, Plessey left London and moved to large factory premises at Ilford, Essex and from here it was to grow into one of Britain's foremost manufacturers and suppliers of un-branded chassis, loud-speakers and components to the Wireless Industry. (By 1950, it was the largest manufacturer of radio components in the Commonwealth). On December 29th 1923, the Marconiphone Company Limited was set up by Marconi's to take over from them the responsibility of the sale and distribution of domestic broadcast receivers and accessories and Plessey continued to make Marconiphone receivers for them until 1926. By then, Marconi's had acquired their own domestic wireless manufacturing company, Sterling Telephone & Electric Co. Ltd., who had a factory at Dagenham, Essex, shared office buildings with Marconiphone at Tottenham Court Road and with whom Marconi's had already established a mutual trading relationship. From 1926, orders continued to be received by Plessey from many other wireless companies and soon Plessey branched out into additional fields of production which led to a long association with the Post Office and the Ministry of Defence.

By 1923, the public were getting more used to having the wireless in their homes and as well as hours of entertainment of all kinds, it was providing special services of news, "S.O.S." messages and communiques and weather forecasts, although to some, wireless was still regarded with suspicion. A dealer who ran a battery charging service round the Exmoor farms in his district in the early 1920s recalled a remark made by a farmer's wife whose husband was off hay-making. "He'd better be careful," the dealer told her, "the wireless speaks of rain!" "Where did 'ee 'ear that?" she demanded. "Why, on Mrs P.'s set up at Higher House," he replied. The woman sniffed the air disdainfully. "Don'ee take no notice of what that wireless tells 'ee," she said, "'tis only a cheap ol' set!"

The wireless was a distraction and as 'Ariel' reported in the January 20th 1923 issue of *Popular Wireless Weekly*, "the craze for wireless is spreading more rapidly than ever. People are indeed going wireless mad and are forgetting their work. One business man has complained to Marconi House that wireless has been responsible for his wife neglecting her household duties. 'At half-past five each evening,' he wrote, 'instead of my wife preparing the evening meal, she sits down to listen-in'. Perhaps before long, we shall hear of wireless divorces."

On September 28th, the first issue of *The Radio Times* was brought out by the B.B.C. and within a few days over 250,000 copies had been sold. Unlike other publications on wireless, this "Bradshaw of Broadcasting" as the B.B.C.'s Director of Programmes Arthur Burrows described it, did not deal specifically with the technical aspect of the subject but took as its main theme the popular entertainment side of broadcasting, and backed this up by including full programme details of all the B.B.C. stations for the coming week together with news of the Company's activities. Since the inauguration of the B.B.C.'s first station in November 1922, listeners had been able to obtain programme times and details from information published in newspapers and in various wireless magazines such as *Popular Wireless Weekly*. But by early 1923, some newspapers began to fear the competition that this new medium of broadcasting was apparently presenting. This led them to hold a one day boycott of the B.B.C.'s programme listing in February as a protest. However, this incident backfired on them for it was enough to convince the B.B.C. (and Reith in particular) that the Company should bring out its own

independent weekly publication and no longer rely solely on the Press for informing listeners of the details of the B.B.C.'s programmes.

In general, the approximate receiving range using headphones of the various types of factory-built receiver available in 1923 was as follows: Crystal sets (12 miles), 1-valve sets (25/30 miles), 1-valve/crystal sets (45 miles), 2-valve sets, HF/DET (50/80 miles), 3-valve sets, HF/DET/LF (80/120 miles), and 4-valve sets, 2 HF/DET/LF (120/250 miles).

One problem encountered by those equipped with moderate-range valve receivers and living close to their local broadcasting station, was the interference from it. Even though only nine B.B.C. stations occupied the Broadcast Band on the medium-wave, some of their wavelengths were relatively close together, and often when attempting to tune into a more distant station on a wavelength similar to that of their local station, listeners-in would hear both signals together. As a device for eliminating the station causing interference, 'wave-traps' became available for the first time in commercial form. They comprised a unit made up of a coil connected in parallel with a variable condenser, and this was placed between the aerial lead-in wire and the aerial terminal of the set. The unwanted station could then be tuned out by adjusting the variable condenser in the wave-trap although this tended to cause the desired station to diminish in signal strength and meant that the wave-trap usually had to be adjusted again when other stations were required. (With the inauguration of the B.B.C.'s Regional Scheme in the early 1930s, wave-traps were once more back in favour and were employed to combat interference problems encountered particularly by listeners using older types of receiver. See 1930).

THE LICENCE PROBLEM

By the end of April 1923, some 260 British wireless manufacturers had become members of the British Broadcasting Company and the number of various different models of receiver given a G.P.O. registration number had reached 1,450 with some 80,000 BBC/PMG-stamped sets in operation. This figure included all classes of equipment, from crystal sets (still by far the greatest number), valve/crystal sets, 1,2 and 3-valve sets and multi-valve sets and amplifiers. Of the valve sets, those with a 3-valve HF/DET/LF type of circuit were the standard product of many of the top manufacturers and were usually chosen by those prepared to pay a good price for a good quality receiver, while the 2-valve DET/LF type were very popular with the general listening public since they permitted the use of a loud-speaker within short-range of a transmitter.

But there was increasing competition from the home-construction market which threatened the section of the British Wireless Industry which produced ready-made sets and which only now was beginning to grow and to establish itself. The licence problem grew worse, and because the Post Office was looking more closely at new applicants for the Experimenter's Licence, a huge backlog built up during the spring and summer of 1923. Every week more interest continued to be shown in home-construction and a great deal of attention was now being paid by component manufacturers to the design and production of component parts from which the wireless experimenter could build his own wireless apparatus in his own home without too much skill. Kit-receivers, a packaged set of parts complete with a cabinet, were also becoming widely available (fig. 89) and most wireless magazines carried regular articles on circuits and also published plans and blueprints to aid home-construction. In May, details of the new Neutrodyne circuit from America were first published in *Wireless World* who tried to encourage home-constructors to build it since it was a very selective circuit with an HF stage free from causing oscillation interference (see also 1925).