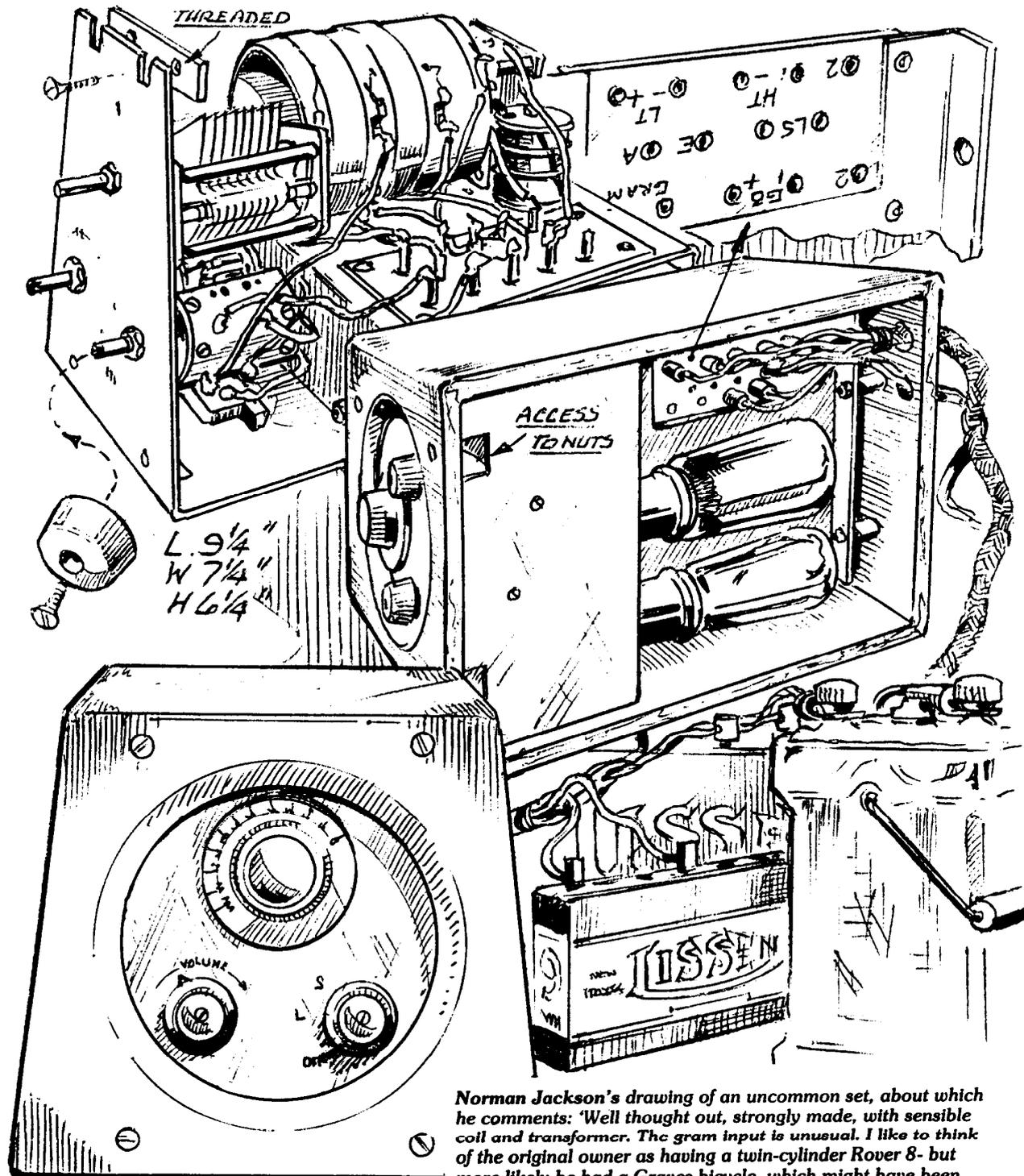


BULLETIN OF THE BRITISH

# VINTAGE WIRELESS

SOCIETY



*Norman Jackson's drawing of an uncommon set, about which he comments: 'Well thought out, strongly made, with sensible coil and transformer. The gram input is unusual. I like to think of the original owner as having a twin-cylinder Rover 8- but more likely he had a Graves bicycle, which might have been made by the firm that made Gaves wirelesses.'*

**BULLETIN OF THE BRITISH  
VINTAGE WIRELESS SOCIETY**

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Editorial and advertisement enquiries should be made to the Editor, **Robert Hawes**, 63 Manor Road, Tottenham, London N17 0JH. Tel: (081) 808 2838.

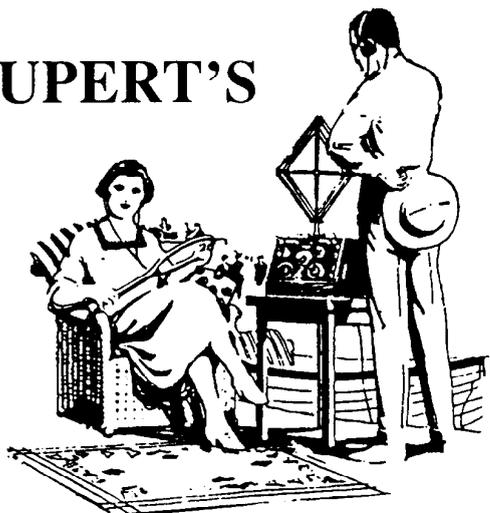
Editorial Assistant: Pat Leggatt.

Layout and design: Robert Hawes  
Cover drawing: Norman Jackson

**BRITISH VINTAGE WIRELESS SOCIETY**

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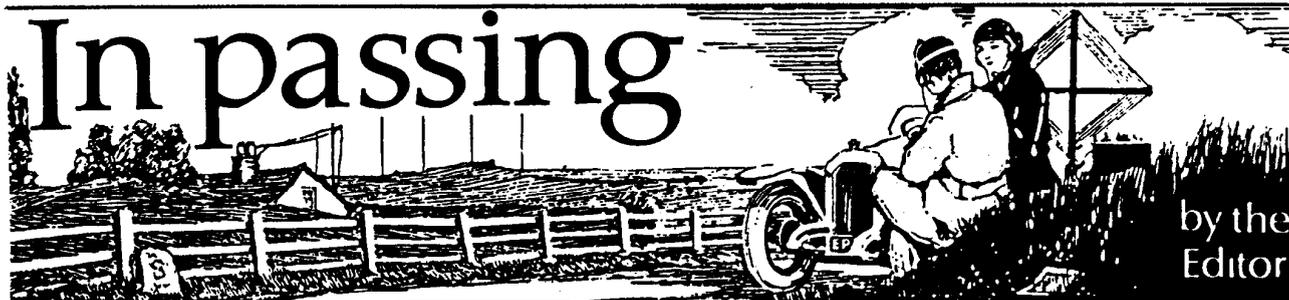


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Correspondence for the Society's Bulletin should be addressed to The Editor, Robert Hawes, 63 Manor Road, Tottenham, London N17 0JH. Telephone: (081) 808 2838.

## Bulletin

The increase in the number of Bulletins from four to six a year – coupled with the six Newsletters that will accompany it – has received much approval from members. In addition, a special supplement is due to be issued in June and also one of our celebrated facsimiles of a rare and historic piece of wireless ephemera. The increase in our publications will, of course, require more material in the way of articles and pictures, so we appeal to everyone to help. The Editor needs everything from "heavyweight" technical and historical material, to articles on practical wireless topics, news and more lightweight interesting and amusing material too. You need not be an egg-head to contribute, for we are glad to do the work of turning modest notes into publishable pieces. We should be glad to have ephemera and old photographs too.

## For your diary

The activities of the Society are increasing. This year we shall have at least six Swapmeets with associated small auctions, in various parts of the country, plus two major auctions and, we hope, another Seminar to follow the one on Valves at the Science Museum. Details of meetings to come are as follows:

**June 13.** Annual Garden Party at Gerald Wells' Vintage Wireless Museum London; **June 14,** our Major Swapmeet and mini-auction at Harpenden; **August 16,** major auction at Harpenden; **September 6,** another Swapmeet at our new venue in Portishead; **October 4,** major Swapmeet and mini-auction at Harpenden; **November 8,** Swapmeet and mini-auction at Southborough (Please note that some of these dates have been changed since announcements in the last Bulletin).

All these events are for members only, who must obtain tickets in advance by completing booking forms which will be posted to them.

## New meeting

Our new meeting in the West Country, launched by our voluntary organiser Alex Woolliams at Portishead in April, was a tremendous success. The meeting, which is now to be a regular one, attracted a good number of members who found a remarkable selection of goods on the stalls, from expensive early apparatus to much-sought-after "Art Deco" sets, some

interesting bargains and a variety of intriguing "junk" boxes which yielded some rare prizes as well as cheap and useful spares. Congratulations to Alex and his helpers, including his charming young daughters Emma and Gemma, for their hard work, which as well as pleasing so many visitors, raised a welcome profit for Society funds. Visitors remarked on the pleasant atmosphere and one said it reminded him of the "old days" at Harpenden. The hall was fully booked and members interested in the next meeting (6 September) might be advised to book early. Details from Alex at 11 Norton Road, Knowle, Bristol BS4 2EZ (tel: 0272 721973). He would welcome useful suggestions.

To extend our coverage of members in the country, we should now like to have a regular meeting in the Midlands or the North and would welcome the help of members in those areas in organising such events.

## Garden Party

There is still time to apply to attend Gerald Wells' Annual Garden Party at the Vintage Wireless Museum, Dulwich on the day before Harpenden: 13th June. It will include the usual attractions: a buffet lunch with wine, tours of the exhibits, demonstrations of early television, showings of the many television broadcasts Gerald has made, competitions, and tea on the lawn accompanied by music from non-hi-fi, non-stereo vintage equipment. You should make application without delay. Enquiries: 081-670 3667.

## Information exchange

Do you know about the Society's "Information Exchange" which is run by Dave Adams our Information Officer? If you need technical or other help or advice and are willing to assist other members in the same way, please join in the scheme and send your details to him at 69 Silver Lane, West Wickham, Kent BR4 0RX. (Tel: 081-776 1531).

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## In passing

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### Communications Museum

The Royal Corps of Signals, formed just after the first world war, has always preserved an important collection of communications equipment which has been for some time housed in the Museum at their School in Blandford, Dorset, where it attracts some 10,000 visitors a year. Since it is part of a military unit, the museum is not easily accessible to the public, so it is to be moved to a new building, planned to be opened in 1994 and incorporating a reference library. The MOD will provide the site but a charitable trust is to raise an appeal to fund building. The project team at the School of Signals can be contacted at Blandford Camp, Dorset DT11 8RH (0258 482258). Major Roger Pickard, the curator, is also seeking certain equipment and spares.

### Compute-a-set

A new way of locating wireless equipment in forthcoming auctions in both town and country is being operated by a company called Thesaurus Fine Art Information. Andrew Hilton, who developed Phillips Collectors Centre in London, is developing the firm's new Auction Search Service. Subscribers are offered a regular postal or fax-machine collation of sale items and prices from its continuously-running computer database, compiled from the lists of some 400 auctioneers in the UK, Ireland and the Channel Islands. Further information from 76 Gloucester Place, London W1H 4DQ.

### Workshop warning

A member has written to restoration enthusiasts whose workshop safety precautions may be just as "vintage" as the sets they work on. We have often stressed the importance of taking safety precautions to avoid electric shock but there are many other hazards involved - some of them chemical. A danger some may not know about can result from the breathing-in of dust raised by attempts to remove corrosion from chassis. Our member was quite ill with cadmium poisoning after such efforts. Even worse poisoning can result from working with certain old paints and from the use of lead. The Editor would welcome an article from a member with medical knowledge on

workshop safety. In the meantime, we should like to recommend that you have the following items hanging above your bench: goggles, mouth-mask with filter, rubber gloves, first-aid kit and fire extinguisher. Stand on a thick rubber mat and make sure your electrical installation includes a safety contact-breaker.

### BVWS "Hams"

The Society now has well over 100 radio amateurs and a provisional membership list has been drawn up which shows their call-signs. The list is available on sending a stamped and addressed envelope to the Editor, who would be glad to hear from other members who would like to be included.

Ray Herbert (G2KU) operates a BVWS "Net" on the first Monday of each month which is now building up. Members use it for exchange of ideas, finding spares and disseminating news, often using vintage equipment. A recent net enabled Fred Ward to find a magic-eye and brought news that Douglas Byrne had discovered a "Television Set for the blind" - a sound only receiver made by Marconi.

### Looking ahead

In time of economic gloom it is scarcely surprising that most commercial concerns are less interested in the past than the future and that accountants seem to be selling off the family jewels. Tales abound of the disappearance of important historic apparatus which really ought to have been saved and exhibited. It is therefore nice to hear of some new preservation work within industry.

Thorn EMI Central Research Laboratories have just set up a small but beautifully organised exhibition at their Haves Centre called "Sight and Sound", featuring some of the innovations which have won the group international recognition. It includes some important historical electronic apparatus related to television, radio and sound-reproduction and is presented in an innovative way, allowing the viewer to access 1,000 photographs, two hours of archive film and other contextual information via interactive video programmes in display areas. The museum is a private one and not open to the public but we hope to arrange a visit for Society members.

## Looking back . . .

Items from Vintage "Wireless World" magazines

Long Waves for Submarines. *March 23rd 1932*

A special long-wave transmitter is under erection by the French Navy at Toulon for communications with submerged submarines. Repeated experiments have shown that short waves refuse to penetrate the ocean depths, and for this reason the new station will work on wavelengths up to 15,000 metres.

Open to all. *March 23rd 1932*

In view of the large number of requests for membership, the Pye Short Wave Radio Society, membership of which was formerly confined to Pye Radio employees, now allows any enthusiastic amateur to join. The Society which contains hundreds of active members, is affiliated to the R.S.G.B. and the A.R.R.L., and owns two transmitting stations G5PI and G6YP.

Wireless for Unemployed. *March 30th 1932*

An example which might well be followed in other parts of the country is that of the George Street United Methodist Church in Burton, which has installed a 4-valve wireless set in a room specially set apart for the benefit of the unemployed.

Radio tests in Arctic. *April 13th 1932*

Professor E. V. Appleton, who is well known to readers for his researches on the transmission of wireless waves, is to lead the second of two Arctic expeditions which are being sent out by twelve countries during the year beginning on August 1st. While one of the parties, led by Mr. J. M. Stagg, will study meteorology at Fort Rae in Northern Canada, Professor Appleton's expedition will proceed to Tromso in Norway to make wireless observations. It is hoped to solve several problems connected with wireless echoes and the possible effect of the aurora borealis.

Goodbye to Savoy Hill. *April 13th 1932*

No one should miss the "Goodbye to Savoy Hill" programme which is being put out on May 14th. On examining Lance Sieveking's draft synopsis I find that twelve studios are to be used, all of them for the last time.

## Radio for hire

Marconi at Sea in 1900

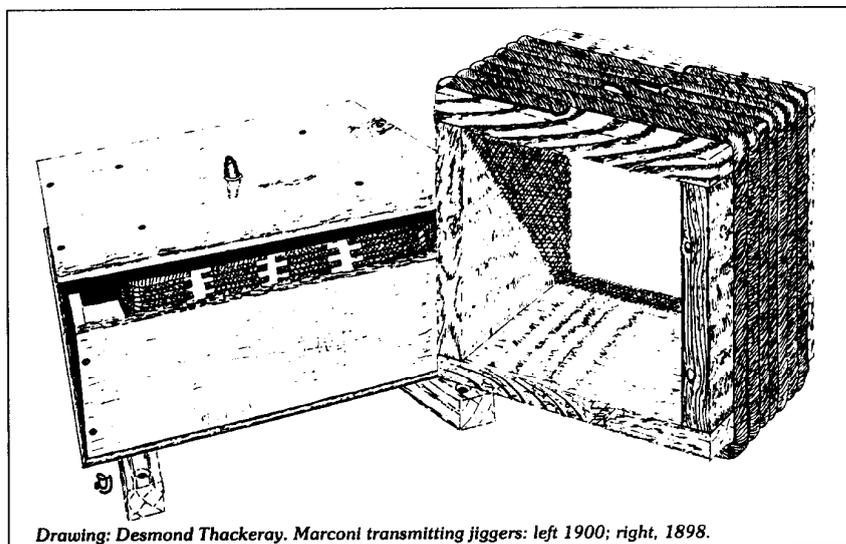
### The first Marconi Marine Transmitters on Short Waves

Dr Desmond Thackeray

Marconi's intentions for marine radio came to fruition by way of land-based transmitters with double-tuned RF transformers called "jiggers," (see the adjacent sketch) wound with power cable on square wooden formers. For shipboard use the jigger increased in size and was cased in a wooden box with terminals. One of these cased jiggers is fixed to the back wall in the view of the radio room of the SS Philadelphia facing page 37 of Hancock's book [4], while Bulletin readers may have seen the earlier uncased version in either the Science Museum or the Marconi Museum (also depicted on p.107 of G.G. Blake's magnum opus [2]). I do not know of any intact example of these early transmitters to be seen today, and very little technical information was published on them. Yet as recently as the Marconi International Marine Jubilee in 1950, the Company assembled the contents of a 1900 ship's radio cabin and put it on display at the Baltic Exchange, London. A photograph of this exhibit is to be seen in the Science Museum booklet on marine radio history by Pocock & Garrett[3]. Most of the components of the spark transmitter were not unusual or "dedicated" items; the Morse key, the Leyden jars, the spark coil and the batteries one might have found in laboratories over a long period and are not so rare in collections today.

#### The Jigger

Not so, however, the transmitting radio-frequency oscillation transformer or "jigger" which was developed empirically by the Marconi Company solely for this purpose, and now seems very rare indeed. Indeed of the five patterns of early Marconi transmitting jigger depicted in various published sources, I have seen in the flesh just two examples of the earliest unenclosed design and a single example of one of the designs in a wooden box that was displayed in 1950. This latter jigger has been on loan to the Science Museum in London from the Marconi Company since 1959. Since it affords virtually the only remaining clue to the RF design of the 1900 Marconi marine transmitter, I recently measured the



Drawing: Desmond Thackeray. Marconi transmitting jiggers: left 1900; right, 1898.

inductance and stray capacitance of the secondary or aerial winding. I am much indebted to the Museum staff for help in this, and also to the Marconi Co. for permission to handle the item. For the record, my measurements fitted an inductance of 102.6 microhenries and stray capacitance of 23 picofarads. Thus it would be self-resonant at 3.276 MHz and capacitive above that frequency.

#### The Frequency

The primary and secondary windings are fixed-coupled, and, with hindsight, are drastically over-coupled. This would have given rise to obvious twin-wave operation had the two windings been tuned to exactly the same frequency. However, such precise tuning would have been difficult; so the chances are high that the two windings were tuned to slightly different frequencies. So the double-humped radiation distribution could have been very lopsided, with the more powerful peak the more useful of the two. The wavelength of "Tune A" was usually given as 60 meters, though it is unlikely that it could have been measured before Round's wavemeter-calibration work later in the decade. Thus if, as is clearly not wholly certain, the aerial and the jigger winding resonated at 5 MHz, the reactance required of the aerial-earth combination at this frequency to resonate with the jigger would have needed to be  $j2425$  ohms.

#### The Aerial

On land, Marconi had been using vertical wires of up to 100 feet, and could also rig these on ships with tall masts. The masts on the SS Philadelphia look to be at least 100 feet [4]. On small boats, only a shorter length

of the wire could have been rigged vertically; so was the rest of the wire brought down to run horizontally if a long gaff at the mast-head was impracticable? Marconi probably used stranded power cable for aerial wire as well as jigger windings, and in a typical diameter at 60-m wavelength this would have a free-space characteristic impedance  $Z_0$  of, say, 450 ohms. The proximity of the "hot" lower end of the aerial to its image would augment its free-space capacitance drastically; so for a purely blind guess how about an actual  $Z_0$  of 212 ohms? A half-wave radiator at 5 MHz would be around  $93\frac{1}{2}$  feet in length; but the actual wire needs to be shorter yet, only 91 feet to give the right inductive reactance of  $j2425$  ohms. Note the  $Z_0$  is not very sensitive to wire diameter, nor is the wire length very sensitive to  $Z_0$ . So the result of 91 feet is not likely to be much in error. On the other hand, the actual resonant frequency clearly varies significantly with wire length, but might have been accommodated to some extent by using a jigger with a different number of secondary turns.

So much for "harmonic" tuning of the aerial, with reactance matching at around 5MHz. There is also of course a "fundamental" match of aerial and jigger reactances at about 959 kHz, where the aerial is effectively much shorter than a quarter wavelength. This is close to the wavelength of 300 meters which in due course became the "Tune B" of the Marconi marine transmitters, or the shorter of the two wavelengths for later ocean-going rigs.

Continued >

## Historical

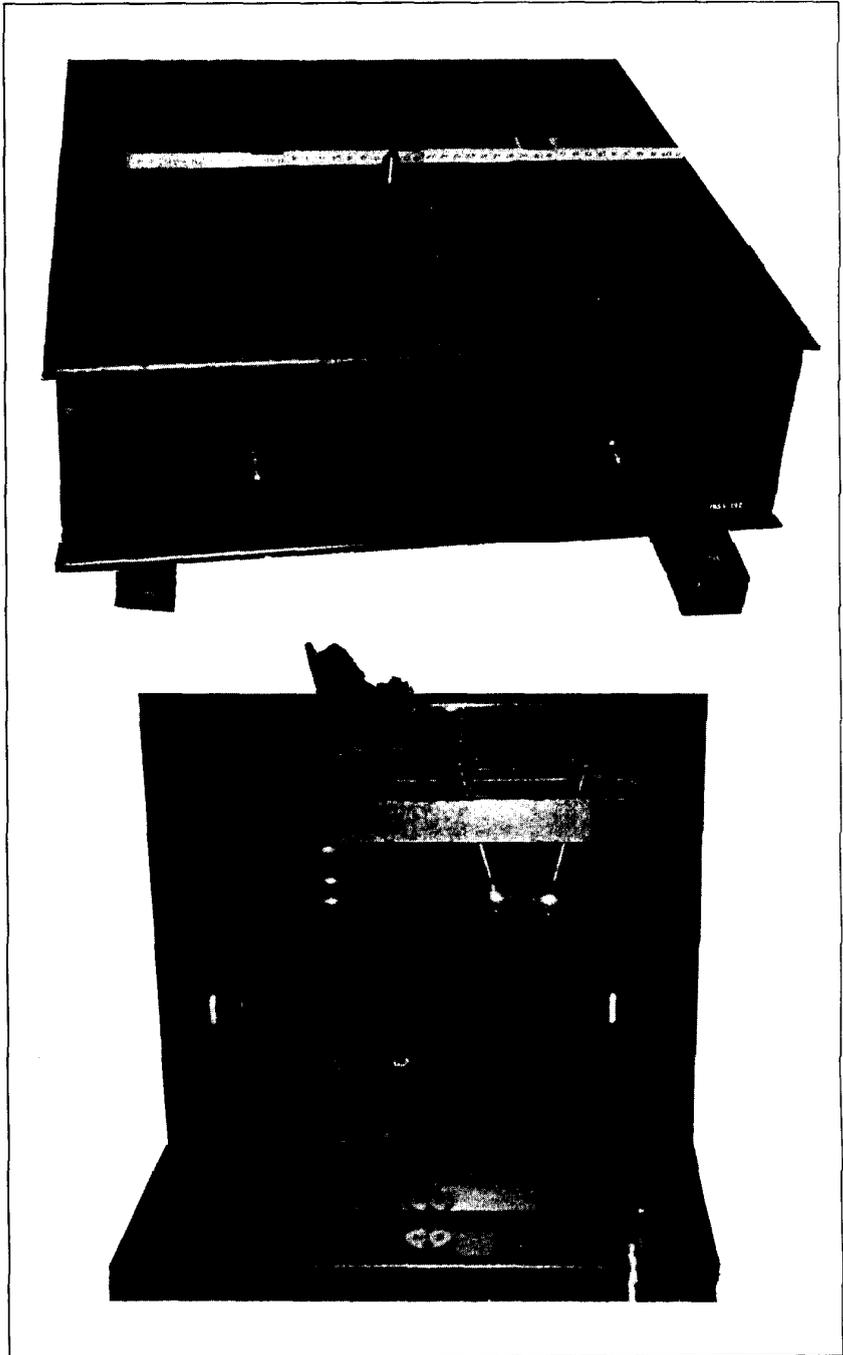
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### Jigger Primary

The primary tuned-circuit had a much lower L/C ratio, the spark capacitance being provided by a bank of Leyden jars in series-parallel configuration, while the inductance was a turn or two of wire on the jigger plus substantial stray inductance in the leads. This stray reactance does help to reduce the overall coupling constant from spark circuit to aerial circuit; but in these earliest transmitters there seems to have been no organized method for adjusting the coupling. The primary tuning could certainly be adjusted by changing the number and/or configuration of jars, though these themselves could have shown wide variations in capacitance unless pre-selected. It certainly looks as though the operator had no way of tuning the transmitter. And perhaps he had no need to, once the Marconi installation engineers had finished the installation and had checked it "on the air." There is some advantage here, in that fixed tuning with no aerial loading coil to adjust meant lower capital costs. But also the operator could not easily mistune the transmitter, accidentally or intentionally. The problems and the cost of tuning to 60 meters must then have been with the installation engineers, though how they juggled the variables of Leyden jars, jigger secondary turns, wiring disposition and the aerial length and shape we can only guess.

### And After That?

With the benefit of hindsight I have already mentioned the possibility of bending any excess aerial wire down to the horizontal and taking it in the direction of an adjacent mast. This is the kind of empirical solution an intelligent engineer would undoubtedly try when faced with short masts; back then to the key, and if all was well the Marconi Company had effectively invented the "inverted L" aerial. As far as I can see from the picture in Hancock's book [4], written for the 1950 Jubilee, the SS Philadelphia had a near-vertical wire some 90 feet to a point on the foremast, continued as a near-horizontal wire back from there to the



**Top: Marconi Transmitting Jigger of 1900. The Science Museum, London, England**

**Bottom: Marconi Transmitting Jigger of 1898 with associated Leyden jar and spark gap. Marconi Museum, Chelmsford.**

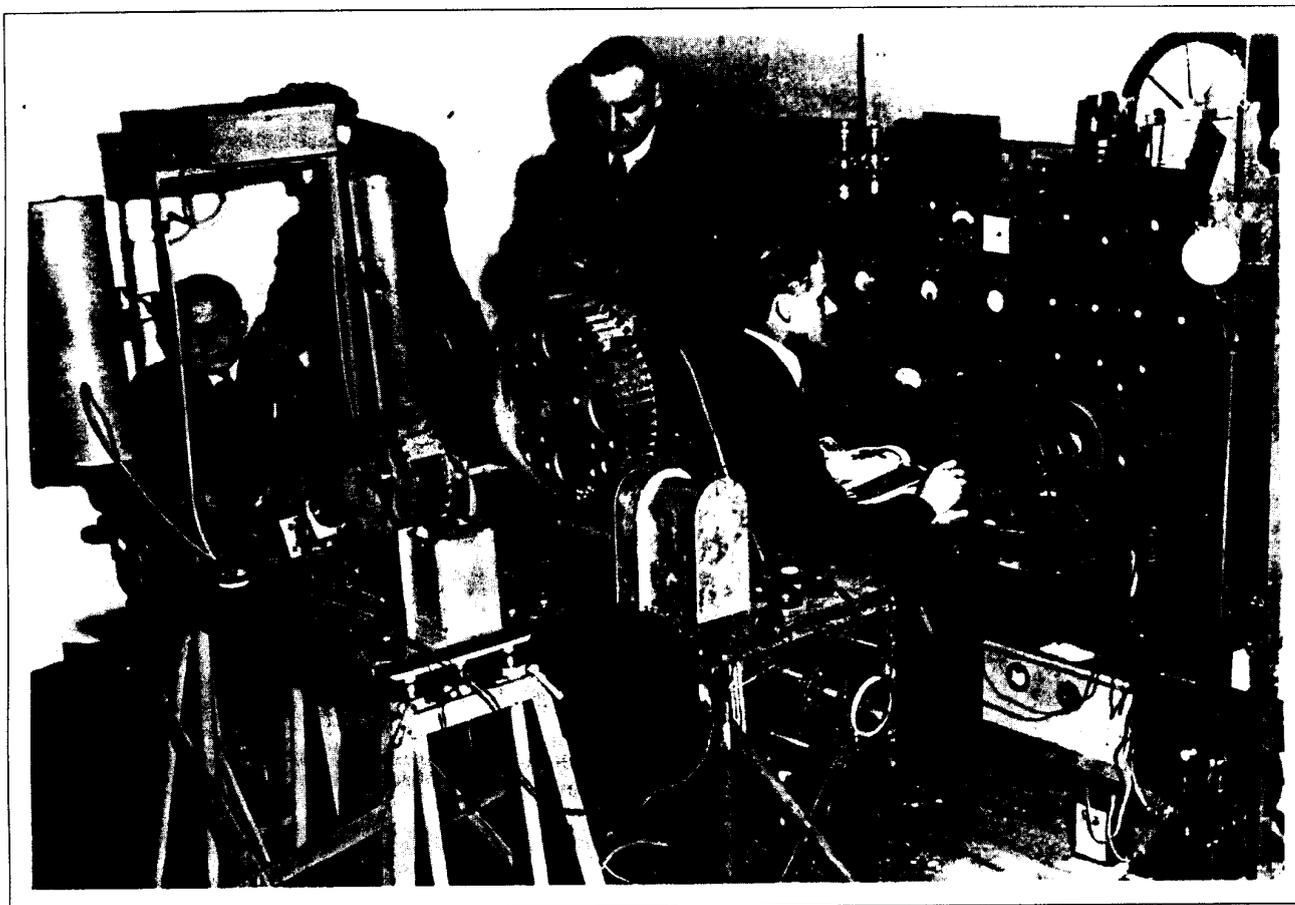
main-mast, perhaps 100 feet to the rear. In the wireless cabin picture already cited, along with the rather unusual jigger with four front terminals, there is a hank of additional wire on a rack; so clearly much longer wavelengths were being explored for ocean-going vessels.

(This text is substantially as printed in *The old Timer's Bulletin*, 32.2).

### Sources

1. *Wireless Communication in the United States*, Thorn Mayes, New England Wireless & Steam Museum, 1989.
2. *History of Radio Telegraphy & Telephony*, G. G. Blake, Arno Press facsimile 1974.
3. *The Origins of Maritime Radio*, R. F. Pocock & G. R. M. Garratt, Science Museum, 1971.
4. *Wireless at Sea*, H. E. Hancock, Marconi International Marine Co. Ltd., 1950.

## Vintage Vision



Harold Bailey G2UF sitting at the control desk. The 60 line mirror-drum scanner (cover removed) is lined up in front of the sitter. Photocells are in the metal boxes above and at the sides.

## Amateur Television Transmissions 1930-35

By Ray Herbert

The activities of those wireless enthusiasts who built their own television receivers in the 30-line days have been recounted in the *Bulletin* (Vol. 10 No. 3) but very little is on the record concerning the transmission of pictures, either on a closed circuit or over the air, by radio amateurs who designed and constructed equipment for this purpose.

In 1930, of the seven half-hour television programmes each week, five went out on weekday mornings when people were at work, which left just two evening transmissions available for the majority of 'lookers in', but at the inconvenient time of midnight to 12.30a.m. Twin brothers Ted and John Holmes now holding the call signs G3ALK and G4GMG respectively but then only 19 years old, undeterred by a serious shortage of pocket money, decided to produce their own pictures to increase the

time available for experimentation. The first arrangement consisted of a 20-line closed circuit system involving transmitting and receiving discs on a common shaft driven by a sewing machine motor. Using a Tungfram Nava E photocell shadowgraphs could be obtained. The results were so encouraging that in the spring of 1931 the Holmes brothers resolved to try out a more ambitious set-up operating on the 30-line standard with the ability to work with reflected light and a separate receiver. This employed the well known flying spot system involving a sharply focused pinpoint of light which scanned the subject in sequential vertical strips. On occasions a mirror-drum would be used as the transmitting projector providing a far more optically efficient arrangement which avoided the considerable loss of light through the small holes in the scanning disc. A photocell detected the degree of scattered reflected light, producing a

current proportional to the intensity. Needless to say this operation had to be carried out in a darkened room.

The flying-spot projector comprised a 200 watt bunched filament lamp located in an old photographic enlarger housing in conjunction with a 30 line scanning disc or mirror-drum and a lens for focusing the light beam. The small current from the photocell was amplified by two screened grid valves with an additional amplifier in a separate metal box. The Tungfram photocell was eventually replaced by an Osram CMG8 which had three times the sensitivity. Initially the pictures were displayed on a disc receiver but a mirror-drum set became available later.

The credit for the first amateur television transmission over the air goes to Owen Relly G22A0. Live pictures were transmitted from his

*Continued >*

# Vintage Vision

> Continued from previous page

## "Amateur Television Transmissions 1930-35"

radio station at Willingdon, near Eastbourne, on 13th January, 1933, and received by his friend Ken Sands G5JZ at Heathfield about 12 miles away. With a low power of 10 watts on a wavelength of 160 metres only local coverage could be expected. He also chose the flying spot system using a modified Baird Televisor with a 500-watt projector lamp in a ventilated housing which occupied the space formerly taken up by the flat plate neon. A lens system for focusing the light spot replaced the viewing tunnel and can plainly be seen in the photograph. The round object on a stand is a saucepan containing an Osram CMG8 photocell. When not in use the lid had to be kept in place to prevent damage to the cell from sunlight. The photocell head amplifier used a screened grid valve followed by five stages of resistance capacity coupled amplification with a PX4 as the output for choke modulation of the radio transmitter. A sound link operated on 5 metres.

During the summer of 1934 Ken Sands had his own television transmitter in operation with the intention of achieving a two-way vision and sound link-up over the air. Unfortunately, at about this time the licensing authority (GPO) indicated that they wished to move these

experimental transmissions down to 10 metres and it is not clear if this interesting project survived the change.

Harold Bailey G2UF, one of the most active of the experimenters, owned a radio retail business in Denton, Manchester, and by the middle of 1934 had completed an ambitious amateur television transmitting station. The most significant innovation was the use of a 60-line mirror-drum scanner or camera which resulted in a considerable improvement in definition.

Two mirror-drum cameras had been constructed. One for the 30-line transmissions on the 10 metre amateur band, the other operating at 60 lines and 16.6 frames per second to be used on a closed circuit. The 60-line mirror-drum, driven by an induction motor separately synchronised by 1 kHz impulses, had a diameter of 15 inches. A 300-watt carbon arc provided the high-intensity light beam.

The 10 metre amateur band extended from 28 to 30 MHz which enabled the separate vision and sound channels to be accommodated without mutual interference. 30-line transmissions were made over a distance of nine miles and received on a 28 inch by 14 inch screen. This exceptionally large picture resulted from the use of techniques similar to those employed

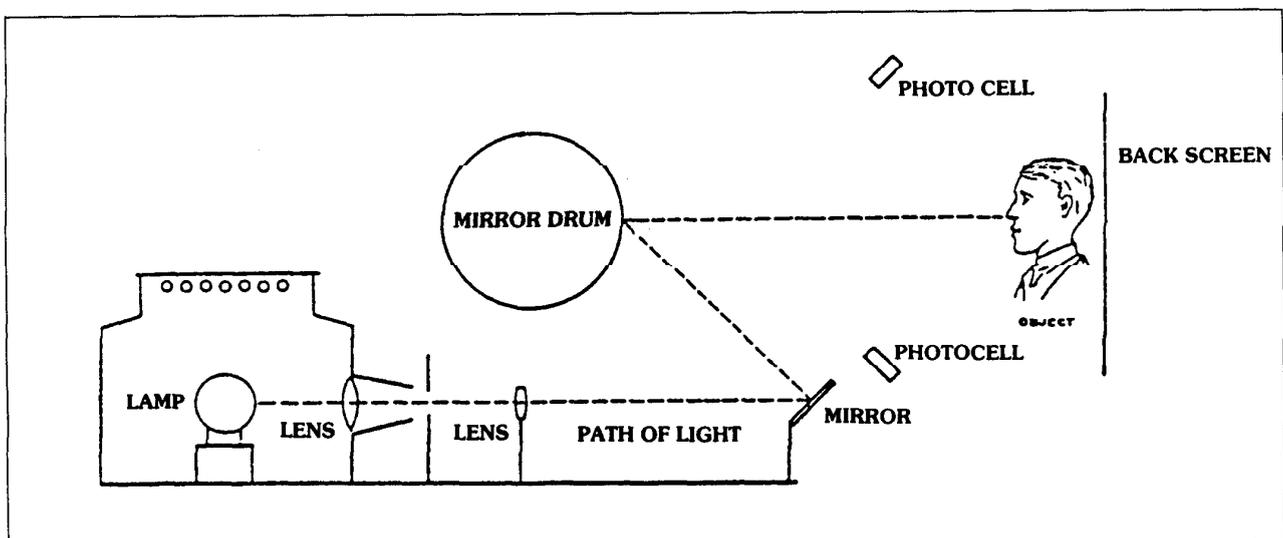
in the studio. An arc lamp provided the high level of illumination necessary to compensate for the loss of light through the Kerr cell which modulated the beam prior to the scanning action of the mirror-drum (see Bulletin Vol. 15 No. 4 page 47).

The BBC progressively reduced the time allocated to television programmes in spite of improved studio techniques and the unflagging efforts of the producer who put on the most imaginative presentations. By April, 1934, there were only two half-hour transmissions a week and only one of these occurred during the evening when people were at home.

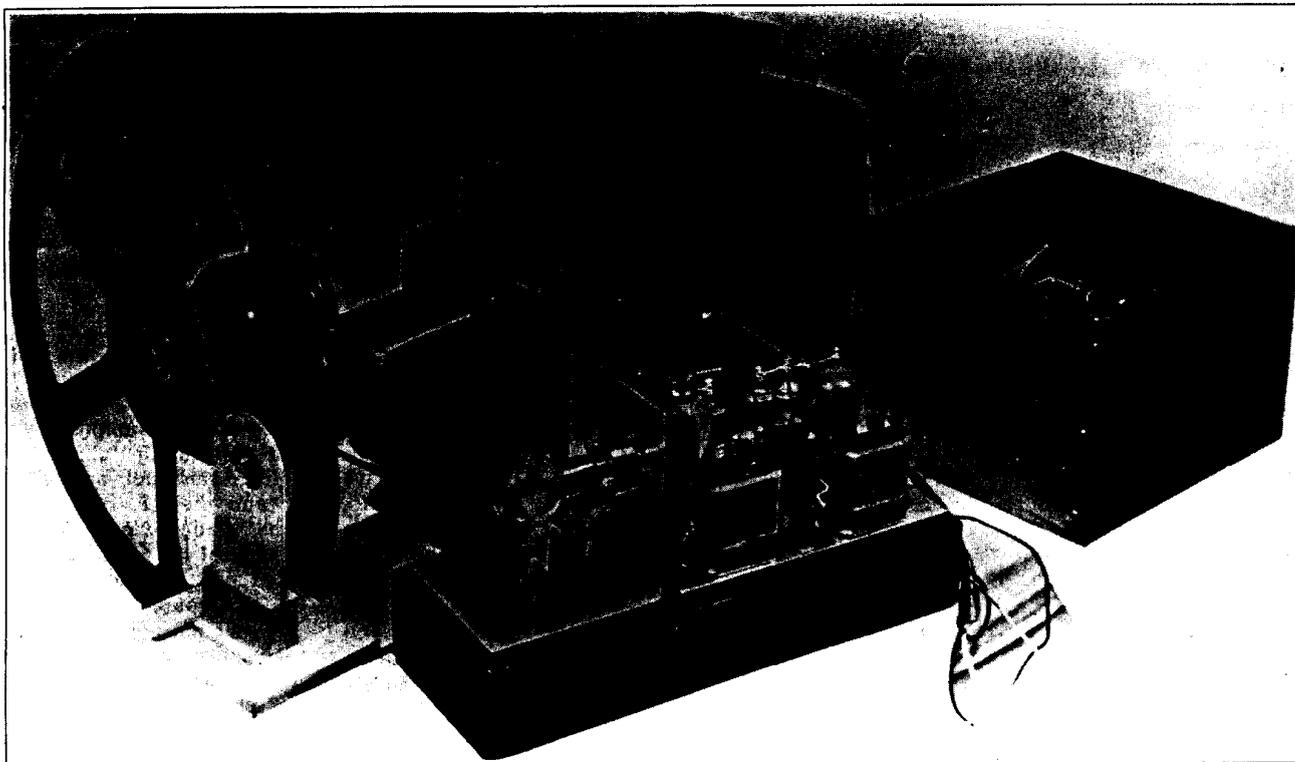
In September, 1935, the BBC 30-line service closed down and for the following twelve months this country had no television programmes at all. Television records were obtainable for ten shillings (50p) playable using an ordinary pick-up and providing moving pictures on otherwise obsolete vision receivers.

Little more was heard in relation to the practical application of this pioneering system until 1975 when Douglas Pitt founded the Narrow Bandwidth Television Association. It now has a thriving and enthusiastic membership; and in the UK, Holland, Australia and the USA low definition pictures are once more being demonstrated, providing an interesting glimpse into past techniques.

Below: The flying-spot transmission system - from Harold Bailey's 1934 sixpenny booklet.



## Vintage Vision

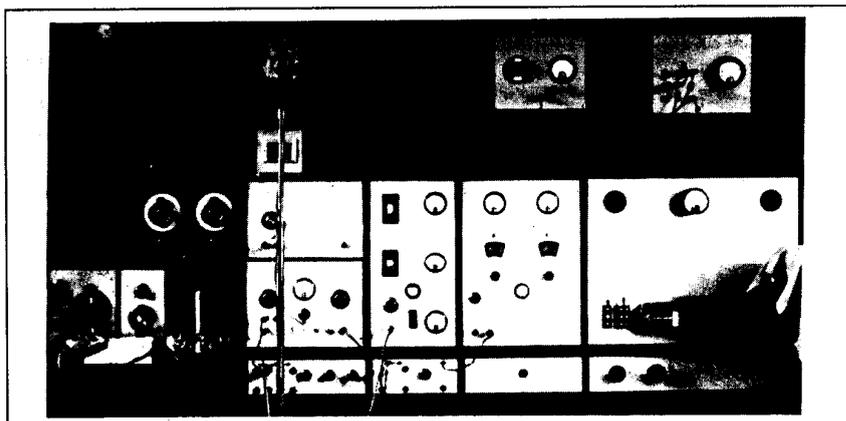


Above: Closed-circuit 30 line scanner built by Ted and John Holmes, 1932.



Above: Flying-spot scanner at G2A0.

**The Photographs:**  
Two of the photographs in this article have never before been published and the others have not been seen for 54 years. The two photographs of Owen Relly's equipment were taken by Ray Herbert as a schoolboy in 1935 with his Zeiss box camera on a visit to Owen Relly.



Above: Owen Relly's neat vision and sound transmitters at G24A0 in 1935

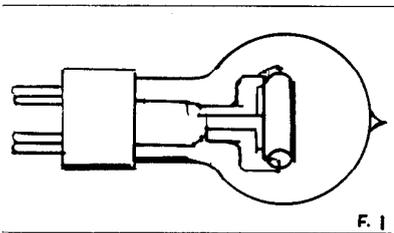
## Technology

### Receiver Techniques of the 1920s. Part 1

by Pat Leggatt

#### Valves and Crystal Sets

Reliable triode valves were first developed in France during World War I by General Ferrié and his colleagues. The receiving version, with a degree of vacuum sufficient to avoid ionisation (blue glow) at anode voltages up to 150 volts or so, was known in England as the R valve<sup>1</sup>(Fig 1).



Government surplus and new production R valves were available on the amateur constructor market after the war; but they, and the batteries to energise them, were quite expensive and many people bought or built the cheaper crystal sets. Even sets which incorporated a valve often employed a crystal detector with the valve as an HF and/or LF amplifier. The widespread use of crystal sets in the early 1920s was recognised by the BBC who planned their transmitter network to bring as many people as possible 'within crystal set range'.

#### Aerial tuning

It was a common concept in the early days that the aerial should be tuned rather than the receiver as such. The Post Master General, at that time the authority responsible for broadcasting matters, decreed that a receiving aerial could be up to 100 ft in length, including the down lead; such an aerial has considerable capacitance of the order of several hundred pfd.

To tune the aerial to a broadcasting frequency it was therefore only necessary to include appropriate inductance in the aerial/earth path. For tuning to the wanted station, the inductance had to be variable and three techniques were employed. The most obvious approach was to provide a slider control running along the length of the tuning coil, thereby bringing the required number of turns into circuit. A variation on this theme embodied coarse tuning by means of a rotary stud switch selecting various

#### A New Series

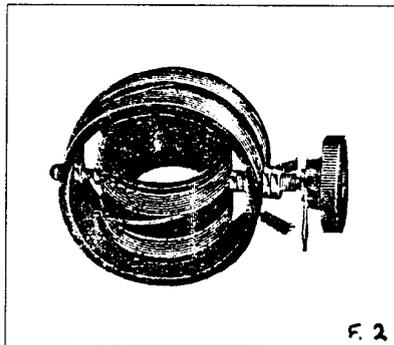
In this issue of the Bulletin we are printing the first of a series of short articles by Pat Leggatt reviewing the circuitry and other features of wireless sets of the 1920s. Each article will outline a particular aspect of sets of this period and the series as planned at present will cover the following areas.

1. Aerial Tuning: Valve and Crystal Sets
2. Long Wave Tuning: & Isolating the Aerial
3. Improving Sensitivity: Reaction
4. Improving Sensitivity: HF Amplifiers
5. Economising in Valve and Battery Life
6. Volume Control
7. Simplified Controls
8. The Superhet: Act 1
9. The Screen Grid Valve
10. Detectors and LF stages
11. Loudspeakers
12. Mains Operation
13. The Superhet: Act 2

These thirteen parts will appear in successive Bulletins over the next couple of years or so; and it is hoped that the series will be useful and interesting in particular to those members who are comparatively new to the vintage wireless scene and not so familiar with the techniques of earlier days.

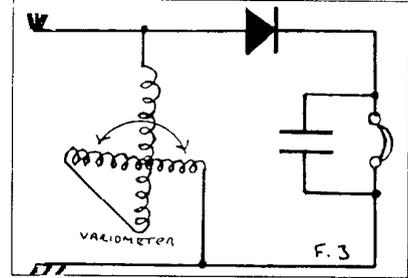
tappings on the coil; with fine adjustment by a second stud switch selecting more closely-spacedappings on a small part of the coil, or sometimes by means of a variable condenser. A switch was sometimes provided to connect a condenser (fixed or variable) in series or in parallel with the coil to extend the tuning range or to cater for long or short aerals.

A rather more elegant method of inductance variation was the variometer (Fig 2).



This consisted of a coil wound in two separate sections, an inner one being arranged to rotate within the outer one. The two sections were wired in series and the overall inductance depended on whether the inner section was oriented so as to inductively aid the outer, or to oppose it. The inner section shaft extended through the receiver front panel and carried a tuning knob giving con-

tinuously variable inductance over a useful range (Fig 3).



Another approach to variable inductance was the rather odd 'spade' method<sup>2</sup>, devised by C.S.Franklin of Marconi's and appearing almost exclusively in their sets such as the Crystal Junior and the V2. Here a copper plate, the 'spade', was moved by the tuning control so as to progressively overlap a flat-wound tuning coil. This acted as a coupled shorted turn and the greater the overlap the more the coil inductance was reduced. The spade must incidentally have increased the effective self-capacitance of the coil, but nevertheless the overall effect was to increase the resonant frequency of the coil/aerial combination and the arrangement formed a usable tuning system. However it was not fully satisfactory since resistive losses in the spade, even though it was of high-conductivity copper, damped the tuned circuit and degraded the selectivity.

Marconi's seemed very taken with this 'shorted turn' tuning principle and used it in a different form in their later Type 21 and 31 sets. In these an annular tuning coil was enclosed within a copper ring rotatable by the tuning control. The coil inductance was reduced when the ring was in the same plane as the coil and hence tightly coupled, but was unaffected when the ring plane was at right angles to that of the coil.

Where variable condensers were used for tuning they were generally similar to today's devices with rotating interleaved plates. A variation occasionally seen was the 'book' type in which two plates with a common hinge, separated by a mica sheet, were pushed together against spring pressure by a cam mechanism: but this was not very satisfactory since nearly all the capacitance variation occurred during the last bit of movement when the plates were very closely spaced.

#### REFERENCES

1. Gerald Garratt: "Why the French R Valve?"; Radio Communication Feb.1981. "Wireless Telegraphy" Ch.IX: Rupert Stanley, Longman, Green & Co 1922. 2. "Harmsworth's Wireless Encyclopedia" Page 2110: 1923. British Vintage Wireless Society Bulletin: Vol.8 No.1. June 1983.

## Tuning-in the avant-garde

Vintage wireless sets played a major role in a unique performance of a work by the famous avant-garde American composer John Cage on the "Radio Programme" on BBC Radio 4 recently.

The programme, broadcast on March 15, began with the playing of an Italian recording of John Cage's 1956 composition "Radio Music", a work in which performers are required to do nothing more than tune and retune radios for a total of six minutes, following a precise score. Introducing the programme, Professor Laurie Taylor, the presenter, explained that as John Cage is celebrating his 80th birthday this year, the BBC had decided to produce another performance of the piece; one which uniquely would be specially recorded for radio and in which the radios would be played by a distinguished cast.

Professor Taylor, one of the seven performers, then introduced the rest of his cast: Marmaduke Hussey, Chairman of the BBC Governors; David Hatch, Managing Director of Network Radio; the conductor and composer Odeline de la Martinez; John Cage's Biographer, David Revell; Radio 1 Disc-Jockey Jakki Brambles; and Robert Hawes, Editor of the Bulletin of the British Vintage Wireless Society.

"As our star-studded cast assembled" Professor Taylor continued "it became clear that it was not going to be all plain sailing".

Robert Hawes had been asked to provide suitable radios, having previously worked with John Cage on performances of a composition requiring a dozen 'Fifties electric gramophones and a wind-up horn-machine to play excerpts from 200 vintage operatic records in combination with two grand pianos, four sopranos, a mezzo, a tenor and a bass for an International Festival of Contemporary Music presented in London, Paris, Berlin and Strasbourg.

For the performance of "Radio Music", Robert chose sets of a vintage that matched the period of the music: Bush DAC 90's and "A" versions and a KB "Toaster", all provided with aerial leads since it was obvious that their frame aerials would be inefficient in Broadcasting House. On arrival in the concert hall, which was designed in 1932 to exclude any kind of wave that wasn't invited down an aerial lead-in, Robert enquired "where's the aerial socket?" only to be told such things no



Distinguished performers tune in their "instruments" at Broadcasting House London before the performance of "Radio Music": (left to right) Marmaduke Hussey, Robert Hawes, Jakki Brambles, David Revell, David Hatch, Odeline de la Martinez, and Professor Laurie Taylor.

longer existed there. Programmes are now piped-in direct – the aerial on the top of Broadcasting House is simply a decorative dummy. To have used ready-tuned signals would have been cheating, so the performance had to be moved to a studio nearer the top of the building where temporary aerial wire could be slung out of a window.

The radios and performers were eventually positioned and as the musical scores were handed out, there was an undignified scramble for the simpler parts but no dispute that the most complex ones should go to Odeline de la Martinez and John Revell, who both attempted to dispel the curious mixture of tension and levity of the performers. "Take it seriously and get it right" they advised. The parts consisted merely of numbers corresponding to frequencies of stations to be tuned-in within a rigid time-sequence and with controlled dynamics and volume. Although the contrapuntal possibilities may have been worthy of Bach, the effect was more of a Bartokian frenzy. "Chance" elements are built into the score, because performers have no control over what comes out of the radios as they tune them: it could be pop or classical music, football commentaries, morse code, static, squeals or simply silence – which John Cage says is as important as the sounds. Performers are also instructed not to cheat by nudging along the waveband to get a proper station.

As the programme proceeded, the engineers behind the glass looked slightly perplexed, but recorded it all with bemused competence, while the performers appeared to enjoy it.

Marmaduke Hussey, a man accustomed to decision-making who had abandoned

himself to chance on this occasion, commented "I found I was a bit weak on the twirling – but my radio certainly played its part in the silences". Jackie Brambles said she could not see it making its way into the top 40, while David Hatch, of whom Professor Taylor said "the only music I associate you with is the Angus Prune Tune", waggishly complained that his score was wrong and that nothing at all came out of his radio, but claimed that there had been a "quality" to his silence.

Professor Taylor summed it all up: "All in all, just about the blend of attentiveness, apprehension and cheerful absurdity which is said to characterise most public performances of works by Cage".

Perhaps best known to the general public for this piano work "4 minutes 33" consisting entirely of a silence lasting for exactly that length of time, John Cage, as with many modern and post-modern artists, has often been met with a mixture of shock, derision and laughter by both the public and critics. Like the Dadaists, he has continually provoked people into re-examining their notions of what music and art are about and has challenged the eliteism and conservatism of institutions. Pieces like "Radio Music" may not themselves survive as works of art – but they shock us into looking at the relationship between "sound" and "music" in a new way. Despite the opposition to his ideas, the influence of John Cage on 20th century music has been considerable.

Radio collectors might like to try out this idea for themselves, by getting together some fellow enthusiasts and discovering whether fixed notions about sound will yield to the twiddling to a variable condenser.

## Reminiscences

# Closing of BBC Daventry

the end of an era.

Leslie W Turner FIEE

Head of Engineering Information,  
BBC (Retired Decemeber 1971)

The closure of the BBC's Transmitting Station at Daventry on 19 March 1992 marked the end of nearly 67 years of BBC Broadcasting from Borough Hill overlooking the Northamptonshire town of Daventry. Opened in 1925 with the bringing into service of the new high power long-wave transmitter 5XX, Daventry is the oldest BBC transmitting station.

The BBC's first high power medium wave transmitter 5GB was brought into service in August 1927 at Daventry inaugurating the BBC's Regional scheme. Both these services were transferred to Droitwich in 1930. The BBC's Empire Service, later to become the World Service, started from Daventry on 19 December 1932 and was transmitted on shortwave from two relatively low-power transmitters. High-power shortwave transmitters up to 100KW were added between 1937 and 1940 during which time the number of masts was increased to take the extended aerial system.

It is understood that work on dismantling the Daventry masts and aerial system will start very soon and all but one of the masts, having heights up to 500 feet, will be demolished and used for scrap. These masts which have been a feature of Daventry town's skyline for many years will undoubtedly be sadly missed.

The BBC programmes broadcast worldwide from Daventry have been transferred to alternative BBC stations. The official switching off of the last transmitter at Daventry, marking the end of an era, took place at 11.30 GMT on Sunday, 19 March 1992. All existing and ex-members of Daventry staff along with their wives were invited to the ceremony at the transmitting station. Some 400 attended including the writer who served at Daventry from 1936 to 1948.

This was an interesting period of development. When the writer first arrived there was a total staff of 22 and three low-power shortwave transmitters in operation. When he left in 1948 the total staff had increased to over a hundred and there were 11 shortwave transmitters, including 8 highpower, 6 with powers up to 100 KW.

During the war years, as would be expected, there were some tense period. A number of incidents, some tragic and some humorous, will be remembered by Daventry wartime staff. To recall but a few – as Daventry was near the flightpath of American bombers from the USAF base a few miles away there was a fairly regular flow of aircraft over the site. These aircraft normally flew at safe heights above the aerial masts which were blacked out at night. But on one occasion a Flying Fortress returning in the early hours of the morning from a bombing mission on Germany came in too low with disastrous results, colliding with one of the Daventry masts, and crashing in flames and killing all the occupants of the plane.

We were always apprehensive about flashovers and corona dischargers on the aerial system as they virtually killed the blackout at night time. On one dark winter's night when there was a lot of ice on the feeders and aerials, the writer, who at that time lived on the Daventry site, saw what was thought to be a large number of coronas spread around the aerial system and ordered the transmitters to be switched off as there was an air raid taking place on nearby Coventry. It was quickly realised however that these were not corona discharges on the iced up aerial system but flares being dropped from enemy bombers overhead. It was thought that an air attack was imminent. But nothing happened. In fact Daventry was never bombed throughout the war. The only attack was when a single enemy aircraft flew over the site at low height in daylight and machine-gunned some outside workmen, fortunately with only one minor casualty.

There was a military guard at Daventry which in the early days consisted of old-timers who were issued with rifles and ammunition. They patrolled the site at night and on one occasion there was a brilliant corona discharge on an aerial feeder a few yards in front of one of these guards. The feeder was carrying a programme in German and the

corona was modulated accordingly. The old soldier had never experienced anything like this – he saw a flashing light and heard a loud German speaking voice. He thought the site was being attacked by German paratroopers so he fired his rifle and unfortunately shot himself in the foot.

To conclude on a lighter vein, there was the incident of the engineer who went out in the dark on his bicycle to switchover an aerial array about half-a-mile away at the end of the site. Having carried out this operation he should have phoned the transmitter engineer to tell him the aerial was ready for transmission. This he failed to do and as the time for the start of the programme was slipping away the situation got a bit worrying particularly as there was no sign of the engineer. He had in fact encountered a very fierce military guard dog which had broken loose and was roaming around the site. To escape its attention the engineer had managed to climb up a feeder pole. And this is where the engineers searching for him found him with the aerial still needing to be switched. The result was that the start of programme was delayed. The announcer in London who had to make the apology announcement for this to listeners was told the trouble was due to a technical hitch but he must have had a strong sense of humour as when later he was told the real reason he remarked "surely it should have been described as a technical bitch".

### Editor's note:

Leslie Turner is now 82 but is still professionally active in broadcasting as a consultant. He has been in broadcasting for most of his working life, and it has taken him to some fascinating places. In 1936, as an installation engineer with the Marconi International Marine Radio Company, he sailed on the maiden voyage of the Queen Mary from Southampton to New York, testing out the ship-to-shore radio on which he had worked.

He came straight back from the return trip to join the BBC, with whom he remained for almost 40 years.

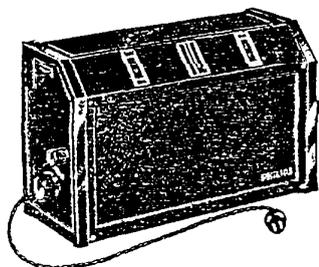
In 1949, he was seconded to the Colonial Office, with the brief of carrying out a broadcasting survey for the four British colonies in West Africa: the Gold Coast, Nigeria, Sierra Leone and the Gambia. His task was to put forward proposals to establish sound broadcasting services (or to improve such services where they already existed). After six months, he made his recommendations – and they were all accepted. But it was his last 20 years with the BBC that he found the most interesting: he represented the BBC worldwide in establishing broadcasting standards, and in the UK was responsible for keeping the public and the Press informed of engineering developments.

Leslie was a member of the first IBC Committee in 1967, and, after he retired from the BBC in 1971, he became IBC Publicity Consultant.

## Vintage Technology

### A rare beast

by Geoffrey Dixon-Nuttall



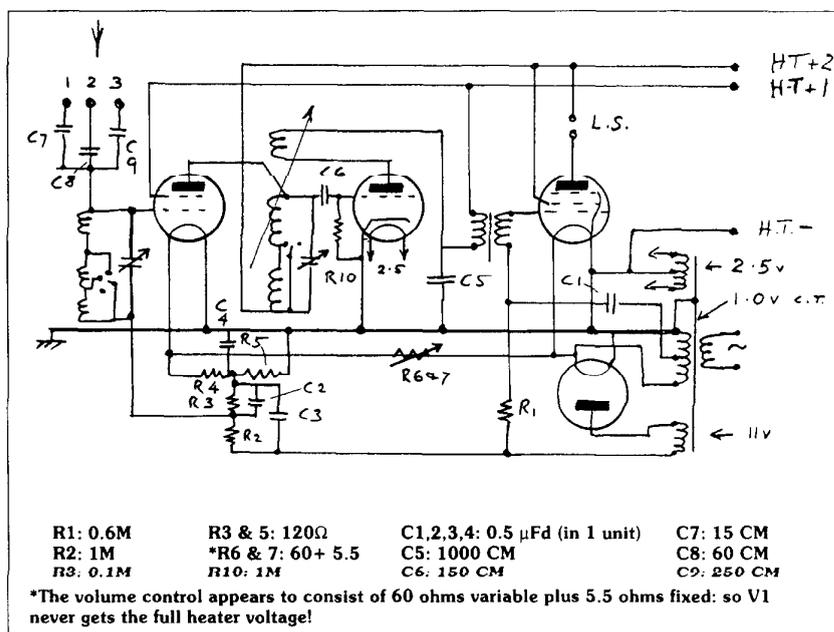
The Philips 2514 is well known and respected as Philips' first mains set. It had a predecessor which is very rare and by courtesy of Rupert Loftus-Brigham I recently met one, the 2503. That, at least, is what it says on the plate; but nothing is straight-forward, as we shall see.

As is normal with sets from Philips, this has several unexpected features. The actual radio circuitry is nothing out of the ordinary, being very similar to the 2514, and sharing its strange tuning arrangements; what is odd is the power supply.

Two of the valves use the first generation of A.C. heaters, when the idea was to use the thickest filaments possible. This led to the 0.8 range from Marconi-Osram, and Philips produced their 1 volt range, both being very short-lived. (The corresponding American type 26 had a much longer life). The screen-grid is type PM11, and the output pentode is a PM 21. The detector had to be indirectly heated to avoid hum, and is type 152T, with a 2.5 volt heater taking 1.5 amps! These are Mullard equivalents of the Continental types C 142, F 215, D 143. In fact they probably are the same valves, re-numbered and pretending to be made in England.

By courtesy of Gordon Bussey I have a copy of the Philips circuit diagram, which is somewhat confusing. I have had to re-draw it because it was in a bit of a state, and also because most people find Philips diagrams impossible to follow.

The position seems to be that the basic set was the 2502. This was for battery operation, using 4 volt valves. The power unit type 2503 converted it into a semi-mains set, with a change of valves. Philips list this set as type 2501, in spite of



the type plate on the back saying 2053!

The position of the rectifier is not the same as given by Biraud, (see "Les Radio Philips de Collection"). This is a half-wave rectifier type 2504, which is a funny little thing with a bayonet base. This also has a 1 volt heater. This one would expect to be the source of H.T.; no, it supplies bias. The H.T. comes from a separate power supply in the form of a battery eliminator, type 3002. This supplies two H.T. voltages, the high line going to the output valve and the screen grid anode, and the low one feeding the detector anode and screen-grid screen. The actual voltages are not marked, but there is a label advising the user to try for the most satisfactory results; as there is a choice of six sockets this could take time!

These valves are not mentioned in any of the usual lists, but I finally ran them to earth in the "Illustrated History of Philips Radio Valves". According to this the output valve D143 heater takes 60 mA at one volt; this can't be right! This book is thick with errors, and this must be one.

The 2504 is still listed in the 1937-8 Lugton catalogue. I doubt if there were many customers for this by that time.

As there are fewer components the set is shorter than the 2514, but in the same presentation. There is no

mains on-off switch; there is an "off" position on the wavechange switch, left over from the battery set, but it does nothing. According to the circuit diagram, there is no thermal cut-out either.

Note that the volume control works in the time honoured way, by dimming the filament of V1. As the current is so large (The book says 0.25 Amps; another error?) the control must be quite massive, and although I have not heard the set working I would expect there to be a considerable delay before anything happened.

It is difficult to see any advantage in this curious arrangement; as a suitable rectifier was available, and used in the battery eliminator, why not make the set completely self-contained? The only suggestion that comes to mind is that as this set was a modification of the battery operated 2502 there was not room for a decent sized mains transformer. Or did they want to get rid of a quantity of battery eliminators?

So what we have is a set half way between the battery set and the later 2514. It is difficult to imagine Philips selling many of these strange things, and the 2514 was much more practical, so that it is probably very rare. It is dated April 1927, which makes it one of the earliest mains sets. Or would have been if they had finished it!

## Book Reviews

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### Book Reviews

by Robert Hawes

*"More Golden Age of Radio" by John W. Stokes, obtainable from specialist booksellers. ISBN 0 908639 29 X.*

This impressive book is a follow-on to "The Golden Age of Radio in the Home" from an author who is already well respected for his "70 Years of Radio Tubes and Valves" which is now regarded as a standard work. These earlier books have both gone into second editions and one is glad to see they are still available.

The new book, a good companion to the first one, in no way repeats material but extends the general theme and adds a great deal of additional information as well as a wealth of new illustrations, much of which features rare and unusual receivers and has not before been in print. What is nice about the pictures is that they are mostly taken from original manufacturers' publications, so that they are perfectly authentic. John is to be congratulated for building up such a splendid source of early material and for researching and analysing it in such a painstaking way. The information is clearly and logically presented and the employment of original material makes acceptable the occasionally variable quality due to the use of old images.

An accomplished technical writer, John also has a flair for making his text accessible to the lay reader. Having constructed his first crystal set in 1929 and spent a lifetime as a radio and television repairman, he knows his subject from the bench and is able to provide some valuable information of a sort not usually found in books.

The new book deals mainly with sets from Australia, New Zealand, the United States and Canada but has an interesting British section which demonstrates how UK manufacturers managed to penetrate foreign markets from the early Twenties. There is also a miscellany of sets made in Germany and Japan which contains some unusual items.

This history of wireless is not simply one of the development of the technology. In trying to preserve what is vintage is it important that we should place it within its social, economic and political contexts. Books like John's help to do this.

An illustration of his ability to reveal "The story behind the set" is John's piece about Thomas Edison's brief dabble in radio. The great inventor dismissed radio as "a commercial failure" in 1926, but three years later when the meteoric new industry knocked out his phonograph and record market, he bought a radio factory. Its products included the attractive "Mickey Mouse" set but the depression ended production after a year.

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### Book Review

*"The Radio Companion" by Paul Donovan. Harper Collins London. £25. ISBN 0 246 13648 0.*

**A reference work about radio personalities and programmes from the early days to the present rather than about the sets themselves, this book will nevertheless find its way on to the shelves of many collectors.**

There are 400 entries, some with illustrations, on personalities from John Henry of 2LO days to the Pop Pirates and Jonathan Ross. It also answers hundreds of questions such as: which DJ was sacked by the BBC for saying the transport minister's wife passed her driving test "because she slipped a fiver" to the examiner?

There are sharp and witty biographical paragraphs on people as varied as Marconi and Mrs. Mopp. A rightful place goes to:

"Wells, Gerry (1929- ) Creator and curator of what is probably the world's most comprehensive museum of old radios. He has about 1,000 sets, all from the pre-transistor age, in the detached Victorian house in West Dulwich where he was born and still lives. He established the Vintage Wireless Museum in 1974, the year after his radio repair and amplifier manufacturing business went into liquidation.

Rates and electricity on the house are paid for by Paul Getty, in thanks to Wells for repairing a rare 1924 HMV prototype radiogram (in which the sound was amplified by a diaphragm, not a horn) which Getty had bought at auction. He lets visitors tour his collection, by appointment.

### Book Review

*"The Lost Voice of Queen Victoria" - the search for the first Royal Recording, by Paul Tritton. Academy Books, 35, Pretoria Avenue, London, E17 7DR. £11.95.*

Queen Victoria, in her remarkable age of invention, used the telephone and can claim to have owned the first home radio, but was oddly reluctant to have her voice recorded for posterity on the "Wonder of the Age - the Talking Machine", it seems. But in a splendid bit of research that reads like a detective story, Paul Tritton has tracked down a cylinder, "buried" in the Science Museum for 70 years, on which the latest audio technology may reveal the traces of Her Majesty's Voice.

Victoria was the first reigning monarch to make a sound recording - a phonograph was taken to her at Balmoral - but it has hitherto been thought to have been lost. The unique recording session was arranged by another remarkable Victorian who has been largely unsung: Henry Edmunds, an inventor who witnessed Edison's first "Mary had a little lamb" recording in 1877 and who claimed to have made the first telephony transatlantic broadcast (the author is researching the latter and promises us further information).

This story of how the "lost" recording was eventually played is fascinating, but confirmation of the authenticity of it still leaves a question-mark.

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### Book Review

*"Guide for Radio Collectors" by Enrico Tedeschi of the Museo della Radiofonia, Rome. £8 including post from the author, Via Fanocle 30, Rome.*

This guide contains much useful information and must have taken a lot of work to produce. It is a pity that there is at present only an Italian version, although the author is considering producing others, including an English one. Also, due to the economics of small-scale publishing, the production is by photocopy-machine so the illustrations are not of high quality. But despite these limitations, the non-Italian-speaking collector will find it of interest. Included are lists of societies, a directory of technical and collecting books, details of museums, and lists of source materials, videos and cassettes.

## Feedback

### Letter

from Stephen Mills  
AJS history

I am writing a book on A. J. Stevens & Co Ltd covering the full history of the company and its products until its closure in 1931.

I have received tremendous help from members of the present Stevens family, but unfortunately the radio manufacturing side of the business is rather sketchy, and I would be grateful for help from your members.

I understood that radio manufacture was started in 1923 at Walsall Street in Wolverhampton by Harry Stevens, one of the founding Stevens brothers. In 1927 production was transferred to Stewart Street, but ceased in 1928.

I would be grateful for the sight of original sales literature, handbooks, photographs or information which could be copied and reproduced in the book. All articles would be returned under cover of 1st class recorded delivery plus reimbursement costs to the sender.

I would be particularly grateful to learn the following:

- Although all the A.J.S. wireless receivers I have seen have A.J.S. printed on the valves, I would be most surprised if they manufactured the valves themselves, So who supplied them?
- Did A.J.S. produce crystal sets and if so, did they publish any sales literature or instructions of how to use.
- Details of company production figures.
- Why did the company stop radio manufacture in 1928?

Stephen Mills, 2 St Andrews Road, Sutton Coldfield, West Midlands. B75 6UG. Tel: (day) 0922 53262 (eve.) 021-378 2857.

### Letter

from Pat Leggatt  
The Théâtrophone and  
Electrophone

Around the turn of the century, music and speech was broadcast over telephone networks from theatres, concert halls and churches to subscribers in Paris (Théâtrophone) and London (Electrophone). There were similar developments in the United States. The systems existed for some years until finally outmoded by the start of wireless broadcasting.

Jack Davis, an American member of the BVWS, is researching the origins and history of these enterprises and would be most grateful for any information, major or minor, that members might be able to offer. If you have anything, please write to me, Pat Leggatt, at Garretts Farm, Pankridge Street, Crondall, Farnham, Surrey GU10 5QU and I will send it on to Jack.

### Letter

from Frank Trier  
Getter again

Re the letter in Vol. 17, No. 1 of the Bulletin, I must say I can see no connection between our word 'Getter' and the German 'Gitter' apart from their superficial resemblance.

Our word 'Getter' which, incidentally, is the same in both German and French (Das Getter, Le Getter), seems rather to be of English or US origin, to which Terman perhaps gives a clue (Radio Engineers Handbook 1943, page 313) when he says that Getters are used to 'obtain' (? get) and 'maintain vacuum'.

Exceptionally too he prints 'Getter' in inverted commas, which tends to confirm it is a made up word or jargon of the valve industry.

The German 'Gitter' on the other hand, in addition to the 'trellis, grille or lattice' meaning obtained from the non-technical dictionary, denotes in radio context the grid of a valve (e.g., Steuergitter, control grid;

Schirmgitter, screen grid).

I should be interested to know more about the origin of 'Getter' if there is another explanation!

### Letter

from Dave Nuttall G4VFG  
RKO Morse

Philip Taylor's letter perpetuates the myth that the morse over the openings of the RKO films contains RKO RADIO PICTURES. It does not. I have carefully checked my recordings of the Astaire-Rogers musicals and they all carry a complete commercial-type transmission as follows:

V V V. A RADIO PICTURE. V V V  
the 'Vs' are standard commercial practice, signifying START and END of MESSAGE.

On the films I have, the letters of A RADIO PICTURE come up on the screen more or less in sync with the morse as it proceeds.

The morse is correct, though not especially fast 20-50 wpm, nor specially machine perfect.

### Wireless Crossword

Here's an attempt at a crossword using a few "wireless words" of which there really aren't enough in our vocabulary. Readers who think they can do better are invited to contribute their efforts. (This one comes from Geoffrey Dixon-Nuttall).

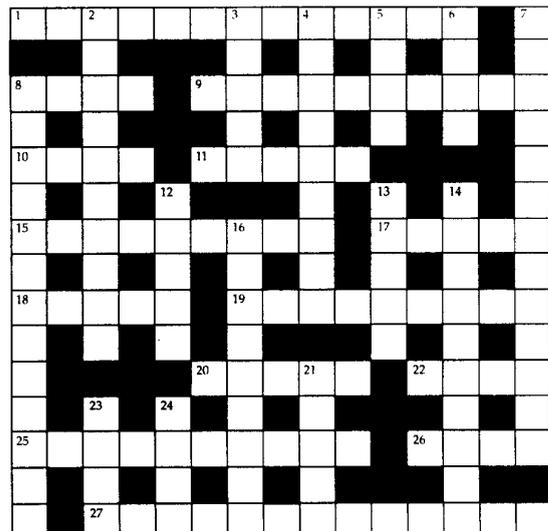
We are sorry that numbers in the grid for our last crossword, No.2, appeared in wrong squares, making the puzzle quite difficult, and apologise to Geoffrey for the error.

#### Clues Across:

- Imp, a fictional invention that enlarges. (13)
- Cad who gets trodden on. (4)
- Shape expert who controls the third, for example. (4-6)
- Happy song. (4)
- Tiny crane-fighter. (5)
- Workman who makes no charge - keep it secret! (9)
- For hanging two ducks in three directions. (5)
- Disneyville. (5)
- Er. (9)
- Positively a poem! (5)
- Fruit that can't fly. (4)
- No motorway race entry. (10)
- Wood bargain. (4)
- e.g. Ekco 510, Phillips 753. (5-8)

#### Clues Down

- Favourite type of share. (10)
- Gibbs used to defend this castle! (5)
- Tram's name is great guns! (9)
- I managed in the Middle East. (4)
- Metric, pecan? The hell with it! (4)
- Retail free air to help you pick up stations. (7-6)
- Vibrating rapidly. (4-9)
- Common artisan. (5)
- High speed grannies. (5)
- Cash the detectives don't quite enter at the same time! (10)
- Ring, like muscle. (9)
- Poor D: he's backward and feeble. (5)
- I'm not F.M.: I'm an Eastern Potentate! (4)
- A reversed spike can sting. (4)



#### Answers to crossword

Across: 1 Amplification 8 Heel 9 Form Master 10 Glee 11 Pygmy 15 Freemason 17 Noose 18 Epcot 19 Hesitance 20 Anode 22 Kiwi 25 Nomination 26 Deal 27 Motor-Operated.  
Down: 2 Preference 3 Ivory 4 Armaments 5 Iran 6 Nuts 7 Ferrite Aerial 8 High Frequency 12 Smith 13 Knots 14 Coincident 16 Sphincter 21 Droop 23 Imam 24 Gnat.

POSTERS: depicting wireless 1922-1956 £4 per set of 3 to members. Cheques 'BVWS' to R.Hawes 63 Manor Road London N17 0JH allowing 14 days for delivery



DISCOVER



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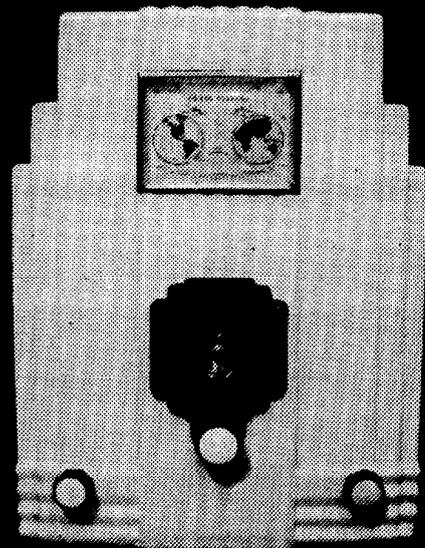
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