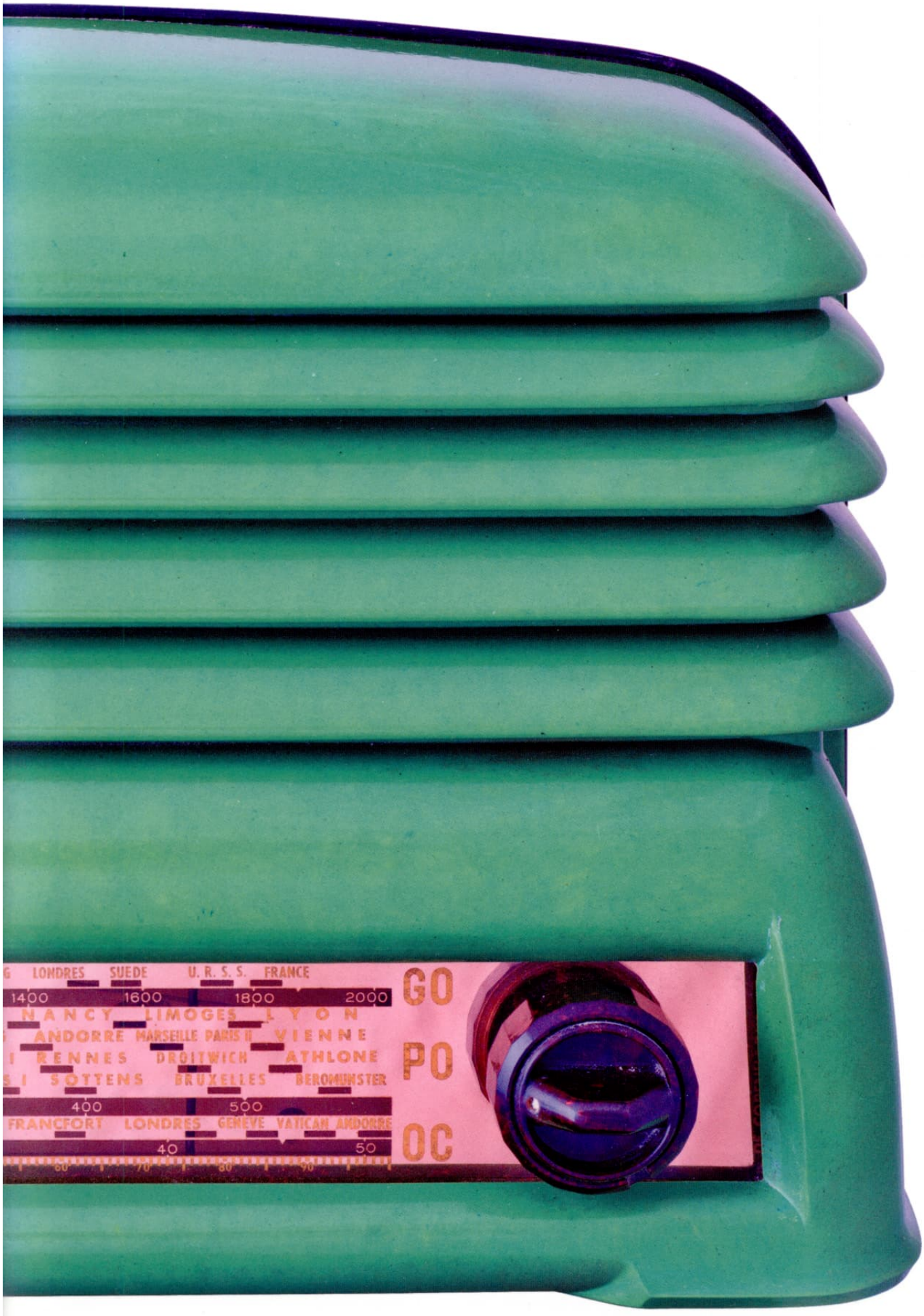
# The Bulletin

Vol. 37 no. 1 Spring 2012




The Bulletin of the British Vintage Wireless Society £5.00 | free to members ISSN 0955-9

# 13th May 2012
# National Vintage Communications Fair
# at The Warwickshire Exhibition Centre

**Now in our 17th year!**
**10.30 to 4.00 £6 admission (under-14s Free),**
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**Up to 250 Stallholders**

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Bulletin of the British Vintage Wireless Society
Incorporating 405 Alive
Volume 37 No.1 Spring 2012

www.bvws.org.uk



Separations and Printing by Hastings Print




Front and rear cover: French LMT type 1840, late 1940

Photographed by Carl glover
Graphic design by Carl Glover and Christine Bone
Edited by Carl Glover. Sub-Edited by Ian Higginbottom
Proof-reading by Mike Barker and Ian Higginbottom

**Contents**



# From the Chair

To start the New Year off, I have pleasure in announcing that Martyn Bennett (current BVWS Committee member) will be taking on the role of new BVWS Membership Secretary. Martyn, who is a very long standing member of the Society, will already be known to many members.

The sales of all Bulletins, Books, other publications and Capacitors will continue to be dealt with by myself and these can be ordered either by post or over the phone by Debit or Credit card.

I will also continue to deal with 2012 renewals for a while longer as they have my return address printed on them.

In recent correspondence, I was asked what "BVWS Announce" was in respect to giving an e-mail address on renewal forms. Simply it is a way in which we as a Society are able to get in touch with the membership by e-mail to alert you to date changes, special events and other late news that we cannot publicise in the Bulletin due to printing schedules.

It is completely private and all received messages come from "bvws announce" as a direct message to "you" without visible distribution lists etc. By the time you read this it will have been used to remind lapsed members that they have not yet renewed. We do not use it without good cause. However we could use it more, but would not wish it to become a nuisance as there is plenty of that already in e-mail.

This year I have had the opportunity to read all of the comments you have placed on the renewal forms. In response to most of them, and taking duplicates or similar comments into consideration, I have compiled some notes/answers which you will find later in this Bulletin.

I would like to thank everyone for their kind and encouraging comments, it is always nice to hear we are getting it right, although we will not be printing "pat on the back" messages as there are far more interesting articles we want to put in the Bulletin pages.

One such comment was the idea that members could bring along a prized object from their collection and display it at Harpenden. We think this is an excellent way for members to put on their own 'Radio Show' and so space will be available for anyone who wishes to bring along a radio or two from their collection to show on tables in the side hall for all to see.

Mike...

# Peter Merriman

It is with great sadness that we report the passing of Peter Merriman.

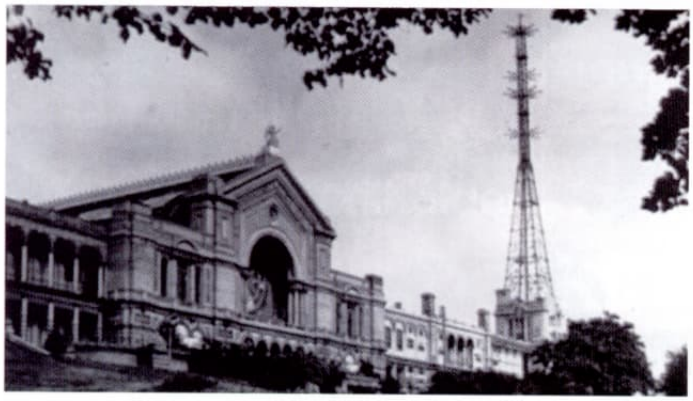
Peter was a member for many years and will be known to many of you, if not by name, then simply as the cheerful man who at every Harpenden auction was holding up 'the next item to be auctioned' for all to view. Often with a smile and witty comment on how very light those RCA AR88 receivers were...

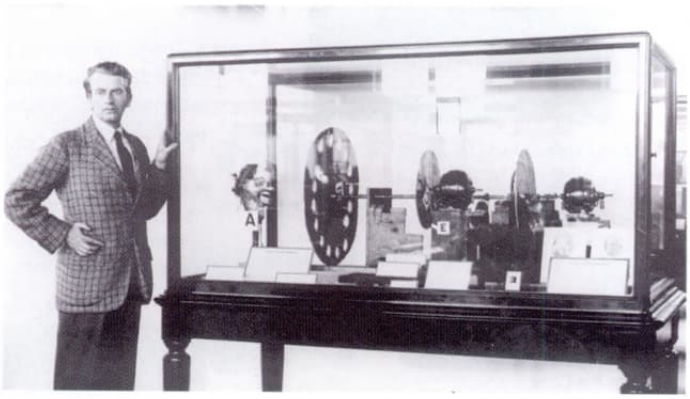
Peter also served the BVWS in exceptional manner by giving his time to proof-read the Bulletin. He will be missed by all of us.

# Television – 75 years after Alexandra Palace

By Malcolm Baird

This is a personal retrospect. It has not appeared in the print media but it was the basis of a short opinion piece in the November 2 2011 issue of Scotland's mass circulation newspaper, the *Daily Record*. Recommended reference books are cited in the text by number and listed at the end.





On November 2 1936, a small group of stiffly dressed dignitaries sat under bright floodlights in London's Alexandra Palace, waiting to be televised. This historic event is said to be the start of the world's first regular high definition television service, although a few months earlier the Berlin Olympic Games had been televised to enthusiastic audiences in special viewing parlours.

The platform group at Alexandra Palace was missing two notable public figures, both scotsmen as it so happened. The director general of the BBC, Sir John Reith (1), was away on a few days' holiday. The television pioneer John Logie Baird (2,3) was present in the studio but he had not been invited to the platform. He later wrote: "All the notabilities … appeared on the platform and were televised. All except Mr. Baird, who sat in considerable anger and disgust in the body of the hall among the rank and file. Thus is pioneer work recognized."

The range of the Alexandra Palace transmitter was limited to the greater London area and only a few thousand households could afford the hefty price of a television set. Viewers were treated to short speeches from the Postmaster General (Major Charles Tryon), the chairman of the BBC (R.C.Norman ) and executives from two rival television manufacturers whose cameras were to be tested for the first few weeks of broadcasting. Baird Television Ltd.was represented by its chairman Sir Harry Greer, a Winston Churchill look-alike. Marconi-EMI Ltd. was represented by a bland American businessman called Alfred Clark, the chairman of EMI. The fifth member of the platform group was Lord Selsdon whose Television Committee had organized the competition between Baird Television and Marconi-EMI.

Selsdon ended the round of speeches with a high-flown line from Rudyard Kipling: "you keep your light so shining, a little in front o' the next!" That line was loosely based upon the Christian gospel according to St.Matthew, ch.5 verse 16. I shall come back to it later in this article.

**Formative years: 1926 to 1936**

Press photographs from 1926 show Baird as a long-haired young man wearing a rather loud checked sports jacket, standing by a mechanical assembly of rotating discs and electric motors and neon lamps… the world's first working television system. In 1928 he sent head-and-shoulders television pictures by short wave radio from London to New York, making front page news in Britain and the USA. From this point on, large companies began to pour money into television research, in particular the cathode ray tube receiver and the electronic camera which were eventually to replace mechanical scanning.

In 1932, Baird Television Ltd., which had been in some financial trouble, was quietly taken over by Gaumont British Pictures (4), a big film-making and cinema combine. After the takeover, Baird Television Ltd. still kept its name and Baird himself stayed on at a good salary, although he lost administrative control of the company. The infusion of capital from Gaumont British

allowed the company to hire talented young physicists, such as Alfred Sommer, Jan Forman and Gilbert Tomes, under the new technical director Captain A.G.D.West.(5).

Baird Television's research began to branch out from mechanical into electronic television and in 1935 the company reached an agreement with Philo Taylor Farnsworth, the young American inventor of the image dissector camera. Farnsworth was embroiled in a bitter lawsuit with the Radio Corporation of America (RCA) who were developing the Iconoscope electronic camera which they claimed had been invented by Vladimir Zworykin. But central to the Iconoscope were ideas owned by Farnsworth. The lawsuit was not finally settled until 1939, in Farnsworth's favour.

The Baird company was also exploring an interesting third alternative technology. This was the "intermediate film" (IF) process in which a scene was filmed conventionally and the exposed film was then continuously fed into developing tanks and finally scanned to give a television signal after an interval of a minute or so. The IF process was awkward because of its use of toxic chemical solutions in the studio, but its great advantage was that the exposed film provided a high quality recording of every television programme, for possible later playback.

Baird's main rival was Marconi-EMI, a joint company that had been formed early in 1934. It took up the earlier development work by EMI and it had full rights to the use of the RCA patents. Marconi-EMI developed its Emitron camera which was an improved version of the RCA Iconoscope camera. All these technical activities were taking place amid increasing public interest and enthusiasm for television.

**Enter the BBC**

Under the terms of the Broadcasting Act, television could only be broadcast in Britain by the BBC. Since its foundation in 1922, its director general had been the formidable John Reith who had trained at Glasgow's Royal Technical College at about the same time as Baird. Both were the sons of Presbyterian ministers; however, the relationship between them was strained (2). Reith believed strongly in the educational value of the spoken word, but his puritanical streak was outraged by the corrupting flickery images of television. He also resented the newspaper articles by Baird's outspoken publicist, Sydney Moseley, pestering the BBC to start broadcasting television.

Eventually and with reluctance, the BBC began experimental broadcasts in 1929, with the programmes coming from a makeshift studio at the office of Baird Television Ltd. A year later the BBC opened its own television studio in the basement of Broadcasting House and they went so far as to hire a producer, Major Eustace Robb. Images were formed at a very low definition (30 lines) which limited the programmes to head-and-shoulder shots for the most part. Songs, talks and poetic recitations were shown late at night on "medium wave" (260 metres) after the close down of the regular radio programme, but nevertheless they attracted much interest and they could be viewed on the world's first mass-produced television set, the Baird Televisor. The experimental broadcasts continued until September 1935, by which time the launch of higher definition television was in sight.

In order to broadcast the higher definition signals, a much shorter wavelength of 6.7 metres was chosen and for this the viewers needed to buy special (and expensive) receivers. The transmitter and the aerial were located on high ground at Alexandra Palace. Despite its disadvantage of limited range (the greater London area), the short wavelength was technically necessary in order to accommodate the bandwidth required by high definition signals.

Baird Television offered a menu of three different camera systems: mechanically scanned cameras using a flying spot scanner, electronic cameras using an upgraded version of Farnsworth's technology, and the intermediate film system. The broadcast pictures came through at 240 lines although Captain West reported that much higher definitions had been achieved.(5)

Marconi-EMI, after expensive and largely unpublicized research, had developed their Emitron camera to give a 405 line picture. The public could buy receivers with dual controls which allowed reception from either system. The video display was on a cathode ray tube (black and white) with a screen size of typically 6 to 12 inches. (15 to 30 cm).

The competition between Marconi-EMI and Baird Television did not last long. Although there was little to choose between the two systems in terms of picture quality, the small and convenient Emitron cameras were more reliable and allowed much easier working conditions in the studio; they could also be used outside, in the Alexandra Palace grounds; Baird's "flying spot" mechanical cameras and the chemical-laden intermediate film system were inflexible, and the Farnsworth electronic camera was found to be rather insensitive. In early 1937 the public decision was made to abandon the Baird system (or rather, systems) in favour of the Marconi-EMI 405 line system. However the BBC retained Baird's mechanical telecine system to broadcast pre-shot filmed items. This was not mentioned in the publicity on the "defeat" of the Baird system.

The BBC's television service continued in the London area until just before the outbreak of World War II. It was resumed in June 1946, using the prewar cameras which had been mothballed for the duration of the war. In 1944 John Logie Baird had proposed to a government committee that television should be developed with the advances that he had been working on throughout the war years (2,5), such as colour and higher definition; but he died in 1946 and there was no money for new television technology. Moreover there was very little money to pay for the television programmes themselves. Throughout the postwar years of austerity, the BBC listed its television schedule in small print on the back pages of the Radio Times; during the fuel crisis of 1947, television was shut down entirely. Over the next few years television stations were opened up in what the BBC condescendingly called "the regions". I have happy memories of the opening of television at BBC Scotland in 1952, an innocent little ceremony at the Edinburgh studio, ending with a prayer of dedication of the new service.

It was only in 1953 that viewer numbers began to expand rapidly. Growth was driven by the televising of the Coronation and also by the falling cost of television for the home viewer. Sets could be rented for a few shillings a week, while the rental charge included any repair costs incurred.

**Enter independent television**

There was a strong feeling among television set manufacturers and some Conservative MPs that BBC television was in need of competition. A leader in this campaign was C.O.Stanley, the outspoken head of Pye of Cambridge (6). In 1954 a new Act was passed, allowing independent (i.e.commercial) television stations and thereby breaking the BBC's monopoly. This was opposed by educational and church leaders and, of course, by the BBC itself. Reith (now Lord Reith) publicly compared the arrival of independent television to the arrival of the bubonic plague.

John Logie Baird had recommended independent television in 1944 in his evidence to the Hankey Committee on the future of television. There is little doubt that had he lived, he would have been one of the strongest supporters of independent television in the 1950s.. His company had also built its own complete independent television studio at the Crystal Palace in 1934, although it was never used for broadcasting and it was later destroyed in the Crystal Palace fire in 1936.

**Technology and change**

In the 1950s, British television (BBC and ITV) still ran on the old Marconi-EMI 405 line system. This suffered from limitations such as the lack of colour, the lack of any reliable means of recording programmes, and the definition which was lower than that of the USA and the newly opened systems in continental Europe. Technical progress continued, slowly but steadily. In about 1960 high quality video recorders were introduced, in 1964 definition was improved from 405 to 625 lines and finally, in 1967, colour television was started. The introduction of colour and higher definition came many years after they had first been recommended by Baird in his testimony to the Hankey committee in 1944.

It is difficult to summarise the most recent technical developments, but there are a few highlights. Communications satellites have turned television into a global medium; digital and flat-screen technology have led to the disappearance of the heavy and rather dangerous cathode ray tubes; programme choice has increased enormously. If Baird, Farnsworth, Zworykin and the other pioneers were alive today, they would be bowled over by what has

7.30 p.m. Lord Tedder (Vice-Chairman of the Board of Governors of the B.B.C.)
invites
The Right Hon. JAMES STUART, M.P., Secretary of State for Scotland,
to open the Transmitter.

A Prayer of Dedication by The Very Rev. Charles L. Warr,
Dean of the Thistle and Chapel Royal.

A Vote of Thanks by the Rt. Hon. James Miller, Lord Provost of Edinburgh.

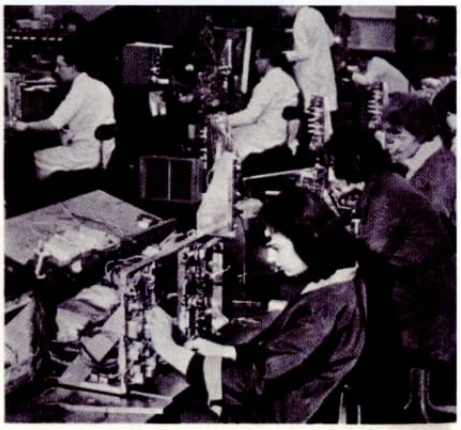
*Scottish Country Dances*
by members of the Royal Scottish Country Dance Society with
Tim Wright and his Band.

8 p.m. Viewing the Evening's Programmes.

8.00 Television Newsreel.
8.15 Kaleidoscope.
9.15 Olympic Training.
9.45 In the News.
(Including Sir William Y. Darling, M.P. and Hector McNeil, M.P.)
10.15 Speaking Personally — Alastair Sim.

[ *BUFFET 8 - 10 p.m.* ]





*Baird colour TV assembly*

happened, in the technical sense.

After about 1970, the television industry in the western world changed profoundly. The mass manufacture of television sets shifted to Asia and the popular British television brand names like Pye and EMI disappeared, In the USA, the gargantuan Radio Corporation of America (RCA) closed in 1987. The meaning of the term "television industry" changed from the engineering aspect to the programme making aspect. In Britain this change was faithfully reflected by the Television Society, which had been a low-key group of scientists and electronic engineers ever since its formation in 1927. In 1966 the society acquired royal patronage, becoming the Royal Television Society. By 1980 its membership was mainly articulate and well-paid producers and media executives, while the low-key engineers faded gently into the background. In the USA, the new power of the television broadcasters was the theme of the award-winning movie Network (1976).

**Programmes: the dross and the nuggets**

Very very occasionally, one hears it said that a television programme is "pure gold". However, gold ores usually contain less than an ounce (28 grams) of pure gold per ton, a small fraction of one percent. The remainder is known as dross, or tailings. The same can be said of modern television programmes.

As early as 1961, Newton Minow (chair of the US Federal Communications Commission) told a stunned audience of television executives that their medium had become a vast wasteland. He went on: "you will see a procession of game shows, formula comedies about totally unbelievable families, blood and thunder, mayhem, violence, sadism, murder, western bad men, western good men, private eyes, gangsters, more violence, and cartoons. And endlessly commercials — many screaming, cajoling, and offending. And most of all, boredom." The only thing that has changed after 50 years has been the disappearance of the western.

The great technical pioneers Farnsworth and Zworykin both lived on into television's modern age and they were appalled by what they saw on the small screen. In Britain, Lord Reith was interviewed in 1967 by Malcolm Muggeridge and declared that television was "a social menace of the first magnitude."(7) He admitted that he had been afraid of it from the outset.

This having been said, there were always some nuggets among the dross. I remember as a teenager in 1954 being entranced by a showing of Bizet's Carmen; I had never seen an opera before, but television and the BBC made it possible. Later there came the brilliant dramatic adaptations of great books, starting with Galsworthy's The Forsyte Saga and reaching a zenith with Brideshead Revisited. But since about 1990, the quality of television has been weakened by the F- word. .. fragmentation. As the number of available channels has increased, the income from advertisers has been thinly stretched and the competition between broadcasters has intensified. The pure gold is gradually getting scarcer, or in mining terms, the ore grade is going down.

The venerable BBC could have provided leadership with the help of its guaranteed licence funding but it decided to "compete" by making its programmes more attractive to the mass audience. With so many television stations broadcasting, often on a 24 hour schedule, a lot of airspace had to be filled at the lowest possible cost. This has all led to a proliferation of repeats, talent shows without much talent, reality shows without much reality, and sketchy documentaries which feature jokey presenters glossing over the factual inaccuracies. As a present-day example of what has happened to television, the disturbing shots of the London riots in August 2011 were followed by an equally disturbing discussion programme on the BBC, seen around the world on their website, with everyone shouting at each other and no one able to be heard. In the USA and in Russia, free fights have broken out in the studio during live television broadcasts. The medium seems to bring out the worst in people.

John Reith and my father were both raised in the Victorian era. They believed in human progress, the value of education and the need for good manners. Although they had some differences, I am sure the two men would have shared the same opinion of most of the current programmes. Lord Selsdon's biblically inspired quote at the 1936 event in Alexandra Palace, "keep your light so shining ..", rings terribly hollow today. At a time in human history when more people than ever before are studying at universities, television seems to be recoiling from education whether it is in the arts or the sciences. In the United States the cash-starved educational television network (PBS) has to resort to on-air charitable appeals.

The outside observer of today's industry is tempted to accept Reith's view of television as a social menace, but perhaps that is too sweeping a generalization. Every now and then we are reminded of television's saving grace – its ability to bring major news and sports events, as they happen, to the home screen. Examples in 2011 have included a big royal wedding, the overthrow of the oppressive

regime in Libya, and the London riots.

Then, with a dull thud, we are dropped back among the dross, with the banal talking heads and the low-budget shows that are so familiar. I have lost count of the number of articles in the British press that say something like "John Logie Baird would have been turning in his grave if he could have seen --- (such and such programme)." Some of these articles appear in the mass-circulation tabloid press (such as Scotland's Daily Record) which does not cater for the educated elite. This weakens the often-made excuse that poor quality television programmes are "what the majority want." Neil Postman pointed out part of the problem is that television is the enemy of rational argument, because viewers are only passively involved.

**Where to now?**

The passive aspect of television has changed profoundly; thanks to technology, viewers have more control and participation. We may be seeing the end of the close-knit media empires that dictate which programmes shall be seen and when they will be seen. Those who hark back to the good old days of television can view classic programmes on DVD or VOD at moderate cost. It has even been said that individually produced online videos with paid advertisements will become "the new television". To go back once more to the mining analogy, the dross will still be there but it will be easier for the viewer to find his or her particular gold. Technology will still be the driving force for television, as it was for the first 85 years of its existence. Let us all hope that Lord Selsdon's shining light will eventually reappear.

**Recommended reference books** –
refs (1) to (5) have been reviewed on this website


(1) Marista Leishman, "My father, Reith of the BBC", Saint Andrew Press, Edinburgh (2006).
(2) Antony Kamm and Malcolm Baird, "John Logie Baird: a life", NMS Publications, Edinburgh (2002)
(3) John Logie Baird, "Television and Me", Mercat Press (now part of Birlinn), Edinburgh (2004)
(4) Nigel Ostrer, "The Ostrers and Gaumont British", Lulu Enterprises, Inc. (2010).
(5) Douglas Brown, "Images Across Space: the electronic imaging of Baird Television", Middlesex University Technical Services (2009) – obtainable via the Radio Society of Great Britain
(6) Mark Frankland, "Radio man: the remarkable rise and fall of C.O.Stanley", Institution of Electrical Engineers (2002)
(7) Malcolm Muggeridge, "Muggeridge Ancient and Modern", BBC (1981) – includes the transcript of the Reith interview in 1967.


## Golbourne Swapmeet

photographed by Mike Barker

Francis Norris loading a table with quality items

Geoff and Nigel with lots of TVs


# The Emor Globe by Roger Grant

At the end of our High street and tucked away just round the corner, there's a little antique and collectables shop from where I occasionally purchase the odd interesting radio, The Ever Ready 5812 in a previous article, was one of them.

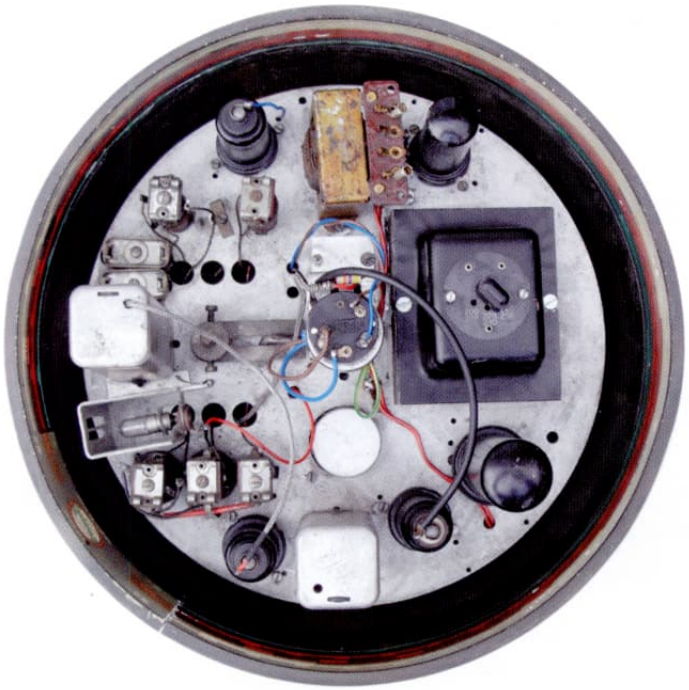
The proprietor, whom I have known for many years, has in the past, from house clearances, provided the odd pile of very useful radio junk, a second good reason for regular visits to his shop.

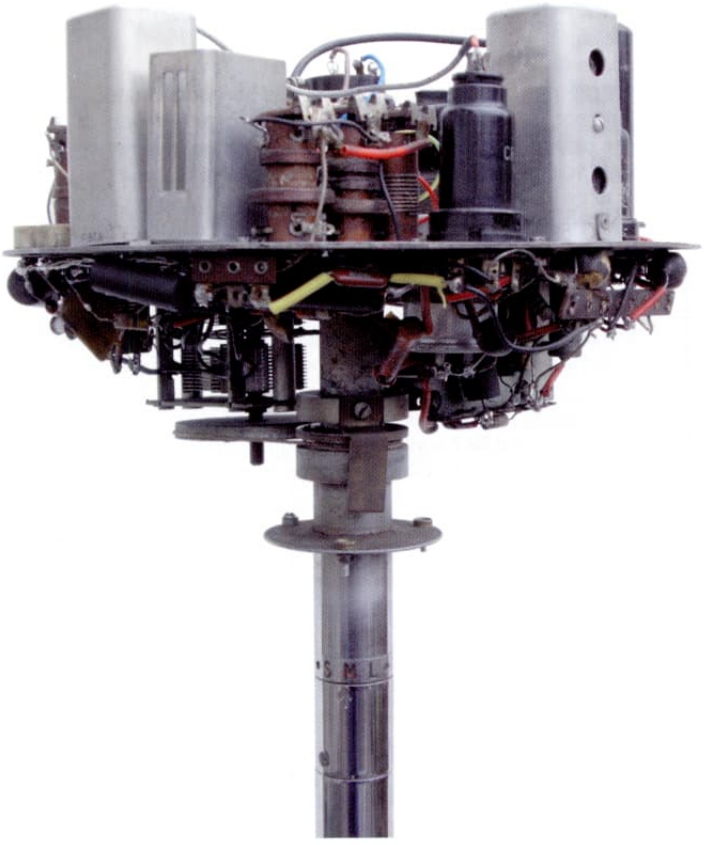


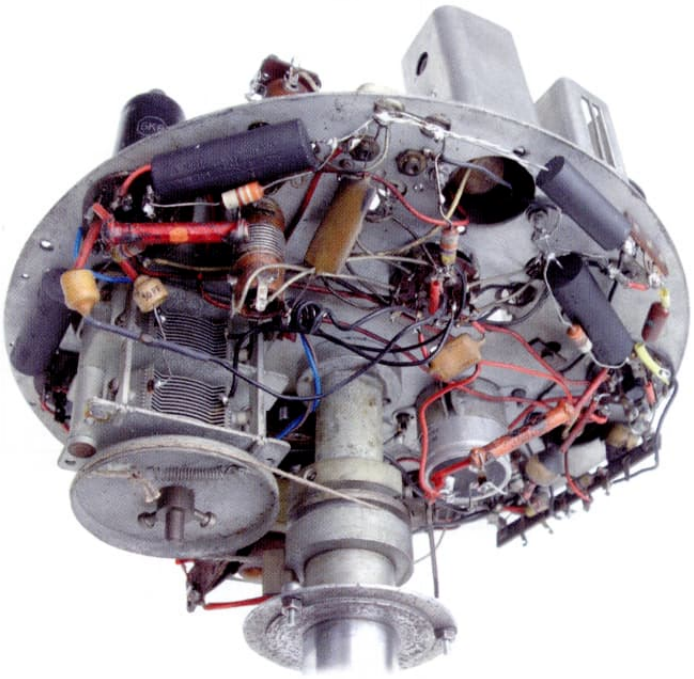
He has a small collection of radios himself, one of which is an Emor Globe and has expressed on many occasions he would like to have it working, he admitted that he had plugged it in and switched it on and all he got was a loud mains hum, then switched it off again quickly before anything nasty happened, I had promised on as many occasions I would take on the job of getting it working, but being out of sight and out of mind, I didn't actually get round to doing anything about it, until on a recent visit I was reminded the Emor was still waiting, as my other projects were awaiting spares or held up for some other reason, I had found myself looking for an interim project and this would fit the bill nicely, I collected the set the same evening, before it slipped my mind yet again.

This Emor Globe was in very nice condition, the globe and pillar both chromium plated, the chrome on the globe is over a sort of crackle finish in the metal, the stand base painted satin black.

I had heard from fellow collectors this classic radio has a reputation of being not very interesting, a standard 6K8, 6K7 series of valves superhet of the late forties, in a metal sphere on a stand that looks like it would topple over very easily. The only other one I had seen was in an auction, a very







scruffy gold one with half its paint missing and it appeared to live up to this reputation.

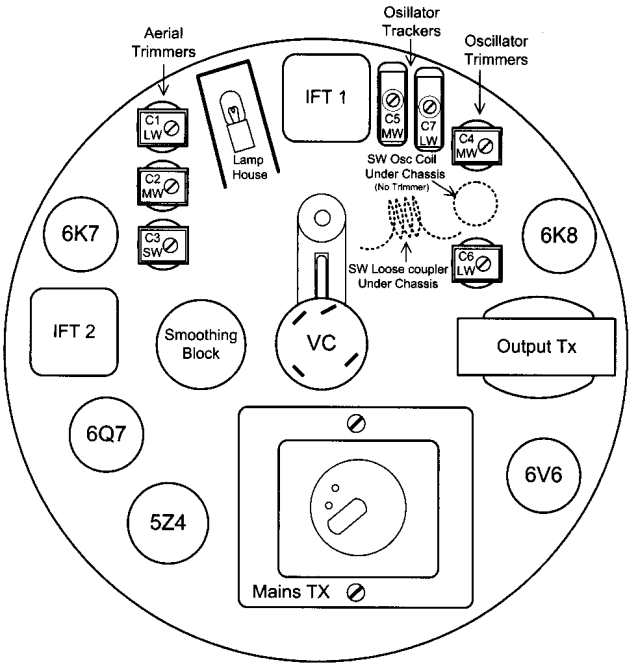
With no cabinet work to be done I thought this project might be just a mundane repair job, how wrong I was and what an interesting project it turned out to be!

The two halves of the globe are separated by the tuning scale, a 1" wide strip of 3/8" thick Perspex around the equatorial circumference. Tuning is achieved by rotating the whole globe about its axis, wave length and station indicated by a pointer projected on the back of the tuning scale, this is from a light box mounted on the static chassis behind. The wave change controlled by rotating a 1½" wide section of the top of the pillar, the on/off and volume controlled by another similar section immediately below the wave change. The speaker is in the top half of the globe with a grill on the top like a polar cap. The mains lead and trailing aerial go down through the support pillar and out under the base of the stand.

The base of the stand is a very heavy cast iron disc one foot in diameter and ½" thick, the stand alone weighs 15 lbs making the whole thing quite stable and unlike its appearance, unlikely to topple over, and just for the record the whole radio weighs in at a hefty 32 lbs.

Getting inside was quite easy, there were three spring clips holding the two halves of the globe together, these straddle the tuning scale and when removed the top half of the globe with the speaker lifts off, plugs and sockets for the speaker leads would be nice here, I had to de-solder the speaker wires while holding the top half of the globe, the leads were not long enough to put it down, I think I'll fit some for ease of servicing and provide a standard connection to the bench speaker.

The bottom half of the globe is held in place by three domed 4BA nuts, the bolts for these protrude through a lower rotating flange via some lock nuts, these also serve as a spacer making a ventilation gap. The rotating flange




is connected to the drum on the tuning capacitor via a drive cord. When removed, this lower hemisphere drops down the support pillar and rests on the base giving access to the under chassis components.

A precursory look round revealed the horizontal round steel chassis plate, very dirty, covered in a heavy layer of fine black greasy dirt, indicating city exhaust residue rather than that from a gritty coal fire or sticky brown nicotine.

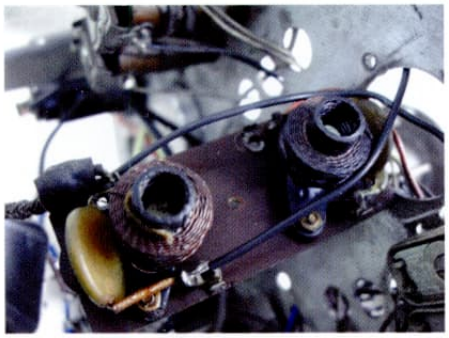
All of the components appear to be present and in tact, allaying the fears of its owner that a lot of the innards may be missing. The valve line up as expected, the 6K8, 6K7, 6Q7, 6V6 and 5Z4 series, all of which are the black metal type and may well be original, the only anomaly, there are no markings on he output valve, this is larger than the norm and I suspect it's a 6L6, a bit heavy duty for a domestic set, but it is member of the same family, a metal type and it fits in with the rest of the valves in the set. Immediately obvious were the leads to both of the top caps of the 6Q7 and 6K7 adrift and floating around in space. At this point I had a look round for any service information and found almost none at all, not even a circuit diagram, The only information obtained, it was made by Emor Radio Ltd, of 45 Kilburn High Road, London W6 in the late Forties.

With this set having a standard set of valves and probably an industry standard circuit to go with it, I decided to use one of my own drawings of a similar superhet and just modify it with the differences and record component values, it can't be that much different.

There is evidence of previous repairs, the output transformer has been replaced, the 6Q7 grid coupling capacitor has been replaced and so has the smoothing block, this carrying a quite late Plessey logo. The mains lead, when removed, was eleven feet long and initially appeared ok, but closer inspection revealed several kinks with protruding, now crumbling rubber insulation. The wave change and volume controls feel very stiff and graunchy and the on/off switch not very positive in operation. From a repair point of view the whole thing is a bit unwieldy, initially I laid the whole thing horizontally on the bench, like a cadaver in a morgue but this was not the answer, it rolled around and needed stabilising.

There are three grub screws holding the globe support tube in a ring at the top of the stand pillar, when removed the chassis assembly pulls clear and the mains lead and aerial wire can be pulled through the pillar and the stand removed, then the lower half of the globe with the tuning scale lifted of and put in a safe place during this repair.

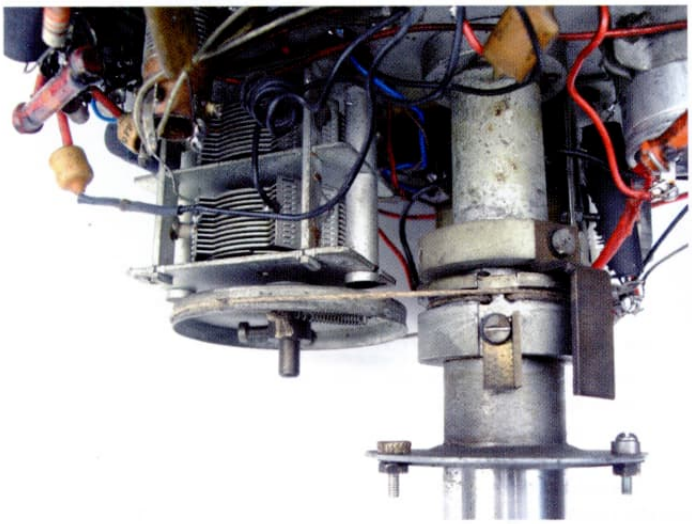
The chassis is now taking up much less space on the bench but even more unwieldy. The answer is to fit two small G–clamps about 70 degrees apart around the edge of the chassis plate, this



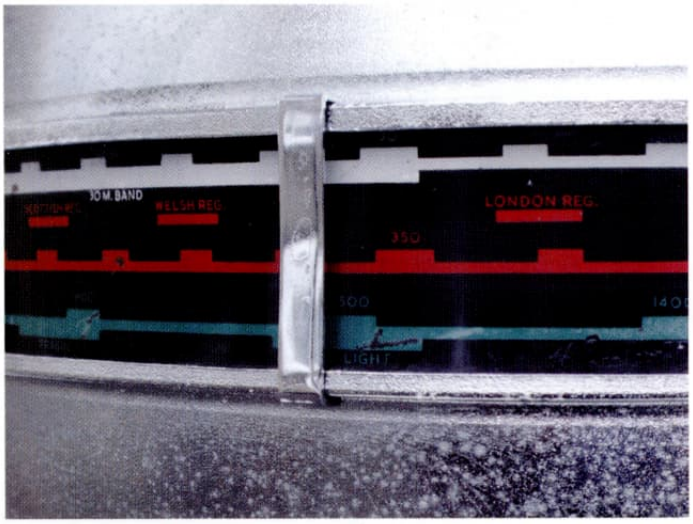
IFT with the can off to replace screened lead


The date on the Electrolytic

The mains lead in the stand cavity



The drive cord arrangement, drums and end stops




The Globe Retaining clip

stops it rolling around under the weight of the mains transformer, a prop is used to hold up the end of the control support tube, this is made from a piece of wood, 2" x 1" about 7" long with a 1" diameter hole about 5½" from the bottom end, this forms a sort of tripod and making it quite stable, the G–clamps can be moved round the circumference of the chassis to access different areas of components.

Before I make this set work I need to keep an eye on its safety aspects, fortunately an AC only model with an isolating transformer, all of the components are completely enclosed in an earthed metal casing, this makes the first part easy, I just need to ensure the earthing is intact and properly connected. I noticed the set only has a single pole on/off switch, this will have to be replaced with a double pole type and just for good measure I'll fit a 3 amp mains fuse.

The crumbling mains lead is next, this needs completely replacing with new modern 5 Amp three core PVC mains lead, fortunately there is well over a yard of unexposed mains lead in the support pillar, this will give a good amount of original outer braiding for covering this new mains lead.

So on with the primary inspection, the smoothing block was disconnected and checked ok, over two megs of leakage. Next the rest of the paper capacitors, most of these were leaky and reading well under a meg, and some at around 100K so I'll replace all of them, the two cathode bias electrolytic capacitors, twenty five microfarads at twenty five volts, were both completely open circuit and will be replaced, Incidentally, the date on them was January 1948.

The mains lead was removed first, on removal the neutral wire connected to the tag on the mains transformer, fell off, it appeared to be hanging on by one strand. The old wires inside the mains lead were pulled from inside the outer braiding, this was done from the end protected by the support pillar, this bunching up along the inner wires, I was very lucky, I got well over six feet of usable braid before it snagged on the crumbling old insulation and I had to chop it off to salvage the free bit.

On fitting the new mains lead there's no need for original outer braiding inside the support tube where it won't be seen, so six feet of braiding should be plenty.

I had a problem finding some suitable modern three core mains lead, this requires an outside diameter of 5mm, the smallest I could find in the DIY stores was 5.5mm, this just a tad too big for the braid to slide over, 0.5mm may not seem much but it equates to over 1.5mm in circumference and makes a big difference, I eventually found some in an electric light shop that still had some old stock, I purchased the last twenty meters he had left while I had the chance.

The end of the braiding was clamped to the new three core mains lead with a tie wrap, this is hidden in the mains and aerial lead cavity under the stand, just out of sight, the other end whipped with cotton thread a similar colour to the braid as it enters the mains plug, this is to stop it riding back along the new mains lead should it fray away from the cord clamp, I also over whipped two small areas of damage to the outer braid caused by the original kinking, this is to stop it parting completely.

Next the on/off switch, with the volume control removed, it reads five meg log, I was a bit surprised it's that high, and has a 47k resistor bridging the top end to the wiper, a bit of a mystery.
I didn't have one in stock or any near it, but I did find a similar type with a double pole switch, so I just swapped the switch and gave the pot a clean and re-lube. Replacing the brass rivets retaining the switch wasn't a problem, I had acquired some long thin brass nails just the right diameter, these were from my local DIY shop on a previous restoration, cut to the right length they peened over into rivet heads very nicely with a dimpled punch.

While the volume control was out, I removed the tube that connects it to its control collar, this is inside the tube that connects the wave change switch to its control collar, both control collars have a sunken 4BA screw threaded into their tubes, with these screws removed, both control tubes pull out through the top of the support tube that connects the chassis to the stand support pillar.
The innermost tube for the volume control is about ½" diameter, in the end of this tube is a paxolin bush about ½" long interfacing the volume control shaft to the tube, this bush has four small holes parallel to the volume control shaft for the mains wires and aerial lead to pass through. These control tubes were cleaned and greased before refitting them, this made their operation much easier and smoother. It was on the reassembly of this mechanism that I realised the reason for the value of the volume control and bridging resistor, there's a window cut halfway through the outermost support tube for the control collar screws to pass through, this restricts the rotation of the control to 180 degrees minus the width of the 4BA screw at both ends of travel, this reduces its total rotation to 150 degrees, half of its normal 300 degrees of travel losing the


The Controls

The Split Control Tube


Window in support tube & control collars


The Support tube retaining ring

top end of the pot. This seriously reducing its value and needs a bridging resistor to get over the lost last couple of Megs or so at the top of the pot, mystery solved. The wave-change switch doesn't suffer from this problem as it only needs 90 degrees of rotation to cover the three bands.

The screened lead connecting the 6Q7 grid to the wiper of the volume control, had already been replaced with a new piece of modern wire pulled through the original screening, so just needed re-soldering to the top cap connector. The screened lead connecting the top end of the volume control to the .047 grid coupling capacitor had also been replaced.

The screened lead feeding the grid of the 6K7 from IF amp was original with the rubber insulation disintegrating, this was replaced the same as the others, probably not done with the other screened leads as it required the removal of the IFT screening can.
I later replaced the screened lead from the volume control wiper to the 6Q7 top cap with fully insulated lead, it passes very close to the mains on/off switch with the risk of the naked screening shorting mains to chassis.

All of the resistors were checked and within reasonable spec, so I started the laborious job of replacing all of the paper capacitors, this is necessary if the set is going to be reliable, I had a good stock of 1000 volt types, these were about the same physical size as the originals, so other than the colour they looked about right, when I had finished I just gave them all a coat of matt black Humbrol model paint just for my own satisfaction and get rid of the hideous bright colours.

While the replacement was under way, I discovered three dry joints on the tag strips, the capacitor wire was wrapped round the tag and the tag soldered, but the capacitor wire dirty and completely dry of solder, this must have caused a lot of crackling and intermittency during the sets life time.

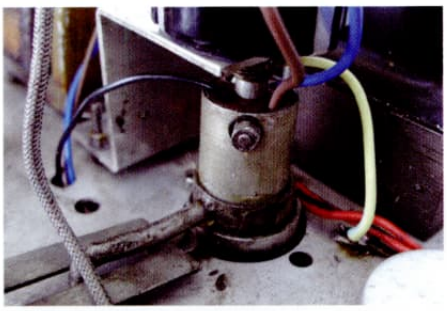
A final run-around with the AVO and all reads ok, no shorts on the HT rail, I ran all the valves on the valve tester and all were up to spec, so its time to fire it up.
On switch on the pilot light came on, the only indication as with metal valves you can't see the heaters, and after a short time I got the usual buzz from the top cap of the 6Q7 audio triode, the most easily accessible point of audio, then tuned through the medium wave band and picked up a few weak stations, these became stronger when the aerial was directly injected into the grid of the 6K8 mixer/ oscillator indicating a re-alignment required, I did suspect this may be the case as the slugs in the IFT's looked a little chewed.

Without any specific manufacturers service information, I used an alignment procedure typical of this era and type of set. The alignment starting with the IFT's. I grounded the AGC line by fitting a shorting link across its decoupling capacitor (.1) to disable the AGC action. I then applied the signal generator to the grid of the mixer oscillator, (top cap 6K8) via a .1 capacitor and swung the frequency between 400 - 500kc/s and found the IFTs peaking at about 460kc/s, there was a lot of evidence of previous broggling, (What appears to be random adjustment of coil slugs) one of the slugs had its trimmer slot broken away, the slugs were set in a white viscous goo very common for a set of this time, this was still live and the slugs moved reasonably easily, the broken slug was removed, I applied some solvent (Ronson lighter fuel) to the area and let it soak in and dilute the goo, this loosened the friction and the slug was easily removed with a pair of broad tipped tweezers, the slug was left out for a while to let the solvent evaporate and the goo return to its original viscosity. The slug was then replaced the other way round exposing the fresh trimmer slot at the other end of the slug, normally inaccessible as there are only holes in one side of the IFT screening can.
I then peaked the IFT's, starting with the last IFT first to 465 Kc/s, a typical frequency of this generation of set, they all tuned up quite nicely.

The RF alignment also done using a typical procedure, all of the adjustments appear to be accessible from the top of the chassis. The lower hemisphere was refitted and the tuning scale aligned so the projected cursor sweeps the whole scale with equal space at each end. I started with Medium wave, I set the cursor to the 200m mark and connected the signal generator to the aerial and chassis via a 200pf capacitor, then set the signal generator to 1500 Kc/s and adjusted the MW oscillator trimmer C4 for maximum output, then adjusted the Aerial trimmer C2 for max output. Next retune to 550m and set the signal generator to 545Kc/s and adjusted the MW tracker capacitor C5 for max output, rocking the gang for optimum results, then went back rechecking the 200m end of the scale repeating the sequence for best results.

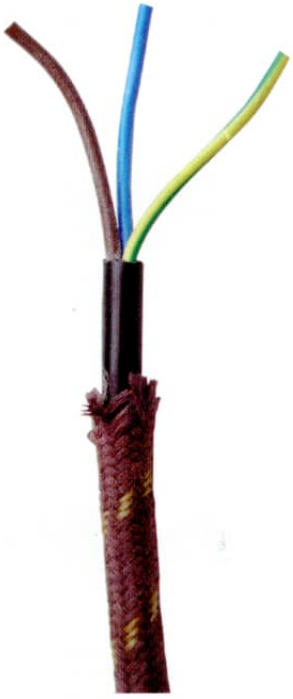
Long wave was done in a similar manner, Set the cursor to 1000m and signal generator to 300Kc/s and adjusted the LW oscillator trimmer C6 for max output, then the Aerial trimmer C1 for max output. Next set the cursor to 2000m and signal generator for 150Kc/s and adjusted LW tracker C7 for max output, rocking the gang for optimum results, repeating procedure for best results.

The shortwave band covers 50 - 15 meters (6 - 20 Mc/s), this frequency band makes the tuning very critical and very difficult to keep on station moving the whole globe, SW appears to have only one trimmer and that's on the aerial coil, I adjusted this for max output in the middle of the band about 30m (10 Mc/s). The only way I could find of calibrating the SW frequency, was by moving the few loose turns of wire connecting the oscillator tuning capacitor to the wave change switch, moving this nearer/further from the SW oscillator coil under the chassis, (I did initially wonder what these few turns were there for), the lower hemisphere will have to be removed to do this, on this set the calibration wasn't too far out, very handy the SW band scale being a bit vague and with SW being reasonably lively, I was happy just peaking the aerial trimmer.
All now well and time to fully assemble the set and give it a bit of a soak test, having



The top end of the control tubes and interface bush

The Rescued Mains lead



The new mains lead inside the original braid

The Speaker

The Projected Cursor

fitted some skeleton wander sockets to the output transformer for ease of bench repair, I fitted wander plugs to the speaker leads on re-assembling the globe, the upper half of the globe was refitted and the set run on its own speaker, I tuned into my favourite radio station and I noticed a bit of distortion, not much but it was there, it was fine on my bench speaker.

The speaker is mounted on spring clips bolted to the top of the globe, leaving a gap between it and the globe for the ventilation outlet. I noticed that the outside of the speaker had been re-sprayed with a silver coloured paint, there was some over spray on the outside of the cone, my first impression was this might be the cause.

I removed the speaker, then removed the black grille cloth covering the front, this was only lightly glued on to the cardboard gasket in front of the cone. Checking the cone I found there was a just discernable rubbing noise when the cone was moved, there was evidence of water marks on the inside of the cone, although this may be paint residue from the other side, the cone didn't appear to be distorted in any way. I then removed the felt disc covering the speech coil this also only lightly glued on, the area behind it was caked in black dust, I removed this with a fine paint brush, but there was evidence of more behind the speech coil and a more in depth clean required.

Before I have a go at fixing it I'll see if I've got one in stock to replace it with in case I break it in the process, there were two possible replacements for this 7" 3 Ohm speaker but both of these were in extension speaker cabinets I didn't want to forfeit, but I could rob one if necessary and replace it later, but I'll give it a best shot at a repair first.

The Cone is firmly glued into the frame and only damage will result if I try and remove it, the only way is to remove the magnet and armature from the rear.

I removed the two 0BA brass screws retaining the magnet, then pulled the magnet and coil armature clear, the area behind was full of black dust and a coarser debris, this was also cleaned out with a soft paint brush and the coil centre armature cleaned of its light rust/corrosion with a piece of Scotchbrite, this was followed by the removal of its sticking ferrous dust with a piece of sticky tape then a light puff of lacquer to prevent future corrosion. The speech coil was checked and moves quite freely in the outer pole piece, proving the cone was not distorted, this area was more thoroughly cleaned ready for reassembly.

**Getting it back together**

With the speaker screwed face down to the bench so it can't move, I aligned the magnet and armature with the speech coil, the magnetic pull trapping and pinching my fore fingers and thumbs equally spaced around the edge of the magnet, once the armature was engaged with the end of the coil, I slowly removed my fingers and thumbs so the armature can slide slowly inside the coil, until the magnetic pull was so strong it caused the last few millimetres of this assembly to snap back into place. The strong magnetic attraction will always pull the armature to the outer pole trapping the speech coil, this then requiring careful re-centring. With a magnifying glass, the widest gap between the coil and armature can be clearly seen inside the speech coil. I then replaced and partially tightened the 0BA screws, this applies some friction stopping the armature snapping back to the side when the armature is moved, I then tapped the magnet and armature to the centre the speech coil, this was done with the plastic handle of a heavy screwdriver, (Not a good thing to do to a magnet but needs must) it took several strong taps from different angles to move the coil against the friction and in the right direction.

I then tested the gap all round with a piece of paper as a feeler gauge ensuring the armature is central to the coil, making final small adjustments with lighter tapping. Finally fully tightening the 0BA screws and re-checking for equal spacing. Phew! What a procedure, but it worked and the original speaker was pressed back into service.

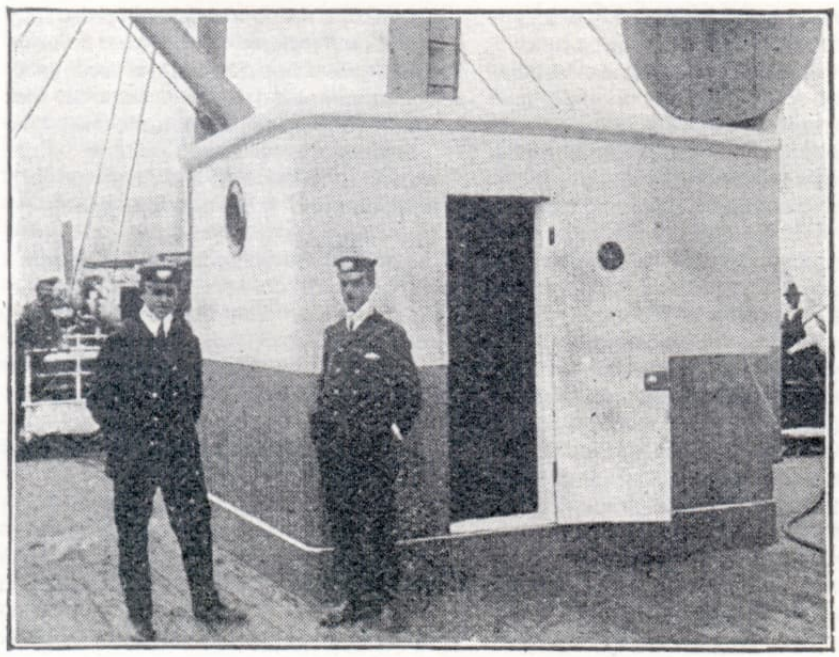
I left the set running for a couple of hours or so, after which time the set seemed to get a bit warmer than expected, this may be due to the heat conduction of the metal cabinet and only a relatively small ventilation gap around the speaker and the base of the globe, on inspection the output and rectifier valves were running a bit warm, re-visiting the output valve, I looked up the spec for a 6L6 and compared it with the 6V6 (Brimar Metal types). The 6L6 ratings are all double that of the 6V6, including the heater (.9A compared to .45A) and anode quiescent current (29m/A compared to 72m/A) although I did find the quoted ratings varied quite a lot from one reference book to another. I didn't expect this very small difference in wattage to make much difference to the running temperature. Just out of interest I measured the impedance of the output transformer, although this is not the original, at 1kc/s it read about 5.2k, a bit nearer a 6V6 than a 6L6 (4.2k), so it looks like the 6V6 may be the correct valve for this set after all, so I replaced the suspected 6L6 with a 6V6, the set then did run a little cooler (much to my surprise) and passed its whole day soak test, the only criticism, it tended to drift a little.

Generally this set works better than expected, even the lively short wave seemed to improve when it was all back together, but its performance still a bit average, the quality of tone is a bit lacking due to the non acoustic metal cabinet but it certainly looks the part, very art deco with an interesting control mechanism. The projected tuning cursor is not very bright or clear, defocused due to the lamp house window being a good inch or more from the back of the scale, I improved the brightness a bit by replacing the 8v pilot lamp with the more usual 6.3v .3A. I spent quite a lot of time on this set, drawing out a circuit and working out an alignment procedure, with many faults to diagnose and repair and I enjoyed every minute of it, an "End of the Golden Age" set you can really get your teeth into. A boring mundane repair it wasn't.

# The wireless telegraph cabin on the SS Minnetonka, 1904

by John Liffen

1. Interior of the wireless telegraph cabin on the *SS Minnetonka*, August 1904. (Reproduced from an original photograph probably taken for Marconi's Wireless Telegraph Co Ltd and held by the Science Museum, London. Science Museum Photographic Studio, image number B500092.)



I read Ralph Barrett's article 'Wireless aboard *Titanic*' in the Winter 2011 Bulletin with considerable interest. Many readers will know that in the Science Museum, London, we display a reconstruction of a typical ship's radio cabin of about 1910. It so closely resembles the set-up shown in photos 5 and 6 of the article that copies of these photos must almost certainly have been used as references in 1971 when it was first installed in the Museum. The original radio equipment in it forms part of the Marconi historical collection, now in the care of, and on loan from, the Museum of the History of Science, Oxford.

Within the Science Museum's Radio Communication files is a fine original photograph of a ship's radio cabin of 1904. Its quality is such that I thought it was worthy of reproduction here as a postscript to the *Titanic* article. The photograph was donated in 1948 by a Mr H J Tattersall of Chelmsford, who sent it together with a long letter addressed to Mr G R M Garratt (G5CS), at that time the Science Museum's

2. Exterior of the wireless telegraph cabin on the SS Minnetonka. (Half-tone block reproduced from a Marconi's Wireless Telegraph Co Ltd official photograph. Science Museum Photographic Studio, image number D120046.)

curator of telecommunications. The content of the letter suggests that the writer was an employee of the Marconi Company but this is by no means certain, as the letter is written from a private address in Chelmsford. Tattersall, clearly a man with considerable knowledge and expertise in radio matters, included a detailed description of the equipment seen in the photograph:

*I am sending herewith a photograph of a typical ship's installation, taken in 1904 on the SS Minnetonka. From left to right on the table are two coherer receivers fitted with aerial 'plunger' switches on teak posts. A morse printer operated by the receiver, and immediately behind on the bulkhead is a small switchboard and an alarm bell. The switchboard connects either the printer or the alarm bell to the receiver. To the right of the bell is the oscillation transformer or 'Jigger' – part of the transmitting apparatus; a teak wood case containing primary and secondary windings of heavy multi-cored cable. Below are six Leyden jars contained in a zinc-lined teak box, while in front is the transmitting key with 'side lever'. The latter is connected, by means of blind cord, to an aerial plunger switch and when in the upward position (as shown) the key circuit is broken thus rendering the transmitter inoperative, while a plunger is let down to connect the aerial to the receiver. (See left-hand receiver.) A 10-inch induction coil, on the right, completes the transmitting apparatus. The switchboard on the bulkhead, behind the Operator's head, is used to switch either the ship's power supply or an accumulator battery supply to the transmitter, and to enable the accumulators to be charged from the ship's power supply.*

The original photograph has a very high resolution and when magnified the calendar pinned on the back wall (Eden Fisher & Co Ltd) shows the month to be August and confirms the year as 1904. The book on top of the 'jigger' is *Nuttall's Standard Dictionary*.

Almost by accident I found an illustration of the exterior of the cabin in J A Fleming's *An elementary manual of radiotelegraphy and radiotelephony* (London, 1908). It shows that the cabin was located on the open deck of the *SS Minnetonka*. In the interior view, to the right of the Operator there is a curtain. This was probably fitted in front of the door to allow ventilation while maintaining a measure of privacy. In the exterior view, the door, open, can be seen.

By the time these words are read the Science Museum will know if it has been successful in its bid to the Heritage Lottery Fund for support for a new Communications gallery. If so, the new gallery will open in the autumn of 2014. The 1910 cabin will be removed and rebuilt in the new display, thus continuing its role of illustrating the early history of wireless telegraphy.

# Reopening of the Radio Room at Seaford Museum

The museum's Radio Room is back in business. After almost a year of extremely hard work by the backroom volunteers, it has been extensively remodelled, re-researched and, on December 3, reopened.


The new room

Bryan McAlley demonstrates a device he lovingly restored

Natalie Graham, daughter Katie and Chairman, Kay Turvey

Natalie, Tom and Katie open the door

In fact, it now deserves a more all-embracing description. It presents a graphic historical record of sound and vision in home entertainment over more than a hundred years, from the recorded sounds and magic lantern shows of the late 19th century to the iPods and digital television and radio broadcasting of the early 21st century. Appropriately, the reopening was performed by a local television personality, Natalie Graham, a BBC 'South-East Today' and 'Inside Out' reporter and presenter who lives in Seaford and is a museum member.

At least, the actual unveiling ceremony was delegated to and performed enthusiastically by her children, Tom and Katie! Among other notable museum supporters at the event was the Mayor of Seaford, Linda Wallraven. They were all welcomed by chairman Kay Turvey, who referred to the very hard work put into the project by many people. She made special mention of Charles Painter, the deputy chairman, who had made a great contribution but was unable to attend the ceremony because of illness. Natalie Graham, in declaring the refurbished radio room open, added the chairman herself to the list of those deserving of special praise for her commitment to the undertaking.

# Single Span revisited by Bill Williams

Some time ago I had my attention called by Gary Tempest to an article in the Winter 1996 Bulletin written by Mr Dixon–Nuttall entitled 'The Single Span or Smurthwaite's Mistake'[see page 20 – Editor]. I must have read it in 1996 but had no recollection of it. On re–reading the article, the thought struck me that readers might think that the single span principle was a technical failure and this would be a grave injuctice to the highly respected circuit designer WJ Cocking who published a series of articles in Wireless World March 23rd, 30th, April 6th and 13th 1934 explains the principles, advantages and practical realisation of a single span superhet. I would advise any reader interested in this rarely discussed circuit principle to carefully read the above four articles before forming any opinions about the merits of Cockings design.

268 *Wireless World, April 20th, 1934*

*The Wireless World*

# Single-Span Receiver

By W. T. COCKING

The receiver and power units of the new set. All controls are fitted to the front of the chassis.

(Continued from page 254 of previous issue)

## Constructing the New Set

NOT the least of the advantages of single-span tuning is the greater latitude which is obtainable in the choice of a layout. The space occupied by a gang condenser and a set of matched coils is saved, and the abolition of waveband switching makes it possible to mount those coils which are still used in the best electrical positions instead of being forced by the switches to a choice based largely on mechanical grounds.

The elimination of components results in a considerable saving of space, and the receiver chassis measures only 15in. by 8in., while the power chassis is even smaller; it is the same length, but only 5in. wide. The chassis are built from metal-covered plywood, and may be obtained with the large holes ready drilled. For rigidity, the front supporting batten of the receiver chassis is of thick wood, but is cut away in the centre to permit the mounting of certain of the components on a thin aluminium plate.

The construction is quite straightforward and little difficulty will be found. The details of the various coils will be given in next week's issue of *The Wireless World* for those who wish to make them, but coils made to this specification will no doubt be available ready made from many firms, as requests from them for details have already been met. It may be as well to say a few words about mounting the finished coils. In each I.F. transformer the trimming condenser is mounted by its one-hole fixing bush through a hole in the centre of the base of the screening can. A large hole is drilled in the chassis beneath the can so that the condenser vanes may be adjusted from under the chassis. The screen base is then screwed to the chassis with three small screws. A number of holes for connections must be drilled through both screen, base and chassis.

### Adjusting the Receiver

The coil itself is mounted with the aid of a small bracket on the condenser terminal for the *moving plates*, and the high-potential coil terminal, which comes at the bottom of the coil when it is mounted, is wired directly to the nearest condenser terminal for the fixed plates. In the case of L6 and L7, a small hole is drilled in the top of the screening can for the anode lead to the valve.

In the large screening can for the oscillator coil L3 many other associated components are located. The first step should be to bolt L3 to the condenser frame, for in this will be found three holes; it is easiest to insert the bolts through the coil former with a pair of thin-nosed pliers and to place the nuts beneath the condenser frame. The grid condenser C3 should then be bolted underneath the frame, inserting a thick washer, for which a 2BA nut will serve, between the condenser frame and the fixed condenser. A hole should next be drilled in the screen base, off centre in the position shown in the drawings (see next week). The condenser bush must be pushed through the hole, the mounting bracket supplied with the dial placed over the bush on the outside and the nut run dn and tightened up. The trimming condenser, the adjusting screw of which can be reached through one of the slots in the screen cover, should next be mounted on two small brackets, and the internal wiring of the unit completed. The tuning unit may then be mounted as a whole on the chassis by means of the bracket. When

Following correspondence with Gary Tempest, he made the suggestion that I should write my opinions on the subject as an article for The Bulletin under the above title and I finally got around to it. In fairness to Mr Dixon–Nuttall, his article is a very complete and accurate description of a single–span set made by FW Smurthwaite and all its shortcomings. The only thing I would change is the title, the 'mistake' should be plural because Mr Smurthwaite managed to alter WJ Cockings design in such a way as to nullify every one of the claimed advantages of the Cocking design.

My first knowledge of the single span principle was circa 1951 when I was the new boy in what was to become an aerospace electronics controls laboratory. My mentor Richard Woodicroft–Haigh had been designer at RGD for a short period between his release from radar development at the end of WWII and the sad demise of the manufacturers of the Rolls Royce of British radiograms.

Richard's lifelong interest was music and perfection in the reproduction of sound. It came as no surprise to hear that his personal equipment at home used push–pull PX25s with an output transformer and speakers of his own design because no manufacturer's product came up to his exacting requirements. I was however, surprised to hear that having access to the top of the range RGD tuner with AFC to keep the received carrier always exactly in the centre of a carefully designed optimum IF pass band he chose a small modification to the original Cocking design (a slightly higher IF at 2MHz) which in no way departed from Cocking's original principles.

The how? of Cocking's single span circuit is a matter of the application of what was in 1934 a very innovative circuit design, which later made considerable contributions to post WWII communications receiver design. The why? may best be understood in the context of early 1930's AM broadcast conditions.

At the beginning of broadcasting, to the man in the street being able to hear faint sounds which had been sent tens of miles through the air was a technical miracle. With rapid advances in receiver design and increases in transmitter power, clear reception at loudspeaker strength would be expected from any acceptable receiver. By 1930 the number and power of stations created a demand for the selectivity of the superhet and restriction of transmitter bandwidth and planned station frequency allocation to avoid interference was essential. At the same time development of the moving coil loudspeaker and push–pull audio output stages capable of low distortion and high power operation gave promise to greatly improved sound reproduction. The actual quality of the sound produced could never be better than that at the audio stages, on medium and long wave AM was limited by practical necessities.

When the carrier wave of a transmitter is amplitude modulated, side bands

are produced and the extent of these side bands depends upon the audio modulating frequency. For instance if audio components up to 15KHz were desired the transmission would spread 15KHz on either side of the carrier so that the transmitter would occupy 30 KHz of spectrum.

By the mid–1930s the demands on the available spectrum forced international agreements on the allocation of station frequencies and 9KHz channel spacing was needed to accomodate all the stations in Europe. With 9KHz channel spacing, the theoretical upper audio frequency which could be transmitted was only 4.5 KHz but if there was a strong signal on adjacent channel the IF pass band of the receiver would have to be much less than 9 KHz to avoid objectional adjacent channel interference with an inevitable further loss of treble. If however the adjacent channel signals were too weak to be detected as would frequently be the case on medium waves in daylight the IF bandwidth could be increased to obtain a much better audio quality. The ideal receiver for a music lover would thus have a simple variable IF bandwidth to enable the best possible audio quality to be obtained under any reception conditions. This is one of several very desirable improvements to existing receiver design which Cocking addressed in his Single Span Receiver.

The single span concept was developed to overcome what were seen as quite serious problems in receiver construction in the early 1930s. This is stated in the first of the four *Wireless World* articles. Single knob tuning in normal superhets required precision coils, capacitors and precise tracking adjustment to obtain good performance. Wave–change switch contacts were also a frequent problem in early sets. The fourth *Wireless World* article states:

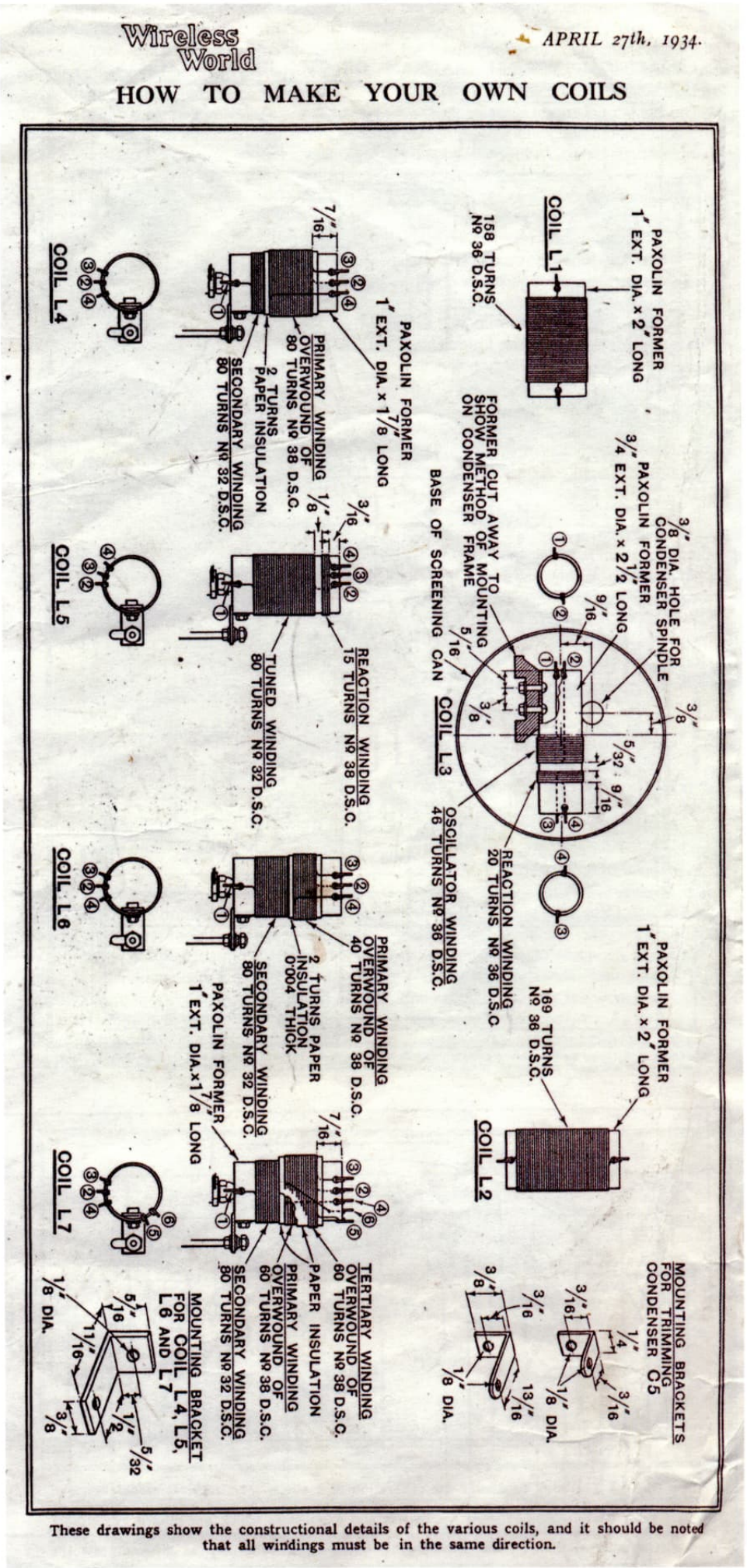
***Features of the new set***

*No ganging adjustments. 200 to 2000 Metres coverage without gaps. No waveband switching. No gang capacitor or matched coils. Tuning unaffected by aerial characteristics. No second channel or kindred forms of interference. Variable selectivity improved quality of reproduction.*

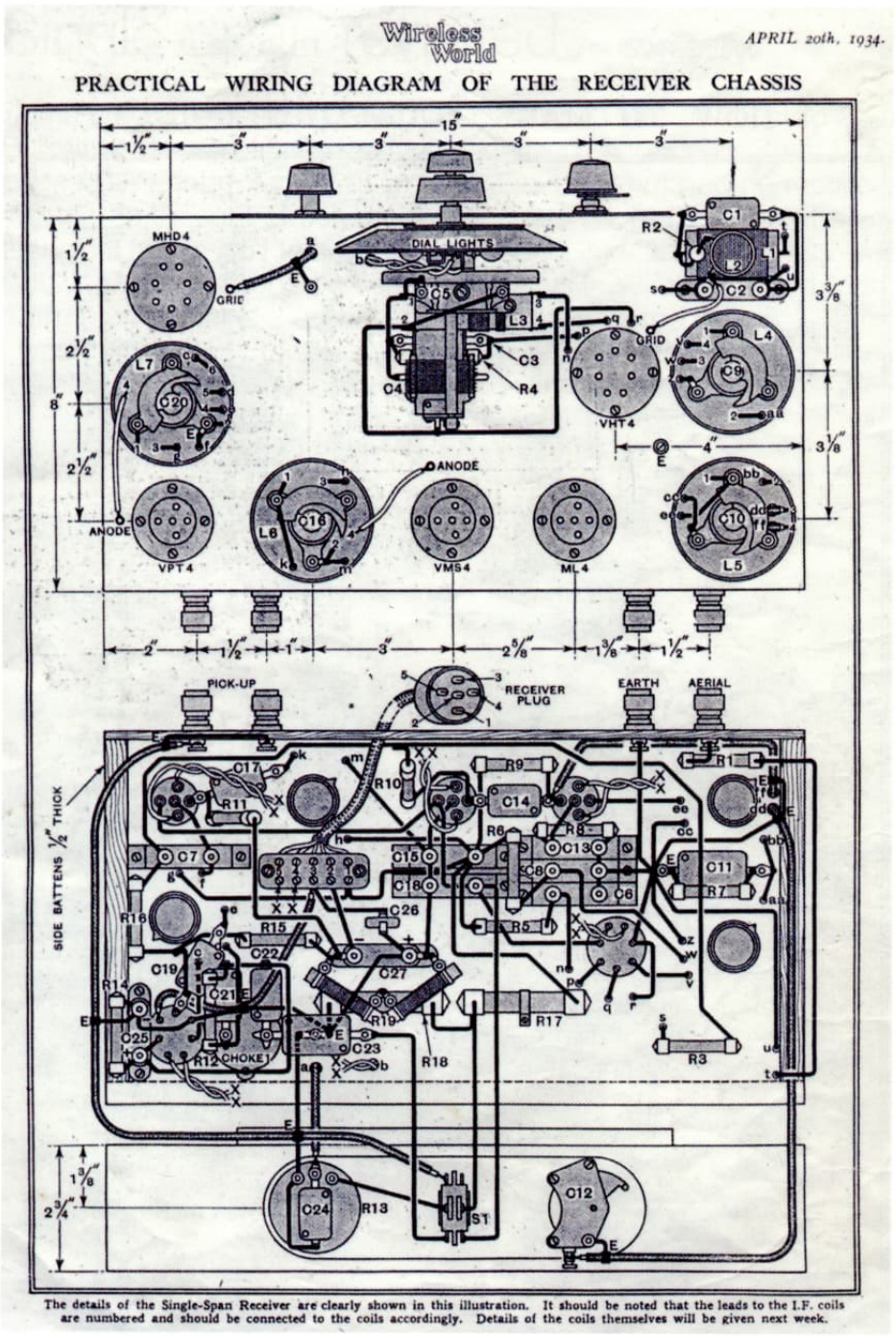
Quite an impressive list of claims but did it live up to them? When constructed and adjusted exactly in accordance with Cocking's articles and under the broadcast band conditions of 1934 I would answer with an unqualified yes. Under today's conditions with some some strong shortwave transmissions in the 3.3 to 4.7 MHz range second channel interference (image response) may not be totally eliminated but it shouldn't be much of a problem.

If the Cocking single span achieved all of its design objectives so well why did it never catch on?

I think the answer lies in the date. In




These drawings show the constructional details of the various coils, and it should be noted that all windings must be in the same direction.




The details of the Single-Span Receiver are clearly shown in this illustration. It should be noted that the leads to the I.F. coils are numbered and should be connected to the coils accordingly. Details of the coils themselves will be given next week.

1934 circuit designers and component manufacturers were addressing the same desired improvements by other means. Ganged capacitors with oscillator sections having different capacities, tuning laws to ease tracking problems, and precision wound coils with respectable close tolerances were beginning low cost mass production. Yaxley–type switches with self–cleaning wiping contacts and ball detents were solving band switching problems. Much higher IF frequencies were beginning to replace the typical 110KHz of the period and they were being made with double tuned circuits designed for optimum bandwidth. The new 465 KHz double–tuned IFs virtually eliminated image responses on medium and long waves.

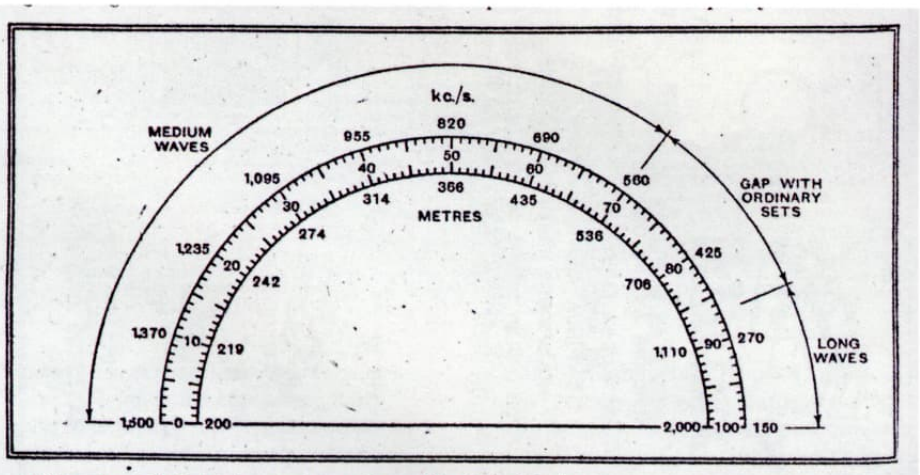
At the same time new valve types with more than one function in a single envelope and much higher sensitivities

Mr Cocking produced a design to overcome some problems which would shortly be solved by other simpler and cheaper means and it fulfilled its promise.

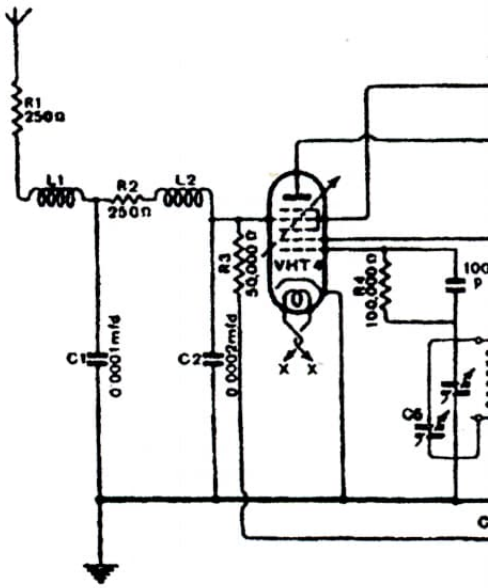
made possible the so–called short superhet using only three valves plus rectifier. All these innovations coming together produced a medium and long wave broadcast receiver with excellent performance which was very simple to operate and could be mass produced at a cost affordable by the masses.

Compare a short superhet of the same year, for example the Ultra 22 with Cockings circuit using 5 valves and a chassis full of components just for the tuner alone and requiring an audio power stage and power supply to make a complete receiver and it is quite obvious that Cocking's design was never going to succeed as a broadcast receiver for the mass market.

Cocking's set had another problem – it had a variable bandwidth control which had to be very carefully adjusted to suit




With a true S.L.F. tuning condenser the calibration of a single-span receiver would be given by this diagram. The medium waves are spread over 70° and the long waves are covered by the last 13°. Wavelengths between 536 metres and 950 metres which are missed by ordinary sets tune in between 70° and 87°. In spite of the apparent crowding of the long waveband, tuning is no sharper than on low wavelengths, but with a condenser of different law the



each signal tuned if the superior quality of reproduction of which it was capable was to be obtained. It was another knob to turn and the general public did not understand what it did, how to tell if you had the best setting or which way to turn if you had adjacent channel interference.

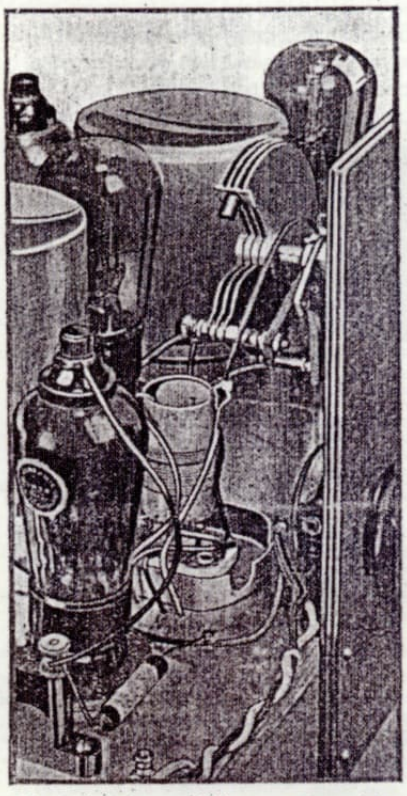
If you were a perfectionist with the knowhow to get the best from it, it could undoubtedly produce the best sound quality possible from any signal strong or weak, clear or with an unwanted station nearby – it couldn't make a bad transmission perfect, it could only minimise the defects if you had the necessary skills.

**Referring to the circuit diagram I will follow the signal path from aerial to audio.** The aerial signal is applied to the frequency changer via a low pass filter to strongly attenuate short wave signals above 3 MHz which would be hetrodyned to 1.6 MHz producing an image response. The signal is thus converted to IF without any amplification or selectivity at signal frequency. This is an important radical departure from conventional practice and was to reappear in advanced, high performance communications receivers in the late 1950s and 60s. The local oscillator runs above signal frequency at 1750 KHz to 3.1 MHz covering 150 KHz to 1.5 MHz in a single unbroken span, eliminating gaps and band switching.

The next stage is the most significant, important and misunderstood part of the entire design.

The frequency changer is immediately followed by a high performance variable bandwidth band pass filter and this block is the only bandwidth determining block in the whole receiver. Unlike standard superhet practice the transformer in the IF amplifier are designed to have wide bandwidth so that the signal width is determined only by the variable band pass circuit. The advantages of variable bandwidth were realised early on in receiver development and double–tuned circuits with variable coupling provided by swinging coils appeared quite early. In the late 1930's and in the 40s and 50s special IF transformers in which the distance between primary and secondary was controlled by a panel control, and a version with a tertiary winding interposed between primary and secondary, which varied the coupling by loading it with a variable resistor were used in the very best communication receivers.

Cockings solution was to design a variable



The tuning system of the new set consists of only one small coil with a S.W. type variable condenser.

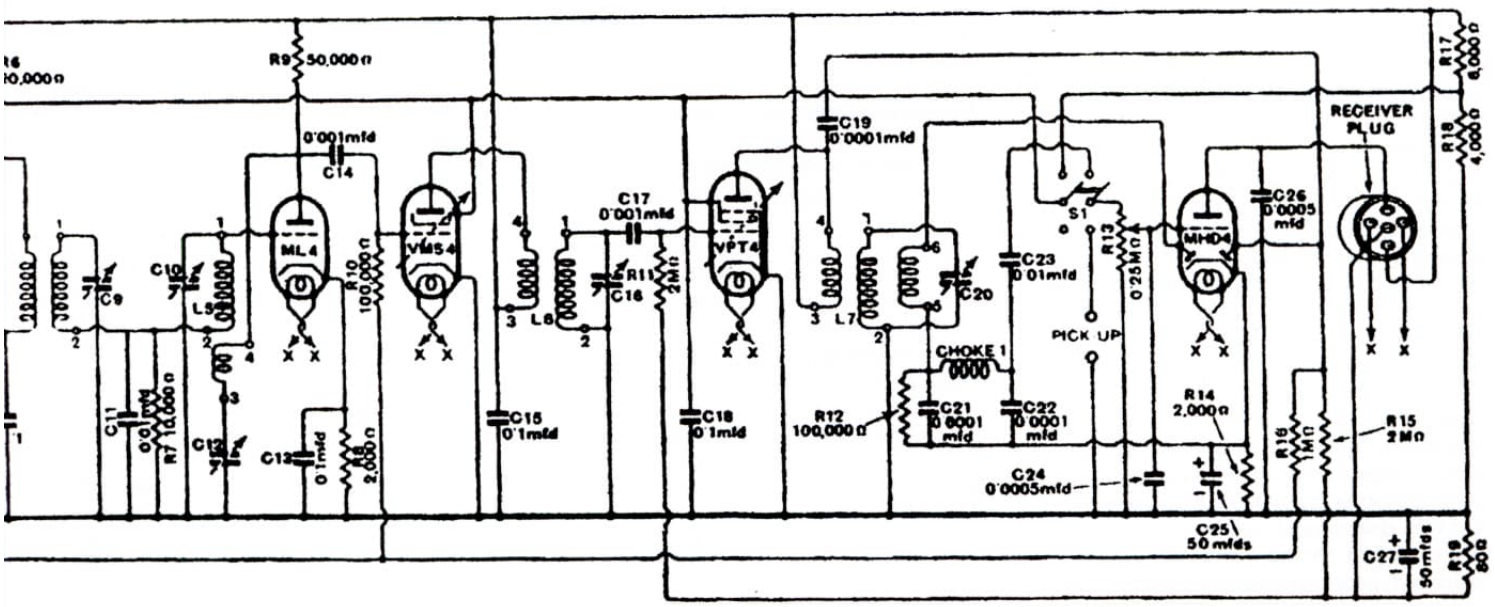
selectivity filter in which the bandwidth was controlled by electronics. The second valve in the circuit is a low impedance triode referred to as a buffer stage. It is not an IF amplifier as such, its function is to supply a variable signal current to a coupling coil applying positive feedback to the band pass pair following the mixer. The higher the feedback, the higher the effective Q factor of the coils because the energy supplied by the buffer replaces the energy lost in the coils, thus the feedback throttle capacitor behaves as a bandwidth control by varying the effective Q of the filter's coils. This principle became very important in improving the selectivity of high performance communications equipment post WWII when its developments were known as Q multipliers.

Two stages of IF amplification follow but as previously stated they do not determine signal bandwidth. Conventional AVC and signal rectifier and an audio voltage amplifier complete the tuner. The AVC control voltage is applied over no less than three stages providing a very tight control over the signal output level.

It is important in understanding the operation of the tuner to note that the variable selectivity block is inside a very high gain AVC loop. Thus varying the bandwidth from wide to narrow has almost no detectable effect on the output volume. Unfortunately in Cocking's text he called the feedback throttle the reaction control, although in pictures of the set it is referred to as 'bandwidth control'. Most misunderstandings of what this circuit does leads frequently to criticisms such as "Turning the reaction control produces almost no increase in sensitivity" (that's how it was designed to work) and "I measured the bandwidth of the IF transformer and it was very disapointing at over 20KHz" (The IF transformers do not determine the bandwidth).

Mr Cocking produced a design to overcome some problems which would shortly be solved by other simpler and cheaper means and it fulfilled its promise. Two of Cocking's circuit innovations are to me the most important thing about this set. They were developed to become of great importance to receiver design more than two decades later. Not just one but two important ideas in one circuit and that is what single span was really about!

I trust that I may have brought to the notice of readers the work of a very good circuit designer. As for Mr Smurthwaite's butchery of a fine circuit design – give it a decent burial!



# The Single Span: or, Smurthwaite's Mistake

by G. Dixon-Nuttall.

Originally in the BVWS Bulletin, Winter 1996

I sometimes buy odd things at auctions, just for curiosity. This was one of them; it was catalogued as 'a Ferranti receiver', because that was the name on the meter on the front panel. Having got it home, I was starting to trace out the circuit, and getting more and more puzzled, when bells rang, and I realised that what I had was a *Wireless World* Single Span receiver.

This may be unknown to most people, but in 1934 it was the subject of innumerable articles in the *Wireless World*.

**What was all the fuss about?**

At that time home made sets had reached the point where superhets were becoming essential, to keep up with the manufactured article. Until then you could actually build a set which was as good as, if not better, than you could buy, but by that time it was becoming a close thing. So they designed a circuit that was easily built, and did not require a signal generator to align it, and had no tracking problems.

The basic idea was simple. If you use a high I.F. it is possible to cover both medium and long bands in one sweep, as the oscillator has a smaller ratio between highest and lowest frequency. But what about the signal circuits? Easy, you don't tune them. Any images will be above 3.5 MHz anyway, and a simple trap will remove them.

The original circuit used an I.F. of 1.6 MHz., and covered both bands easily. It had a wide bandwidth, as one might expect, and used reaction to tighten it up a bit when needed. Three separate circuits were published, for A.C., AC/D.C. , and battery, and then they had second thoughts and produced another version in time for the Radio show. Altogether you couldn't escape the thing if you took W.W. in 1934.

My set bears a plate saying that it was built by F.W. Smurthwaite. I looked him up, and found that he had a business building sets to order, mostly from W.W. designs. He exhibited at the 1930-33 Radio shows, but then disappeared, so this must be one of his last. On the whole I am not surprised; people buy home-made cakes, but not usually home-made radios.

In this case he had not been very clever, because he had grafted an R.F. stage in front of the original circuit. This is a silly idea, because the advantage of the circuit was that you didn't need a bandswitch, and had only one tuning control, and to add both missed the whole point. In this case, the front end could not be used, as the original coil pack used Ferrocart coils, and these had done their usual trick of exploding very slowly, as the iron rusted. I believe Cossor had to replace large numbers of coils due to this happening.

He had made quite a nice job of it, using the original chassis layout, but underneath he had knitted it himself, and it could have been tidier. The cabinet is impressive, with a drop front. It is finished in black enamel, and looks funereal, like a coffin for a pet dog.

Without the R.F. stage I had to supply

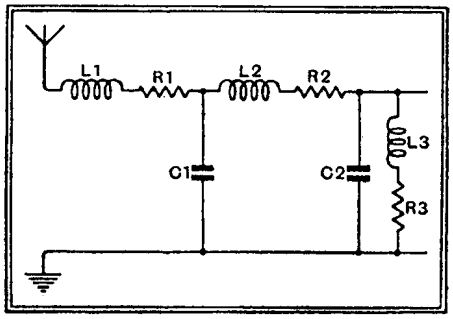



**Fig. 2.—The connections of the new filter are shown in this diagram. The values of the components are $L_1 = L_2 = 200$ μH; $L_3 = 1{,}450$ μH; $C_1 = 125$ mmfds.; $C_2 = 100$ mmfds.; $R_1 = 700$ ohms; $R_2 = R_3 = 300$ ohms.**

the front end filter. This is detailed in the original articles,and they published an update later in the year, so I used that one.

Desmond Thackeray, who likes such things, has made a computer model of this filter. The response curve is exactly what the Wireless World says it should be. This looks like a rather slack two-pole tent; the response has a peak at about 200 kHz, so as to boost Long wave, and then another one at the H.F. end of Medium wave. Unfortunately this is a bit near to the I.F., so anything around 1500-1600 kHz tends to come in. This produces whistles, particularly after dark. These can be reduced by tuning the second coil with a trimmer.

Various capacitors had suffered. In course of investigations I found one or two more of Mr. Smurthwaite's clangers. The anode load of the audio triode should have been 100k, with a 10k plus 8 mfd decoupling circuit. He had misread this, and just fitted the 10k, which is far too low. The volume control was 1 Meg instead of the specified 1/4 Meg, which introduced hum. He had added a tuning meter (the 'Ferranti' one), an I.F. gain control, marked 'Range', which is not much use, and an 'A.V.C. on-off' switch which is also unnecessary. But they help to make the front panel look interesting! The meter hit the pin, and required a shunt resistor; had it ever worked?

Having put together a power unit and an output stage it was time to switch on. The first problem was instability, as the resistors feeding the screen grids had gone high, but eventually it worked quite well. The I.F. transformers were aligned (easy, the air trimmers have knobs on), and it gave quite a good account of itself.

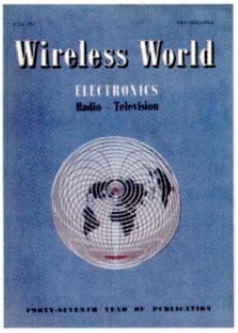
One would expect whistles, but in fact in daylight there are only one or two faint ones. However, after dark it really twittered. This seems to be due to the fact that the medium waveband has expanded since 1934, and there are now stations down to about 1550 kHz.; hence my alteration of the filter.

It is now quite a nice radio, but while I was at it I had a look at the bandwidth. Without the reaction it is quite wide – 20 kHz @ -6 dB. Adding reaction tightens things but has an unfortunate effect, as two spikes appear, one larger than the other. This is what one might expect, as the reaction is applied to a bandpass pair. I have improved things by adding a bit more bottom coupling, increasing the capacitor from .01 to .015mfd. This reduces the secondary spike, but the main one is still on one side, so re-tuning is needed. The reaction capacitor has a slow-motion drive, which is as specified, but unnecessary.

This set shows very little sign of wear. I wonder if the original owner got fed up with the two tuning controls, or maybe it was just too big? Remember that the cabinet does not include the power unit or output stage. In any case, the circuit soon went out of favour; this was mostly caused by the emergence of the all-wave receiver, and the decline of home building, particularly of such an expensive set. The only survivor of the Single Span circuit is the little MCR 1, which as anybody who has one will know, covers both medium and long bands in one sweep, using the same principle. In this set the input filter seems to have been designed in rather a hurry, or else they fitted the wrong coils by mistake, as the response is very strange. But at the time they all had other things to worry about.

# The Twin-Triode Transistor – the First Integrated Circuit?

by Stef Niewiadomski




At the Royal Wootton Bassett BVWS meeting in December 2011 I bought a full set of 1957 Wireless Worlds for a very reasonable price. The magazines are packed full of vintage articles and adverts (which I think often tell us more about the times than the articles), and if you can find space to store them – Wireless Worlds are very bulky – they are a very useful source of historic data.

A brief feature in the July 1957 issue entitled 'Twin-Triode Transistor' caught my eye, reproduced in full in the accompanying diagram. As you can see General Electric in the US had recently announced a twin-triode transistor, targeted at the frequency changer, IF amplifiers and audio stage of consumer transistor radios. It's not clear from the article whether the transistor, and the radio it was meant to be used in, was actually built. The original source of the information was the April 1957 issue of Electronics magazine. I presume there is nothing ominous about the April date, and I'm sure Wireless World would not have picked up the announcement had there been any doubt as to its truthfulness.

The winter 2011 BVWS Bulletin article 'The Emerson 868 Miracle Wand 4 Transistor Receiver' shows a typical 1957 design, optimised to keep the number of (expensive) transistors down to four, plus a diode. GE were a big manufacturer of radios, including transistor-based ones, at the time and their own sets were presumably the target for this new type of transistor.

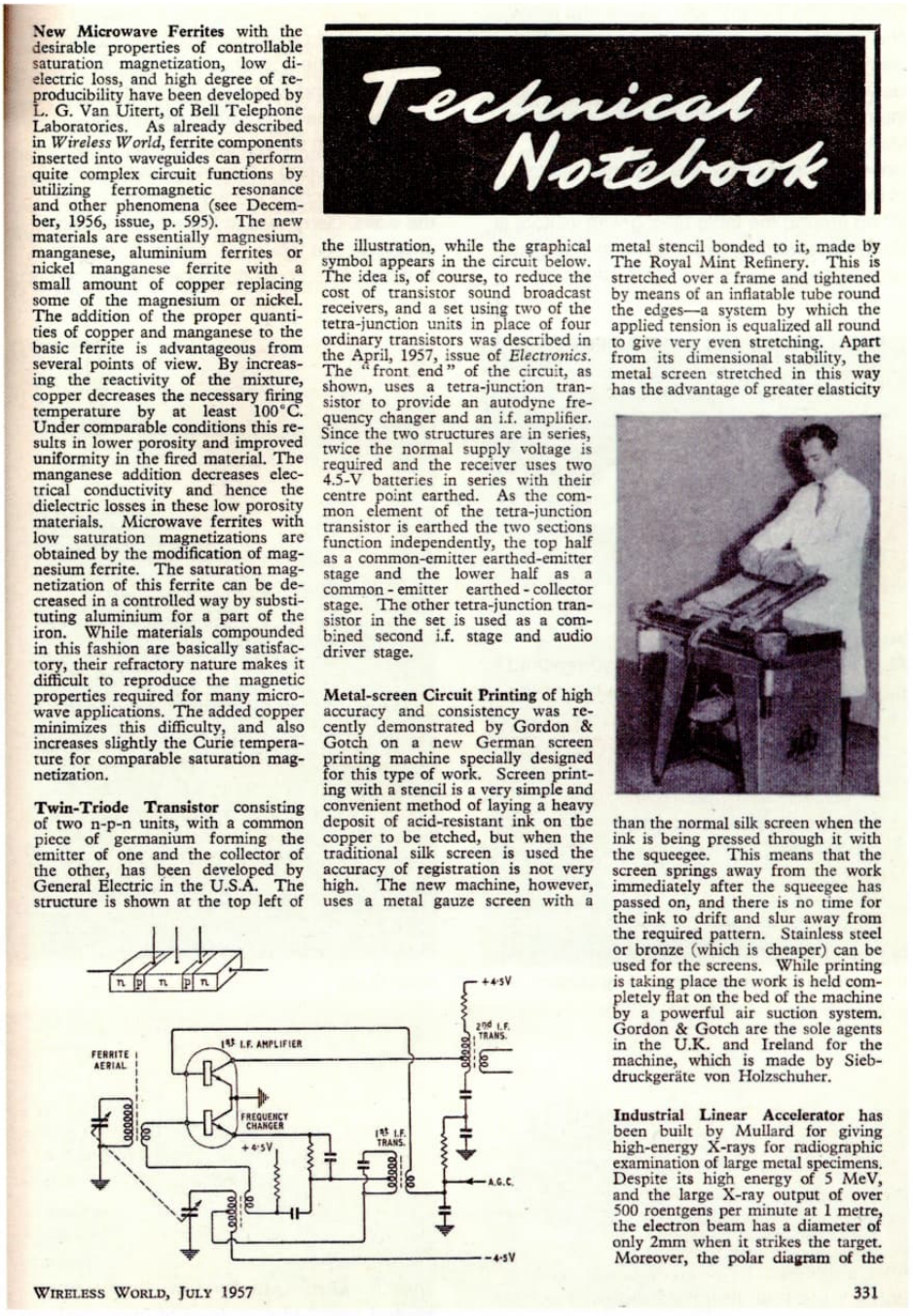
The device had four junctions, producing two NPN transistors, and was described as a tetra-junction transistor, so I suppose if allocated an RMA code, it would have had a 4Nxx part number. It strikes me that since there are two active devices on a single piece of semiconductor material – germanium of course – does this qualify as an Integrated Circuit? The common understanding of an IC is that it's a planar device, with active transistors, diodes and resistors deposited across its surface, and interconnected using metal, though I'm not sure if this is too restrictive a definition?

Jack Kilby at Texas Instruments is generally credited with inventing the IC, the first germanium part fabricated in September 1958. Robert Noyce at Fairchild was working on the same idea at the same time and produced the first IC on silicon. After several years of legal battles the two companies eventually agreed to cross-license their technologies. If built it seems to me that the GE tetra-junction transistor pre-dates TI's and Fairchild's introduction of the IC.

US Patent 3,138,743 for 'Miniaturized Electronic Circuits', the first integrated circuit, was filed on February 6, 1959. In the patent application Kilby described his new device as 'a body of semiconductor material ... wherein all the components of the electronic circuit are completely integrated'. At the time this was an optimistic (and all-encompassing – a key feature of a successful and long-lived patent) view of what could be achieved. Early ICs typically integrated only the transistors of the circuit and many external components, for example the capacitors and any resistors that needed to have precise values, were still needed.

Does anyone have more information on this GE device? Was it ever made? Were any radios built using the device?

http://www.pat2pdf.org/ is a good patent website where you can download pdf versions of many original patents, including the key IC patents of Kilby (3,138,743) and Noyce (2,981,877).



Technical Notebook

**New Microwave Ferrites** with the desirable properties of controllable saturation magnetization, low dielectric loss, and high degree of reproducibility have been developed by L. G. Van Uitert, of Bell Telephone Laboratories. As already described in *Wireless World*, ferrite components inserted into waveguides can perform quite complex circuit functions by utilizing ferromagnetic resonance and other phenomena (see December, 1956, issue, p. 595). The new materials are essentially magnesium, manganese, aluminium ferrites or nickel manganese ferrite with a small amount of copper replacing some of the magnesium or nickel. The addition of the proper quantities of copper and manganese to the basic ferrite is advantageous from several points of view. By increasing the reactivity of the mixture, copper decreases the necessary firing temperature by at least 100°C. Under comparable conditions this results in lower porosity and improved uniformity in the fired material. The manganese addition decreases electrical conductivity and hence the dielectric losses in these low porosity materials. Microwave ferrites with low saturation magnetizations are obtained by the modification of magnesium ferrite. The saturation magnetization of this ferrite can be decreased in a controlled way by substituting aluminium for a part of the iron. While materials compounded in this fashion are basically satisfactory, their refractory nature makes it difficult to reproduce the magnetic properties required for many microwave applications. The added copper minimizes this difficulty, and also increases slightly the Curie temperature for comparable saturation magnetization.

**Twin-Triode Transistor** consisting of two n-p-n units, with a common piece of germanium forming the emitter of one and the collector of the other, has been developed by General Electric in the U.S.A. The structure is shown at the top left of the illustration, while the graphical symbol appears in the circuit below. The idea is, of course, to reduce the cost of transistor sound broadcast receivers, and a set using two of the tetra-junction units in place of four ordinary transistors was described in the April, 1957, issue of *Electronics*. The "front end" of the circuit, as shown, uses a tetra-junction transistor to provide an autodyne frequency changer and an i.f. amplifier. Since the two structures are in series, twice the normal supply voltage is required and the receiver uses two 4.5-V batteries in series with their centre point earthed. As the common element of the tetra-junction transistor is earthed the two sections function independently, the top half as a common-emitter earthed-emitter stage and the lower half as a common-emitter earthed-collector stage. The other tetra-junction transistor in the set is used as a combined second i.f. stage and audio driver stage.

**Metal-screen Circuit Printing** of high accuracy and consistency was recently demonstrated by Gordon & Gotch on a new German screen printing machine specially designed for this type of work. Screen printing with a stencil is a very simple and convenient method of laying a heavy deposit of acid-resistant ink on the copper to be etched, but when the traditional silk screen is used the accuracy of registration is not very high. The new machine, however, uses a metal gauze screen with a metal stencil bonded to it, made by The Royal Mint Refinery. This is stretched over a frame and tightened by means of an inflatable tube round the edges—a system by which the applied tension is equalized all round to give very even stretching. Apart from its dimensional stability, the metal screen stretched in this way has the advantage of greater elasticity than the normal silk screen when the ink is being pressed through it with the squeegee. This means that the screen springs away from the work immediately after the squeegee has passed on, and there is no time for the ink to drift and slur away from the required pattern. Stainless steel or bronze (which is cheaper) can be used for the screens. While printing is taking place the work is held completely flat on the bed of the machine by a powerful air suction system. Gordon & Gotch are the sole agents in the U.K. and Ireland for the machine, which is made by Siebdruckgeräte von Holzschuher.



**Industrial Linear Accelerator** has been built by Mullard for giving high-energy X-rays for radiographic examination of large metal specimens. Despite its high energy of 5 MeV, and the large X-ray output of over 500 roentgens per minute at 1 metre, the electron beam has a diameter of only 2mm when it strikes the target. Moreover, the polar diagram of the




WIRELESS WORLD, JULY 1957 331

# The British Vintage Wireless and Television Museum, West Dulwich, London

by John Thompson, Chairman, photographs by Carl Glover

Seven years have now past since I was asked by Gerry Wells and the Trustees of the British Vintage Wireless and Television Museum if I would consider being Chairman. After no more than a second or two's thought I accepted the challenge.

In 2005 the Museum was getting used to being awarded Charitable Trust status; this brought with it many advantages and many challenges. I was extremely conscious that Gerry had developed the museum as part of his wireless obsession and was, and still is, the most important exhibit on the premises! Many of the visitors to the museum are close friends of Gerry, the informal nature of the museum makes it unlike any other; sitting around the table talking with visitors is always a rewarding experience, exchanging reminiscences, technical information and stories of recent finds or near misses.

I saw my role, as first Chairman of the museum to protect the heritage of the museum as well as securing the future and helping Gerry by removing, where possible, any pressures from him. From the visitors point of few I was keen that the Trust's role should be a background activity, acting as a critical friend, steering policy, keeping a close control on efficiency, finance, building issues and the collection with Gerry's well–being and wishes being central.

Thinking back to 2004, I remember standing with Gerry one morning in the workshop during a torrential downpour of rain and watching the water running down the walls. Gerry was at the end of his tether unable to see the way forward. It was clear that the roofs could no longer be patched up; a full replacement project was needed. An appeal was made to BVWS members through The Bulletin and with a few committed and hard working volunteers the roofs were replaced to keep the collection safe and dry.

Early on we decided to launch a Friends Group. This has gone from strength to strength, we now have in excess of 150 Friends who, many, give days of their time helping with projects on the premises, DIY, cleaning helping with open days and events etc. The income generated by the friends group has now become the museums largest income stream. We are all extremely grateful to the BVWS members who have in addition to their BVWS membership, chosen to support the Museum by becoming friends.

Over the last seven years we have tried hard to display the fantastic collection to

The museum in Rosendale Road, West Dulwich

Acliffe Room

Acliffe Room

show it to its best, this is always difficult as space is at a premium. I hope you can see from the accompanying photographs that the galleries are looking pretty good. If you haven't visited for a while I would urge you to visit Gerry and the Museum soon.

As well as working on displaying the existing objects, we have acquired many new exhibits; also replacing existing items with better condition examples.

There have been some larger capital projects undertaken which have been made possible from the NVCF profits kindly donated by the BVWS. We have overhauled the central heating system including replacement of the old boiler in the house with the latest high efficiency condensing type. This has made the system more reliable and has dramatically reduced our gas bills!

We have also rebuilt part of the workshop, where the cladding, and both wall and floor timbers were replaced, insulation was also fitted. Many hours of work have also been undertaken in the garden making it easier and cheaper to maintain in the future. We have had a CCTV system installed to ensure the continued safety of our visitors, Gerry and the collection. We have re–carpeted the front room and many of the pre war television sets exhibited there are now in full working order.

A project is currently underway to document and transfer our archive to DVD. This contains much historical footage as well as Gerry's numerous TV appearances!

We are developing a museum guide book, using the fantastic photographs by Carl accompanying this article.

As Chairman, my contributions pale into insignificance compared to the commitment shown by Eileen who is on the premises every day running the day to day activities voluntarily on behalf of the Trust. I cannot thank Eileen enough and only hope my small time contribution and availability for support and advice helps to share the stresses and strains she undertakes regularly.

On a day to day basis we have regular visits by groups and societies who often join our friends group or return as individuals. We raise funds by hiring items for television and film shoots; including a significant contribution to 'The Kings Speech'. We have regular friends group social events, two table top sales, the annual garden party and two music events details below, we have made the premises available for hire, customers including BT and the Science Museum. I'm sure we are in a good position to go from strength to strength.

**Forthcoming events**

The garden party this year is on Saturday 9th June 2012. This very popular event will be enhanced this year by the New Foxtrot Serenaders. They are a 7 piece band, who will be playing jazz and dance music. They will really make the party go with a swing. It is essential to book tickets in advance, tickets £15.00 (£19.00 on the door)

Also this year; we are celebrating the analogue television service which is being switched off in London this April. On 15th April from 10.30 am we are having

Rickard Taylor Room

Rickard Taylor Room

Dave Adams Room

Dave Adams Room

Dave Adams Room

a combined open day, table top sale and analogue service celebration. Entry fee of £5.00 will give you the opportunity to buy a new project, or something for your collection from the table top sale, look at working vintage television sets and have a tour around the museum. We are inviting visitors to bring their television sets along to show off. There will be space, power and RF feeds available to use. Please let us know in advance if you intend bringing a set along.

Our popular Music Nights have now been moved from Friday nights to Saturday during daylight hours. The next event is Saturday 11th August. Doors open at 1pm, there will also be a small museum table top sale where you may pick up a bargain.

Let me finish by thanking all who support the museum and look forward to seeing you there in the near future. There's always new things to see at the museum, always interesting people to talk to, don't leave it too long; we would love to see you soon.

Paul Getty Room

Dave Adams Room

Paul Getty Room

Paul Getty Room


Marconi Room

Marconi Room

Marconi Room

Paul Getty Room

Marconi Room

Marconi Room

Daventry Room

The rear of the museum, viewed from the sheds.

HMV and Marconi collection

HMV and Marconi collection


Workshop and American collection

Daventry Room

HMV and Marconi collection

Workshop and Philco Collection


Droitwich Room

Droitwich Room

# Gecophone Stork Loudspeaker 1929 by Gary Tempest

I found my first one of these more than ten years ago. It came from a lady who had "... got a lot of old radio stuff out of the loft for you to look at". It was amusing to see "stuff" on newspaper on an otherwise clean living room carpet. She said it had been up there for more than 60 years and the loft must have been well ventilated as it was all truly filthy with a thick layer of gritty dust. We tell people not to plug them in or mess with them she had certainly not done with these, although most would have wiped a damp cloth over prior to viewing. The cabinet was not bad, all the veneer was present and not coming away and the fretwork was undamaged (unlike the second one, see picture). In both of these oak cabinets there was no sign of woodworm and I was told that they don't like a very hard wood and a wood that is rich in tannin. The edge beading was broken and missing in places and peering in through a hole in the torn cloth of the back, I could see that the speaker was not original. I wasn't too impressed with it or the rest of the items, which were mostly junk. Anyway she said it wasn't going back in the loft if I didn't buy it and pointed to a skip outside the front door. No! I couldn't let that happen.

The finished speaker

The original grille cloth

I took 'old Storkie' home expecting laughter and derision from my wife. But this wasn't so as she thought it lovely and reckoned it would be very eye catching if I could restore it. This is actually true as visitors always remark about it whilst passing by what to me are far more interesting radios.

**How does it work?**

A few words are permissible just in case we have someone new to the hobby. It is of course a 'moving iron' type with the iron in this case being a ferrous strip or leaf that extends over the pole pieces of a permanent magnet (see picture). On the topside of the leaf is welded a steel pin that connects it to the cone.

The leaf, some sort of high tensile steel, is curved away from the magnet poles. It has a strong coil spring attached to its underside the other end of which is connected to a threaded stud. This has a knob that protrudes on the outside of the cabinet. By turning the knob the gap between the leaf and the poles can be set for the best audio quality.

As can be seen there are two series connected coils around the permanent magnet which carry the audio current. By adding and subtracting to its field they move the leaf in sympathy.

**Cabinet refinishing**

The first thing after stripping all the old lacquer was to try to find some of the

missing beading. In this I was really lucky as there used to be an old timber yard in town with helpful people. Sadly, it's now gone. After a lot of searching they found some lengths of the exact beading. I didn't attempt to use pins through this and just glued it in place with epoxy adhesive. After staining, the cabinet was refinished with Brushing Cellulose Lacquer from Restoration Supplies, Bury, Lancashire. Over the years this has held up well although it tends to be brittle and can flake. From experience this is certain if it is used over original cellulose lacquer for patch up.

**Work done**

The speaker fitted was not the one shown in the picture and I can't remember what it was. The Blue Spot shown was a later swap meet find. What was in there (I vaguely think it was a permanent magnet type) was mounted on a crude baffle board pressed up against what remained of the original grill cloth. This was quite exotic being brown with a gold swirl pattern that looked like paint, in that it is only on the front side. I wonder how they did that. The baffle board was held and pressed in place by a cunning method. It used three hand made wooden toggles (see picture) that had been screwed to the side and top panels. They turned on a single wood screw but to stop them rotating once set, another screw, a small distance away, had been screwed in and then had its head nipped off leaving a sharp point. Thus, when the single securing screw was tightened this bit into the wood and stopped any tendency for the toggle to move. For the Blue Spot I couldn't think of a better way of fixing and so continued with it but did make a new baffle board. As can be seen, I didn't have a fly cutter and so used a hole-saw to make a pattern of holes. A new grill cloth covered the baffle and apart from refinishing that was it for now.

**The second Speaker 2011**

I spotted this on an on-line auction catalogue and asked a friend, who was going, to bid for me providing the speaker was original, complete and with an undamaged cone. This was the case and he made a winning bid within my limit. Why I would want to do this is one of the crazy things about restoration. The speaker with the Blue Spot had never been played since completion but it wasn't right, and now I would have the chance to make things original barring the grill fabric. I hadn't liked what I had chosen before and this could now be changed to something more appealing.

The speaker cone was a little distorted and I corrected this by softening it with steam from a kettle and re-shaping. The motor was in good condition with the series connected coils measuring 500 Ohms.

**Fitting the new grill cloth**

This time I wouldn't be able to use a baffle board and without this, and with cut outs going very close to the top and bottom edges, I knew fitting the cloth wasn't going to be easy. My stores had only one


Did it really need twelve screws

The second speaker

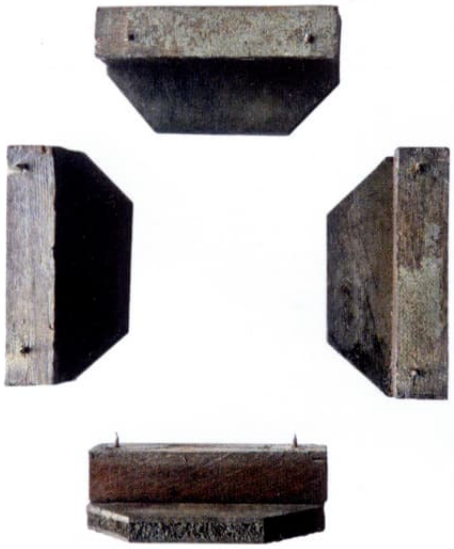
piece of cloth that was ideal and just large enough, so I had to get it right first time.

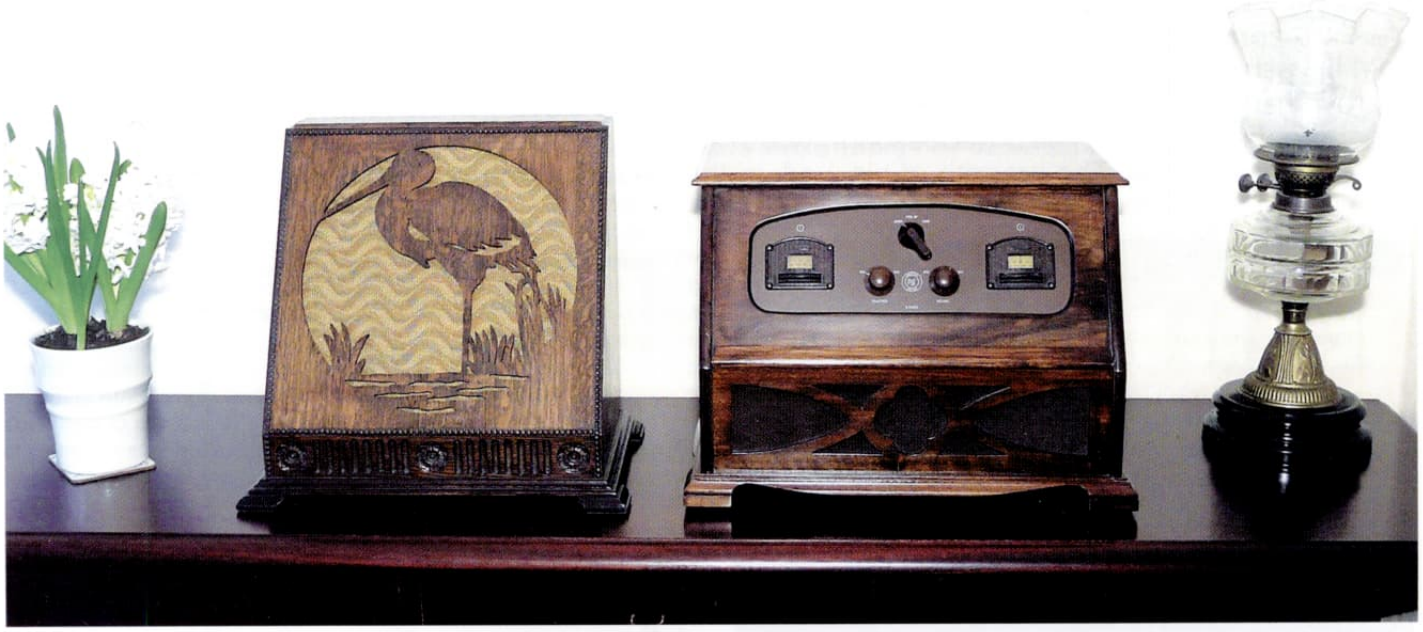
For this application I needed an adhesive with quick grab and so used UHU which is a transparent contact adhesive. Used directly (non-contact) the grab isn't fast enough and used as a contact it's too quick. What does work well is to apply glue to the cabinet surface and press the cloth onto it before peeling it back and allowing time for both to dry. Then apply another thin film of glue to the cabinet, which allows a little slip for the material but a rapid grab once the cloth is worked into place and pressed down.

I started with the top edge, working the ironed cloth out with fingers, until it was taut and safely held. Then it was left for a while during which time I went to the garage and removed adhesive from my finger pads with Cellulose thinners: it is a little messy. Later, I did one side the same way, stretching the material downwards as I went. Again another clean up and then wait a while. The next step was the difficult one as the other side and the bottom had to be done together. I stretched out the side in both directions and once this was holding concentrated on tightening the cloth along the bottom. With little spare cloth to hold onto this wasn't easy but it was successful.

An inside view. Below: fitted with a Blue Spot speaker

Above: Homemade toggles.
Below: The correct speaker cone fixings

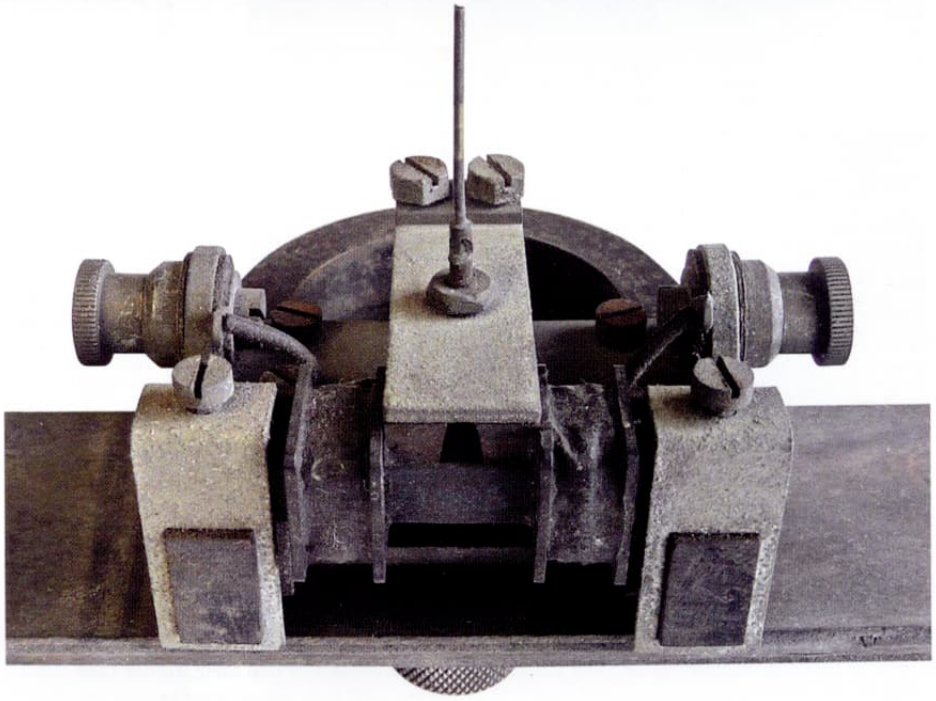




A final touch was to rub adhesive through the material where it contacted the body of the stork. This was done originally and with the front panel sloping backwards is desirable. Before doing this I had checked that the cloth was taut enough. If not, as a last resort I, would have 'spritzed' the cloth with water before rapidly drying with a hair dryer. On some occasions this does tighten the cloth but with modern fabrics they often go back as they were with time. What, from my experience, doesn't work would have been to have dampened the cloth after gluing it to the body of the stork. This may tighten it in one place but not in others leaving really sad baggy areas.

**Fitting the speaker cone**

As shown in the picture there are clamps that hold the cone, with its soft felt surround, in place. The top part swivels on small wooden blocks that were held with panel pins and glue. This had been so liberally applied that it had soaked through the cloth and bonded this and the block to the front panel. After some deliberation I decided to use quick set epoxy. After cleaning the bottom of the blocks I sharpened the panel pins to needle points with small files. I was worried about the lacquer finish coming away from the front and wanted to avoid using a hammer. But I needed to be able to press the block really hard forcing the pins into the front panel. To do this I cut a piece of heavy duty chipboard, to just fit inside the front panel beading and then wrapped this with an old tea-towel secured at the back with Duck Tape. I transferred the approximate block positions from the cabinet, onto the cloth, using a piece of transparent film, having marked this with the original panel pin holes. Once these were pierced then a marker pen was applied to the cloth. Having established positioning, I was pleased that mounting the blocks was so easy. Steady pressure and a little lateral movement pushed the pins through the cloth and into the front panel. Once the glue was set it was a simple matter to mount the speaker cone.



The motor ready for refit

**The motor**

All I could do here was brush and air blow any dust away and slide a piece of clean paper several times between the armature and it's pole piece. Mounting to the cabinet was just a matter of screwing its crossbeam in place and setting the knob that attaches the cone to the driver spindle.

**Conclusions**

I'm always surprised that something that looks so unpromising does produce surprisingly reasonable audio quality. It's very mellow of course but not at all objectionable. It's certainly much better than those early plastic cased transistor sets.

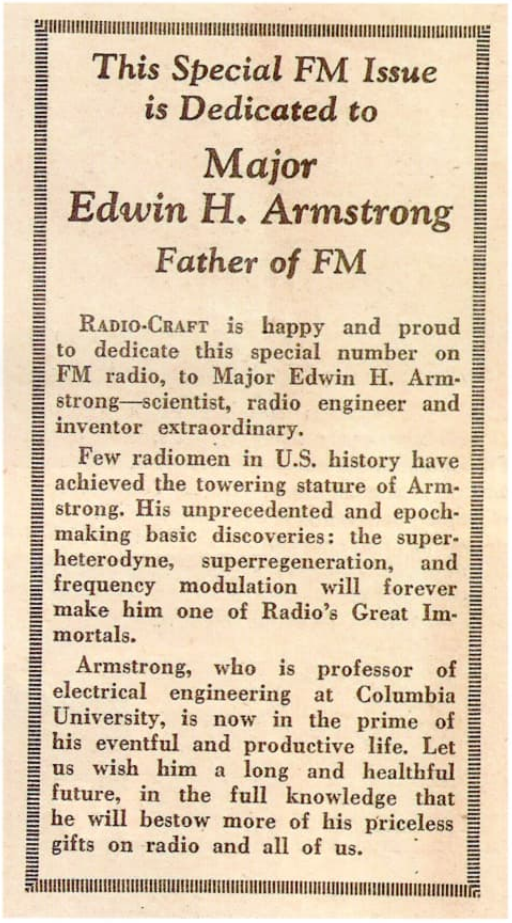
The grill cloth was a piece intended for Zeniths but it suits Storkie well, making him look like he's tramping through small waves.

# FM Broadcasting in 1948

by Stef Niewiadomski

In the winter 2009 issue of The Bulletin I described the life, inventions and tragic death in 1954 of Edwin Howard Armstrong, affectionately known as Major Armstrong, retaining his rank title from his service in the Great War. He is credited with the invention of five highly significant improvements to radio technology (regeneration, the continuous wave oscillator, the superhet, super-regeneration and FM broadcasting), which we still benefit from today, and will continue to for many years to come. The breadth of his work in the field of radio resulted in a total of 42 patents.


Figure 1: Front cover of the June 1948 issue of Radio Craft magazine, showing a distinguished looking Major Edwin H Armstrong – The Father of FM - superimposed on a picture of a transmitter antenna mast.



*This Special FM Issue is Dedicated to*

*Major Edwin H. Armstrong*

*Father of FM*

RADIO-CRAFT is happy and proud to dedicate this special number on FM radio, to Major Edwin H. Armstrong—scientist, radio engineer and inventor extraordinary.

Few radiomen in U.S. history have achieved the towering stature of Armstrong. His unprecedented and epoch-making basic discoveries: the superheterodyne, superregeneration, and frequency modulation will forever make him one of Radio's Great Immortals.

Armstrong, who is professor of electrical engineering at Columbia University, is now in the prime of his eventful and productive life. Let us wish him a long and healthful future, in the full knowledge that he will bestow more of his priceless gifts on radio and all of us.

Figure 2: The editor Hugo Gernsback's introduction to the issue, being very complimentary to Armstrong.

In June 1948 Radio Craft magazine, edited by the famous Hugo Gernsback, dedicated a special issue to Armstrong and the state of FM broadcasting in the United States (see Figure 1). I think this is relevant to how FM broadcasting was developing in some parts of Europe at the time, the UK excepted where the introduction of any FM radio services seemed to have a low priority with the BBC and the government.

Gernsback's introduction to the issue was very complimentary to Armstrong, see Figure 2. The precise reason for the dedication of a whole issue of the magazine to Armstrong and FM at that time is unclear, but with the 463 FM broadcasting stations actually in operation in the US, the 564 authorised by the FCC but not quite yet in operation, and 88 broadcasting applications still pending, the total number of potential FM stations had recently exceeded the 1,000 mark. A remarkable number considering that the total number of FM stations at that time in the UK, planned and operating, was precisely zero!

I've tended to use MHz, rather than Mc/s, and kHz, rather than kc/s in the article, though the latter terminology would have been used at the time. The only exception to this is where I am directly quoting contemporary sources.

**FM Broadcasting Begins**

During the 1930s there were a small number of experimental stations attempting to broadcast high fidelity audio using wide-bandwidth AM on VHF frequencies. FM broadcasting in the US officially started in 1939 when the FCC allocated the frequency range of 42-50MHz to this service. In that year W1XOJ, located on Asnebumskit Hill in Massachusetts (still a popular location for radio antennas, being well elevated at about 1,400 feet above the surrounding countryside), became the first FM radio station, transmitting to the Boston area with an initial power of about 2kW on 43MHz. It later upgraded to 50kW when a suitable transmitter design became available.

See: http://jeff560.tripod.com/fm2.html for an article which appeared in *Broadcasting* on 1st June 1939 announcing the start of this service. Business executive John Shepard 3rd was the owner and operator of W1XOJ: he believed in and supported Armstrong's work, and recognised a profitable investment when he saw one. Interestingly the programs were transmitted from the Yankee Network studios in Boston to the W1XOJ transmitter site by an FM relay link, designed by Armstrong of course, transmitting on 133.030MHz with a power of 250 watts. General Electric and Stromberg-Carlson built the first radios capable of receiving FM on the 42-50MHz band.

To help 'kick start' broadcasting Armstrong created his own FM station, W2XMN, in Alpine, New Jersey in 1940.

To everyone's surprise applications for FM licenses poured in and the network built up quickly, prompting more and more manufacturers to add the FM band to their sets, and paying Armstrong royalties for the privilege. On 1st March 1941 W47NV began operations in Nashville, Tennessee, becoming the first modern commercial FM radio station, broadcasting on 44.7MHz with 20kW of power. Note that the '47' in the station's call sign indicated the last two digits of its frequency allocation, the leading '4' being assumed.

When the US entered the war in December 1941 production of commercial radio equipment was suspended, which meant a dead stop to the development of FM broadcasting. Existing FM stations, including Armstrong's own W2XMN continued to broadcast, but no new stations or new FM receivers were built throughout the war years. Armstrong dedicated his work during the war to the application of FM to military radios, where it was adopted with great success.

On 27th June 1945 the FCC officially moved FM broadcasting in the US to the frequency range of 88-108MHz, where it still is today. The change in frequency was said to be to avoid possible interference problems between stations in nearby cities and to accommodate more FM radio channels. However, the FCC was influenced by RCA chairman David Sarnoff, who, it is often said, had the covert goal of disrupting the successful FM network that Armstrong had established on the 'old' band by displacing the FM stations with band I TV stations. The move in frequency rendered some half a million FM receivers obsolete overnight, and more significantly caused great disruption and cost impact on the FM stations already broadcasting. Whether this is true or not is unclear, and some sources report that Armstrong himself was in agreement with the change in frequency, seeing the greater potential for more FM broadcasting channels. This frequency band, plus-or-minus a few MHz, pretty much became the FM broadcast band throughout the world.

**Armstrong in 1948**

The cover picture shows a serious looking and distinguished man. In the magazine he looked back at the state of radio broadcasting (all AM or course) in 1922, and as it stood in 1948, looking forward to the era of FM broadcasting. Throughout his life he was always suspicious of mathematicians who 'proved' that certain engineering possibilities had no merit. For example he quoted the 1922 commonly-held view of FM:
'... this method of modulation (frequency modulation) inherently distorts without any compensating advantages whatsoever'. This view was probably based on the analysis of the sidebands inherent to an FM signal. In theory FM sidebands stretch out to infinity on either side of the carrier, and although not all these are necessary to maintain a very good quality demodulated signal, certainly many more are needed than the two required for AM. Presumably the mathematicians had analysed the effect of restricting the number of sidebands, maybe to two, which would have resulted in their conclusion. It was Armstrong who made the leap in understanding by realising that 'all' you had to do was to broadcast a much wider bandwidth FM signal to get the benefits that the scheme promised. There were many implications in transmitting a signal with much wider bandwidth, not least of all that the medium wave band was inherently unsuitable for this.

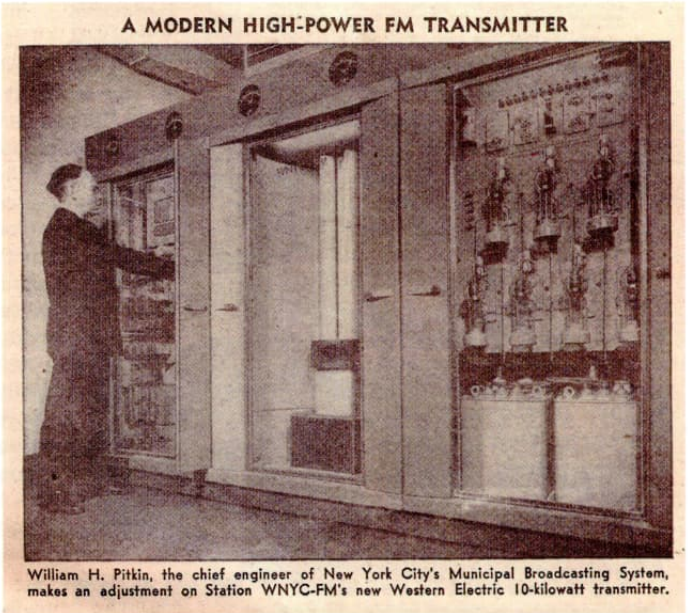
By 1948 Armstrong had been proved right: FM broadcasting had been proved to be possible and it gave the benefits he had predicted. All the changes needed in the move from AM had been made, at considerable financial and personal cost to Armstrong himself. Transmissions were on VHF, giving the necessary bandwidth, and the infrastructure of transmitters was building at considerable pace. However Armstrong's basic FM patents had only two more years to run. Since 1933 he had taken on himself all the technical and commercial risks of getting FM adopted as a high quality radio service. 1948 is significant because just one month after the publication of this special edition of Radio Craft Armstrong's lawyers began law suits against RCA and NBC for 'wilful infringement, and inducing others to infringe' Armstrong's basic FM patents. Armstrong stood to win damages on all FM radio and TV (TV sound used FM) equipment manufactured by RCA, and its licensees, during the full term of the patents, a vast sum of money by any estimates. The debilitating long term effects of the law suits resulted in his tragic death in 1954.

Figure 3 shows Armstrong revisiting the house in 1032 Warburton Avenue, Yonkers where he grew up, and browsing in the attic room where he performed most of his early pioneering radio experiments as a young man. Close examination of the picture shows that the room has plaster hanging off the walls and littering the floor, and maybe we should assume that the whole house was in similar condition? You can 'fly over' Warburton Avenue on Google Earth and get an impression of the area, bearing in mind that although Yonkers is only a few miles from Manhattan the area was more rural in Armstrong's youth. Sadly 'number 1032' is no more, and is unusual for having achieved listing

Figure 3: Armstrong revisiting and browsing in the attic room of the house in 1032 Warburton Avenue, Yonkers where he grew up and performed most of his early pioneering experiments as a young man.

*Courtesy of Fortune Magazine; photo by Eric Schaal*
Armstrong revisits the Yonkers room, scene of his early work.

Figure 4: The 10kW FM transmitter of New York City's Municipal Broadcasting station, WNYC-FM.




William H. Pitkin, the chief engineer of New York City's Municipal Broadcasting System, makes an adjustment on Station WNYC-FM's new Western Electric 10-kilowatt transmitter.

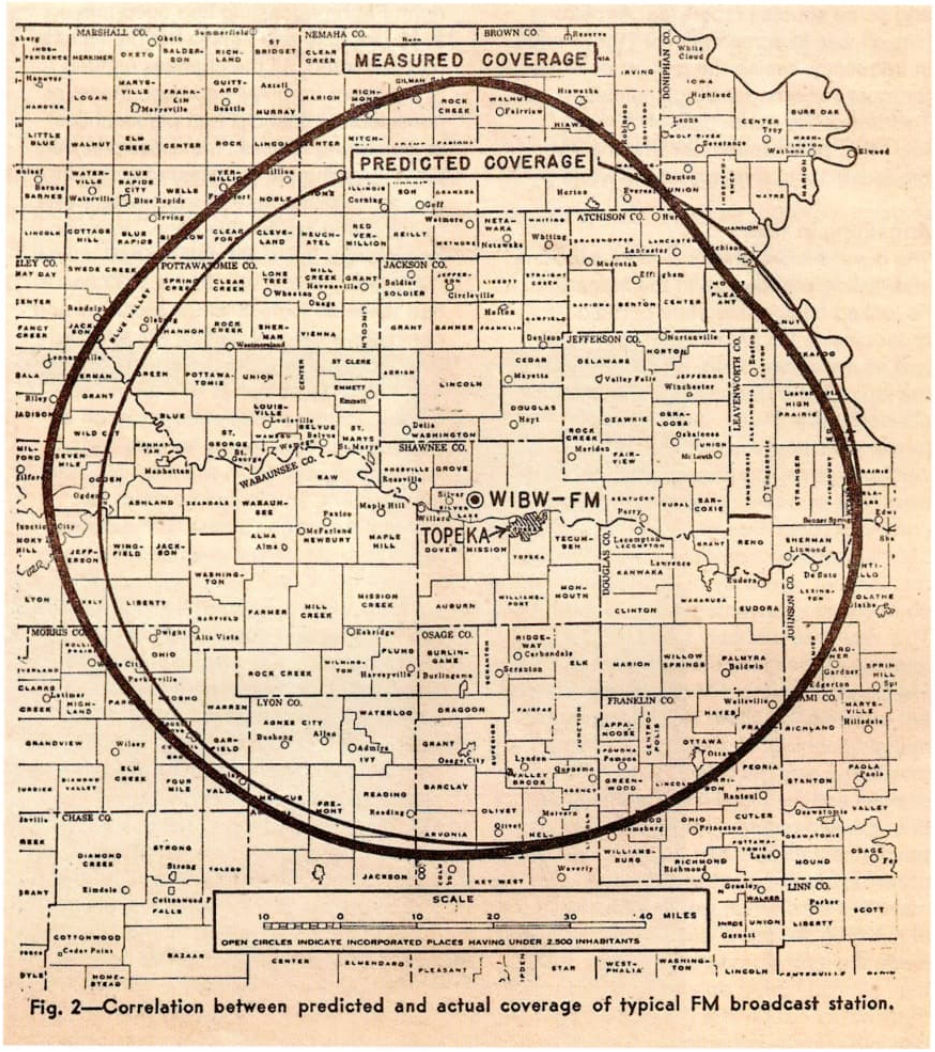



Fig. 2—Correlation between predicted and actual coverage of typical FM broadcast station.

Figure 5

Figure 5: Map of the predicted coverage area in 1948 of one FM station, namely W1BW-FM, in Topeka, Kansas, with the actual coverage obtained. Good correlation between predicted and actual was obtained which helped validate the coverage prediction model used by the FCC.

Figure 6: In anticipation of receivers needing repairing and aligning there was already much suitable test equipment available. McMurdo Silver combined FM and TV servicing gear.

Figure 7: The Heath Company's 5 inch 'scope, using 'surplus tubes', and available only as a kit of course.


Figure 7


Figure 6

on the National Register of Historic Places and even designation as a National Historic Landmark, only to be demolished. Its subsequent removal from National Historic Landmark status is the only such occurrence for a New York State site. It was designated a National Historic Landmark in January 1976, but was demolished in 1983 after suffering fire damage. It was subsequently de-designated as a National Historic Landmark and delisted from the National Register of Historic Places in 1986. The site is now occupied by a block of apartments.

Philosophy Hall, the Columbia University building where Armstrong developed FM, was declared a National Historic Landmark in 2003 in recognition of that fact. See: http://en.wikipedia.org/wiki/Philosophy_Hall for more information on the history of the location.

**Quality of FM Broadcasting**

Armstrong had envisioned two drivers for the move to FM broadcasting. Firstly, freedom from interference, and secondly, improved bandwidth so that the quality of the transmitted audio could be greatly improved over that achievable with AM broadcasts.

The FM modulation technique, or perhaps it's more exact to say that the demodulation technique, gave the promise of freedom of interference from man-made and natural noise. This type of noise is essentially random amplitude pulses which an AM receiver finds impossible to distinguish from the desired amplitude-modulated signal. An FM signal could be amplified and 'limited' (see later for more detail on this) whereby any amplitude variations caused by noise were eliminated and did not appear on the demodulated audio output.

Another drawback of AM broadcasting on the medium wave band that became apparent as soon as the density of stations had reached a certain point was another form of interference. At night medium wave signals travel much further than in the day time as they propagate by sky wave, rather than by ground wave. This caused unwanted distant stations to be super-imposed on the ground wave reception from local stations. Of course this effect is still with us today. This contrasts with the distance VHF signals travel which is roughly the same by day or night. Interference

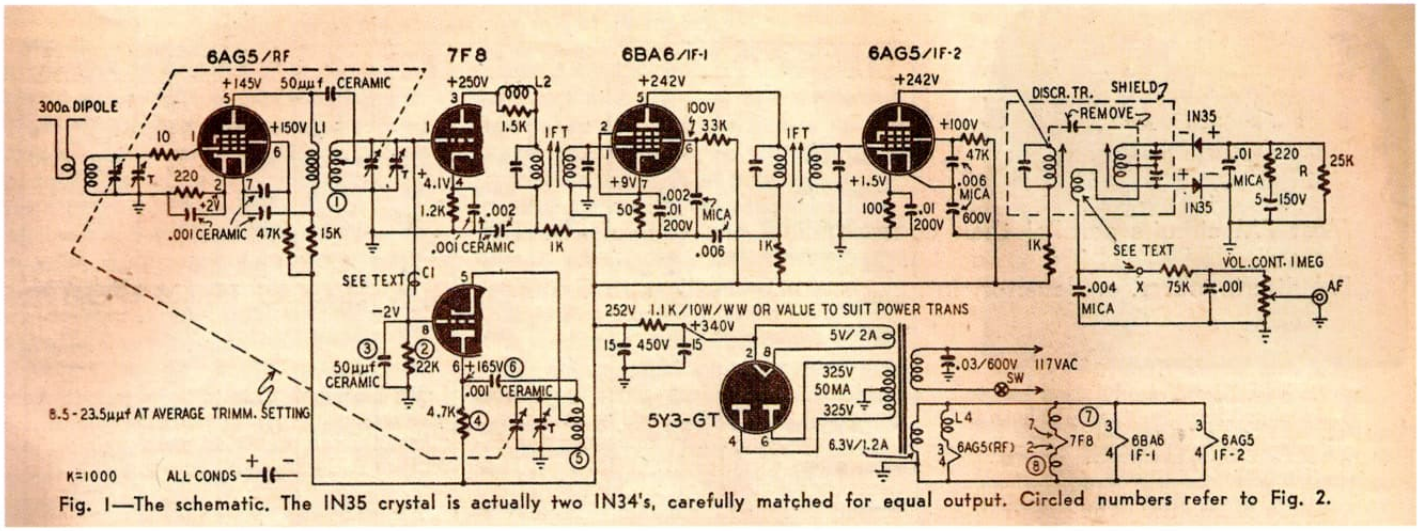



Fig. 1—The schematic. The IN35 crystal is actually two IN34's, carefully matched for equal output. Circled numbers refer to Fig. 2.

Figure 8: Schematic of the receiver described in 'Simplified FM Receiver Uses Crystal Detector'. Rather than use a valve-based pair of diodes the design used a pair of 1N34 germanium diodes (introduced by Sylvania in 1946), or more exactly a 1N35 'dual germanium crystal unit'– a matched pair of 1N34s in a single case.

from other FM stations is much less than with AM because the desired FM signal needs to be only twice as strong as the interfering signal to blanket it entirely. A desired AM signal must be approximately 100 times stronger than an interfering signal for the interference to be unnoticeable.

The available bandwidth at the VHF frequencies used for FM broadcasting meant that high quality broadcasts (for which the FCC set the standard that a station was supposed to achieve) could be made, far in advance of those achievable on 'good old' AM on the medium and long wave bands. It's interesting to read therefore in Gernsback's editorial to the issue that there was 'an unmistakable trend towards a solid duplication of those broadcast by the AM stations ... even though this means sacrificing high-fidelity transmission to ordinary network standards (100-5,000 cycles)'.

Using a process known as multiplexing the wider bandwidth enables the FM broadcaster to send more than one signal over a given FM channel: specifically it held the promise of stereo broadcasting. See later for how and when this was introduced.

**Transmitter Stability and Modulation**

Maintaining frequency stability while transmitting at 100MHz brought its own challenges. One method used was to pass a sample of the transmitter's output frequency through a chain of dividers until a frequency of about 5kHz was obtained. A temperature-controlled crystal oscillator was used as a frequency standard, and its output was also passed through a divider chain whose output frequency was nominally identical to that from the first chain of dividers. The outputs of the two dividers were then applied to balanced modulators whose outputs were 90° out of phase. Each output was then amplified and applied to separate windings of a two-phase inductor motor whose shaft was connected to a frequency compensating capacitor in the tank circuit of the transmitter's modulated oscillator. Any difference between the centre frequency of the modulated signal and the crystal standard produced a beat frequency whose direction of drift operated the motor to adjust the compensating circuit. This sounds very much like a frequency-locked loop (whether the system could achieve phase locking is uncertain) with a mechanical element rather that an all electronic system, probably using a variable-capacitance diode, which we would tend to use today.

Two basic systems were then in use for producing FM at the transmitter: the indirect, or Armstrong method, and the direct method. The indirect system consisted of a crystal-controlled oscillator whose output was split into two paths, one of which was fed through a 90° phase-shifting network, and the other contained a balanced modulator. When these two paths were combined the result was a phase-modulated signal, linear up to ±30°. The frequency deviation was very small. The necessary 150kHz swing was obtained by multiplying the oscillator output to a high frequency, which was then reduced in frequency by heterodyning it with the output of a second crystal oscillator. It was then put through another series of multipliers to raise it to the final frequency. This system allowed a higher order of frequency swing than if simple frequency multiplication had been used.

In the simpler direct method of frequency modulation a reactance valve controlled the master oscillator, which usually operated at one-sixteenth of the output frequency. The oscillator output was fed through multiplier and buffer stages to the transmitter's final power amplifier. A key feature of FM, whatever the exact modulation method used, is that the modulation is applied to the low power stages of the transmitter, which is not the case with AM where the final stages need to be modulated with considerable audio power.

Figure 4 shows the 10kW FM transmitter of New York City's Municipal Broadcasting station, WNYC-FM, in use in 1948.

**Planning the New FM Network**

It was the FCC's responsibility to allocate frequencies and set the effective radiated power (ERP) of FM stations in the 88-108MHz band. Two types of station were envisioned: 'class A' stations, designed to serve small communities and towns, other than the main city of an area and its surrounding rural area. These stations were limited to an ERP of 1kW and an antenna height of 250 feet above the average surrounding terrain. The second type were 'class B' stations, intended to provide service to a metropolitan district or principal city, and its surrounding rural area. The ERP permitted by the class B stations depended on where they were located in the US. Area I was pretty much defined as the Eastern seaboard, including all its major cities of course, and Area II was the rest of the country. Area I class B stations were limited to ERPs of between 10kW and 20kW, depending on the height of their antenna. Area II class B stations were limited to a minimum ERP of 2kW, with no limit on the maximum ERP provided that a new station did not interfere with existing stations. This allowed these stations to serve large sprawling areas, and it was not untypical for them to use ERPs of 450kW or more.

This may sound like a complicated scheme but it should be remembered that FM broadcasting at VHF was in its infancy, and the scheme was conceived to ensure that cities were assigned FM channels on a population basis. That is, the larger the population, then the more channels allocated, and that a balance between large scale and local needs could be achieved. The nature of propagation at 100MHz or so meant that no changes had to be made between day and night. In the New York area the scheme resulted in 20 class B and 13 class A channels being allocated, giving a total of 33 FM stations to serve both broad and local interests. According to http://www.nyradioguide.com/freqlist.htm there are now 44 FM stations in the New York area (most of which can now be listened to on-line), so the original FCC estimate wasn't too far away from what its original propagation estimates and demand for station types predicted. One development not predicted was the appearance of low power (100W


Figure 9 (above): Front view of the 1947 Pilotuner T-601, typical of an FM-only tuner capable of being plugged into the 'gram' input of an existing AM radio.

Figure 10 (right): Table of the more popular FM Tuners available in the US in 1948.

**CHARACTERISTICS OF THE MORE POPULAR FM TUNERS**

| TUNER AND MODEL | LINE OPERATION | NO. TUBES | R.F. | MIXER | I.F. | LIMITER | DISCRIM-INATOR | OTHER FEATURES |
|---|---|---|---|---|---|---|---|---|
| Approved Electronic Inst. | a.c. 7Y4 | 6 | 6AG5 | 6J6 | 2-6SH7 | 6SH7 | 6AL5 F-S | |
| Brooks | a.c. 6X4 | 8 | 6AK5 | 6BE6 | 3-6AK5 | 2-9001 | 6AL5 F-S | 6U5 tuning indicator |
| Browning RJ-12 | external pack | 8 | 6BA6 | 6BE6 6C4 | 2-7AG7 | 2-6SJ7 | 6H6 F-S | separate AM channel |
| Browning RV-10 | a.c. 80 | 7 | 6AU6 | 7F8 | 2-6AU6 | 2-6SJ7 | 6H6 F-S | 6U5 tuning indicator |
| Collins Audio Products | a.c. 6X4 | 9 | 6J6 | 6AK5 6C4 | 3-6AG5 | 2-9001 | 6AL5 | 6AL7 indicator |
| Collins Audio Products FM-AM Tuner | a.c. 5Y3/GT | 9 | 6J6 | 6AG5 6C4 | 1-6AK5 2-6AG5 | 2-9001 | 6AL5 | V-R tube, audio channel 6AL7 indicator |
| De Wald | a.c.-d.c. 35W4 | 5 | none | 12AT7 | 2-12BA6 | none | 12AL5 F-S | 12SA7 oscillator |
| Dongene | a.c. 5Y3 | 8 | 6BA6 | 6BE6 6C4 | 2-6SG7 | 2-6SJ7 | 6H6 F-S | separate AM channel |
| Edwards Fidelotuner | a.c.-d.c. selen. | 5 | none | 6J6 | 2-6SH7 | 6SH7 | 6H6 F-S | long-lines tuner ckt. |
| Espey 512 | a.c. 5Y3-GT | 6 | 6BA6 | 6BE6 6C4 | 2-6SG7 | none | 6AL5 ratio | also AM tuner 6U5 indicator |
| Meissner 8C | a.c. 6X5-GT | 7 | none | 2-6AG5 6C4 | 2-6BA6 | none | 6AL5 ratio | |
| Meissner 9-1093 | external pack | 9 | none | 2-6AG5 6C4 | 3-6AG5 | 2-9001 | 6AL5 F-S | AM channel, 6U5 indicator separate |
| Pilotuner | a.c. selen. | 5 | 6BA6 | 6BE6 | 2-6BA6 | none | 6AL5 ratio | |

JUNE, 1948

or less) FM stations designed to serve very local, usually ethnic, communities, either legally or illegally. Incidentally there are still 28 medium wave AM stations serving the New York area, so the prediction that FM broadcasting would quickly kill off AM was wildly optimistic.

Figure 5 shows a map of the predicted coverage area in 1948 of one FM station, namely W1BW-FM, in Topeka, Kansas, with the actual coverage obtained. Good correlation between predicted and actual was obtained which helped validate the coverage prediction model used by the FCC. It has to be said that Topeka is a relatively flat area and propagation in hillier cities must have been more complex, with corresponding impact on the placement and coverage of FM stations. According to Wikipedia W1BW-FM still operates, with a country music flavour. A total of seven FM stations now broadcast in the city.

**FM Receiver Servicing and Test Gear**

FM receivers operating at VHF brought new challenges to servicemen used to repairing and aligning medium and long wave AM radios. There was of course the need to generate FM-modulated signals at 100MHz+ for the testing of front ends, and a way of aligning IF stages, operating at 10.7MHz, which was by 1948 the standard for IF transformers and amplifiers in FM radios. With AM sets the IF stages could be aligned 'by ear' but the wider bandwidth of an FM signal meant that more scientific means had to be found to ensure that the IF bandwidth was set correctly for a flat response, otherwise the high fidelity benefit of the transmitted signal would not be reproduced at the output of the receiver. TV broadcasting was being extensively rolled out at the same time and so any service department with an eye to the future was also gaining the skills and test gear to handle TV set repairs. TV sound was broadcast as FM and the skills gained on FM receivers were definitely transferable to TV sets.

The magazine advised service departments to invest in the following test gear: 'a sweep signal generator with frequency ranges from 5-15Mc/s and 80-110Mc/s; a vacuum-tube voltmeter (VTVM); an AM signal generator with a frequency range from 5-125Mc/s; and an oscilloscope'. As they stated, it was possible to repair FM radios with just the VTVM and the AM signal generator, but testing time would be greatly increased and that would cost the service department money. By setting the FM sweep generator to sweep 300kHz above and below the IF centre frequency and monitoring the output of the discriminator with the 'scope, ideally an S-curve with a straight line in the IF pass-band should be obtained. Deviation away from the ideal S-curve generally indicated mis-alignment of the IF transformers which could be tweaked until the curve was satisfactory.

In anticipation of receivers needing repairing and aligning there was already much suitable test gear available. McMurdo Silver combined FM and TV servicing gear, as shown in Figure 6. The fledgling Heath Company (based in Benton Harbour, Michigan) offered a range of test gear kits, including a 5 inch 'scope, VTVM and signal generators, but surprisingly didn't offer a sweep generator. The 'scope (which I think is an O-1, though there is no part number on the advert, see Figure 7) sold for just under $40. At the 1948 exchange rate of $4.03 to the £1 (set at this constant level from May 1940 to September 1949, when it was abruptly devalued to $2.80), this equated to the equivalent of about £10. This was a significant period for Heath as they had only just entered the electronic kit business, having focused on small aircraft accessories before the war. Howard Anthony, the owner of the company, had bought a large stock of war surplus electronic parts, and these were largely what constituted the immediate post-war kits. As you can see the advert for the scope stated 'order today while surplus tubes make this price possible'. This referred mainly to the CRT which is the most expensive part of any 'scope. The kit was a huge success for the company, and as they say 'the rest is history' as the company benefitted from the boom in radio and electronics from the end of the war until the 1970s. The company finally left the electronic kit business in 1992.

This claim and counter-claim between Armstrong and RCA, not just on the nature of the FM discriminator but on all aspects of FM broadcasting, lasted from 1948 until 1954, when it was a significant contributor to Armstrong's suicide.

**FM Discriminators**

In FM receivers the general term used for the equivalent of the detector process in an AM set is an 'FM discriminator'. Armstrong's original concept for an FM discriminator had two distinct stages for the process: firstly a limiter stage where the output from the final IF amplifier stage was greatly amplified and clipped so that any amplitude variations in the received signal were removed, and secondly the discriminator stage, often called the ratio detector, where the limited FM signal was turned back into the original modulating audio. This arrangement needed at least one extra valve in the receiver and so tended to be used in more expensive sets.

Armstrong had developed this concept as the solution to impulse-type noise interference that plagued AM sets. In the 1920s and 1930s the elimination of this type of noise, at a reasonable cost, had been the 'holy grail' of radio designers. This had never been achieved with AM broadcasts. Armstrong's 'back to basics' solution was to change the modulation method from AM to FM, with all the consequences that entailed, including new transmitters, new receivers, a move to VHF, and so on – effectively the creation of a new radio industry.

The other form of FM discriminator used at the time was the Foster-Seeley discriminator, invented in 1936 by Dudley E Foster and Stuart William Seeley. The circuit

was envisioned for automatic frequency control of receivers, but also found application in demodulating FM signals. This form of discriminator has no distinct limiter stage and is therefore sensitive to both frequency and amplitude variations, unlike the limiter / ratio detector combination, which from Armstrong's point of view negated one of the major advantages of FM broadcasting. The lack of a limiter stage made any receiver incorporating it cheaper, to the delight of radio manufacturers. It is debatable whether this resulted in any significant degradation of the demodulated audio (as Armstrong argued), especially since most FM reception was more local to the transmitters than with AM, and therefore probably in much stronger signal areas.

The Foster-Seeley discriminator has implications beyond its technical merits (or de-merits) in that Foster and Seeley were working at RCA in 1936 when they invented it. RCA's lawyers saw in it a way of avoiding paying royalties to Armstrong as they claimed that it was fundamentally different from Armstrong's form of FM discriminator on which he held patents. Eventually Armstrong established that the Foster-Seeley discriminator contained an inherent limiting function and was therefore not significantly different from his discriminator design, but that it was definitely inferior in performance in the presence of interference. This claim and counter-claim between Armstrong and RCA, not just on the nature of the FM discriminator but on all aspects of FM broadcasting, lasted from 1948 until 1954, when it was a significant contributor to Armstrong's suicide.

Whichever form of discriminator was used a pair of diodes (in 1948 a 6AL5 dual-diode valve was popular for this function) was needed to produce the final audio. An interesting design, and definitely the shape of things to come, was published in the magazine as 'Simplified FM Receiver Uses Crystal Detector'. Rather than use a valve-based pair of diodes the design used a pair of 1N34 germanium diodes (introduced by Sylvania in 1946), or more exactly a 1N35 'dual germanium crystal unit'– a matched pair of 1N34s in a single case. The circuit of this receiver is shown in Figure 8.

**Use of War Surplus Radios**

As was the case in the UK for many years after the war there was much war surplus electronic equipment around in the US that was suitable for conversion to amateur and broadcast radios. One such piece of equipment was the BC-624, designed for use as a 4-channel crystal-controlled single conversion receiver in the 100-156MHz range, and which was often used by amateurs as an AM receiver on the 2m band. An article in this issue of Radio Craft described its conversion to an FM receiver.

The RF amplifier and mixer made use of 9003 valves, which had been designed in 1943 by RCA as a B7G equivalent of the 956 VHF acorn pentode. The oscillator was converted to be free-running using a 9002, again a B7G valve, equivalent to the 955 acorn triode. The oscillator's frequency determining components consisted of a variable capacitor (with a slow motion mechanism), and trimmers and padders were chosen to give the limited tuning coverage of 88-108MHz.

To make use of as much of the set as possible the original IF transformers were retained, even though their AM bandwidth was too narrow for broadcast FM reception, where the bandwidth needed to be 200-300kHz. For the modified circuit only one winding of each transformer was used in the anode circuit, with capacitor coupling to the grid of the next stage. A relatively low value for the grid leak resistor was used to load the coils and broaden their response. By stagger tuning the transformers the desired wide bandwidth could be achieved.

The trickiest part of the conversion was the winding of the 12MHz (which was the IF of the BC-624) discriminator transformer to replace the original 4th IF transformer. This needed three windings, including a bifilar secondary to drive the discriminator diodes (using a 12H6, an Octal dual-diode). The final receiver was said to result in 'a reasonably good FM receiver. It is sufficiently sensitive to bring in stations to a distance of about 30 miles away, with only a 3- or 4-foot wire as an antenna'.

**FM-only Tuners and AM/FM Receivers**

Introduced in 1947 the Pilotuner T-601 was typical of an FM-only tuner capable of being plugged into the 'gram' input of an existing AM-only radio. Alternatively it could be connected to a stand-alone quality audio amplifier and as such marked the beginning of the hi-fi era when FM tuners and record decks were the audio sources for high quality amplifiers and loudspeakers.

Figure 9 shows a front view of the T-601. The controls are simple: an on/off switch and a tuning knob. We can see that it covers the 'new' FM band of 88-108MHz, and is therefore still usable today. The valve line-up consisted of modern B7G valves, specifically: 6BA6 RF amplifier, 6BE6 frequency changer, 6BA6 1st IF amplifier, 6BA6 2nd IF amplifier, and 6AL5 ratio detector. As I write this article I can see several Pilotuners for sale on eBay. com, so the sets seem to have lasted well and are still sought after today.

10.7MHz was by now commonly accepted as the intermediate frequency of FM sets covering the '100MHz' band. Typically sets which had covered the 'old' FM band had used an IF at 4.3MHz. In 1948 Motorola still used this frequency for some of their early 'new' FM band tuners.

It's interesting that for VHF FM tuners the IF was set to about one tenth of the RF frequency to be received. With medium wave radios there is about a 3:1 ratio between the upper and lower frequency limits, so the 'one tenth' rule of thumb would lead to an ambiguous answer as to where the IF should be placed. The IF frequency of these radios eventually 'settled down' to the range of 450-480kHz where a gap was created between the upper frequency end of the long wave and the lower end of the medium wave.

Figure 10 shows a table of the more popular FM Tuners available in the US in 1948. It's interesting that by this time modern B7G valves such as the 6AG5, 6J6, 6AL5, 6BA6, 6BE6, 9001, etc predominate, but the occasional Octal valve such as the 6SH7 still creeps in. As far as I can see the only B9A valve used is the 12AT7 in the De Wald tuner. The 12AT7 was introduced in the second half of 1947 so De Wald had done well to design it into their tuners for sale in 1948.

There were many AM/FM radio plus record deck (78rpm of course) consoles available in the US in 1948, including ones from Admiral, Crosley, Belmont, Montgomery Ward & Co, Motorola, National, Philco, RCA, Westinghouse and Zenith. The highly-collectable Zenith 7H820 was particularly interesting in that with its 7-valve line-up, it could be tuned to the 'old' Armstrong FM band of 43-48.5MHz, the 'new' FM band of 88-105MHz and the medium wave AM band. I believe this radio was only manufactured very briefly and within a year the 'old' FM band was removed, as broadcasting on this band had ceased.

As far as I can see there were no FM receivers at this time with automatic frequency control (AFC). The concept of AFC was used purely in the context of transmitter frequency stability, as described earlier. My initial thought was that these sets must have needed constant 'tweaks' of the tuning, especially as they warmed up. Then I thought that since broadcasts were in mono only for many years, if the received station drifted around in the comparatively wide IF pass band, any reasonable drift may not have been noticeable. Modern analogue FM sets use an error signal feedback mechanism from the discriminator to the local oscillator to achieve fine frequency control, as the oscillator tries to drift away from the correct frequency.

A table in the magazine shows a total of 71 FM receiver/tuner manufacturers in the US. That's an impressive total for such a new concept in broadcasting and shows that initial doubts as to its viability and longevity had by then been dispelled.

**Stereo Broadcasting**

The FM signals being broadcast in 1948 were of course in glorious mono. In the late 1950s, several systems to add stereo to FM radio were considered by the FCC. Included were systems from many set manufacturers including Crosley, Halstead, Electrical and Musical Industries Ltd (EMI), Zenith and General Electric. The individual systems were evaluated for their strengths and weaknesses during field tests in Uniontown, Pennsylvania using KDKA-FM in Pittsburgh as the originating station.

The GE and Zenith systems, so similar that they were considered theoretically identical, were formally approved by the FCC in April 1961 as the standard stereo FM broadcasting method in the US and later adopted by most other countries. It is important that stereo broadcasts

should be compatible with mono receivers. For this reason, the left (L) and right (R) channels were algebraically encoded into sum (L+R) and difference (L–R) signals. The (L+R) main channel signal was transmitted as baseband audio in the range of 30Hz-15kHz. The (L–R) sub-channel signal was modulated onto a 38kHz double-sideband suppressed carrier (DSBSC) signal occupying the frequency range of 23-53kHz.

A 19kHz pilot tone, at exactly half the 38kHz sub-carrier frequency and with a precise phase relationship to it, was also generated. This was transmitted at 8–10% of overall modulation level and used by the receiver to regenerate the 38kHz sub-carrier with the correct phase. The final multiplex signal from the stereo generator contains the main channel (L+R), the pilot tone, and the sub-channel (L–R). This composite signal, along with any other sub-carriers, modulated the FM transmitter.

A mono receiver used just the (L+R) signal so the listener heard both channels in the single loudspeaker. A stereo receiver added the difference signal to the sum signal to recover the left channel, and subtracted the difference signal from the sum to recover the right channel.

On 1st June 1961 FM stereo broadcasting in the US was authorised: on this date the FCC received its first notifications of such regular operation, from WEFM Chicago and WGFM Schenectady (in New York). Both stations had previously experimented with stereo broadcasting, as had others. Apparently WGFM has the honour to be the first to broadcast in stereo, as WEFM had to wait an extra hour because of the difference in time zones.

I used the past tense for the description of how FM stereo broadcasts worked in 1961: in fact it's pretty much the same today, with the addition of other low bandwidth data, such as RDS (Radio Data System).

**Worldwide FM Broadcasting in 1954**

In the years after 1948 FM broadcasting around the world continued to develop and expand. I obtained another snapshot of the state of FM broadcasting around the world from the publication: 'Listener's Guide to the Radio and Television Stations of the World' compiled by B B Babani, picked up at a recent BVWS meeting. This was published in September 1954 by Bernards (Publishers) Ltd, London.

At this date US FM stations numbered 521 in the band from 88.7-107.7MHz, so maybe the full promise of more than 1,000 stations in 1948 had not been fully realised. Outside the US there were a total of 251 stations. In Europe there were 173 stations, of which only one (Wrotham, which in 1954 was still broadcasting an experimental service) was in the UK, indicating the slowness with which the UK adopted FM broadcasting! The leader in Europe was definitely the Federal Republic of Germany (that is, West Germany), with 113 stations. Even Italy had 13 FM stations. The USSR operated two FM stations, one in Moscow on 46.5MHz, and one in Leningrad on 45.8MHz, both on the 'old' FM band.

As a further data point it was reported by the FCC in 2004 that there were 13,476 FM stations in the US.

Official FM broadcasting began in the United Kingdom on 2nd May 1955 (though there had been test broadcasts for several years before this) when the BBC started an FM service broadcasting the Light Programme, Third Programme and Home Service to the south east of England using the sub-band 88.0–94.6MHz. UK stereo broadcasting started in 1966.

His contribution to the science fiction genre is recognised in the Hugo Awards, named after him, first awarded in 1953 and which are still awarded to outstanding science fiction writers today. He even has a crater on the Moon named after him!

**The Editor, Hugo Gernsback**

As well as being an editor and publisher, the editor of Radio Craft magazine, Hugo Gernsback, was a pioneer in amateur radio and public broadcasting. He even founded his own radio station WRNY, an AM radio station operating in New York, to promote his radio and science magazines. The station was the first to have regularly scheduled experimental television broadcasts, starting in 1928. The technique used was a mechanical scanning system, having 48 lines and 7.5 frames per second. This was about the limit that could be transmitted, without sound, on the 5kHz bandwidth of the AM radio channel. The picture at the receiver was about 1.5" square. Gernsback's magazines at the time had described how listeners/viewers to his radio station could build TV receivers for his transmissions.

The March 1937 Short Wave Craft magazine included a training course on Television entitled 'Mechanical Scanning – How It Works'. Of course by 1937, the writing was on the wall for mechanical TV, and the magazine also described positive results of CRT-scanning TV transmissions on six-metres (that is, about 50MHz) transmitted from the Empire State Building in New York City, seen at up to 70 miles away. The article also described what we understand as a modern TV distribution system, using 'concentric' cables (that is, co-ax) to carry the signals between cities to the local transmitters. A possible system for distributing TV signals via co-ax inside steel-framed buildings was also described, overcoming the absorption effect on the TV signal.

Incidentally, Gernsback is also well known for his science fiction writing and publishing, which included Amazing Stories, the first major science fiction magazine, originally published in 1926. It's fair to say that he has a mixed reputation: although he was certainly a visionary and made many predictions of the future of science and society, and sponsored the publishing of many science fiction magazines, he was also know to be a shrewd business man and didn't pay his contributing authors very well.

His contribution to the science fiction genre is recognised in the Hugo Awards, named after him, first awarded in 1953 and which are still awarded to outstanding science fiction writers today. He even has a crater on the Moon named after him! Before you start looking for it through your telescope, it's only fair to point out that it's located close to the edge of the far side of the Moon and is only rarely visible edge-on from Earth. See the Useful References section at the end of this article for a couple of books about Hugo Gernsback.

**The Short Wave Scouts**

In the pre-war period Gernsback had sponsored the creation of 'The Short Wave Scouts' who listened to the short waves and logged the stations they heard. An imposing trophy (silver-plated metal and Bakelite base, standing 22½" high), was awarded every month to the Short Wave Scout who logged the most short-wave stations as possible, amateurs excluded, in a period not exceeding 30 days. At least 50% of the stations logged had to be foreign ones.

In this 1948 issue of Radio Craft the Scouts were expanding to include 'FM Scouts'. Encouraging listeners to report cases of reception of long distance FM stations, Gernsback wrote 'The behaviour of radio waves in the FM band is still understood imperfectly. According to theory, FM signals should not reach much beyond the horizon. Yet they often do. In some cases extraordinary DX reception has been reported'.

Some reports of reception over long distances had already been received: 215 and 190 miles seem to have been the best distances so far, though the editor had to implore listeners to report the 'air-line' distance, as some had reported the road mileage to the station received! This contradicts the 'line of sight' theory of propagation of signals at 100MHz, but the nature of FM demodulation meant that these relatively weak distant signals should not have been audible over the top of local signals on the same channel.

**Tributes**

There are several tributes to Edwin Armstrong on YouTube, including a recording, entitled 'Final Broadcast of Experimental FM Station KE2XCC', of the final broadcast of his experimental FM station in Alpine, New Jersey on 6th March 1954. At that time the station transmitted on 93.1MHz, having moved from its original frequency of 42.8MHz in 1946.

Another delightful set of video clips and photos can be found on YouTube entitled 'Edwin Howard Armstrong: The Yonkers Man Who Made Radio and the Alpine Tower'. The building at the base of the tower, with 'W2XMN' carved over the doorway, is now a museum to Armstrong

and the technology he made possible.

So far I've been unable to track down a recording of his voice: if you manage to do this, please let me know.

**In Conclusion**

By 1948 FM broadcasting in the US was well established, supported by the paraphernalia of transmitters, tuners, test equipment, aerials, etc, needed to support the network and its listeners. Europe still lagged behind what was happening in the US, and disappointingly the UK seems to have been in last place in Europe.

Armstrong's view of radio set manufacturers was not always complimentary. In the magazine he wrote: 'It is on the operations of the manufacturer that the spotlight is now focussed. For over two years, as everyone knows, the efforts of a very large part of the industry have been centered on the manufacture and sale of equipment that is already obsolete; that is, AM sets without an FM band. A small part of the industry is engaged in practices which bid fair to bring back the days of the "blooper" – sets which oscillated directly into the antenna. And there have been still others who have engaged in the equivalent of selling an automobile without a gearshift, ie an "FM" set without proper noise-suppressing facilities'.

Armstrong's vision for broadcasting in general was that AM on the long and medium wave bands would die out sooner rather than later in favour of FM broadcasting at VHF. This was a 'purist's' view of broadcasting whereby the system capable of the highest quality would prevail and others would fall by the wayside. Clearly even in the 21st century this hasn't happened: the two modulation systems still happily co-exist, and the threat to both today is from new digital modulation systems such as DAB and DRM. AM is still a force in popular broadcasting, with many high power stations still crammed into the relatively narrow medium and long wave bands, just as they were in 1948. FM is generally reserved for high quality stereo broadcasts from a network of relatively local transmitters, and of course mobile broadcasting to vehicles.

Today the most likely method of the demise of AM broadcasting will be government-driven, and not to the benefit of FM broadcasting (which itself may be relegated to the dustbin on the whim of government) but to digital modulation techniques. The mantra that 'digital is good and analogue is bad' seems to drive policy by men who don't know the difference, and AM and FM may die together.

It is perhaps apt to give this update on Armstrong's work in 2012, just 100 years since he, then a 22 year old electrical engineering student at Columbia University, made the first of his many significant contributions to the art of radio when he devised the regenerative or 'feedback' circuit, and thereby amplified the strength of incoming signals by many times. This enabled radio signals to be received over much larger distances than previously possible, and also led to the triode-based oscillator which made stable and tunable transmitters possible, and eventually led to the superhet receiver.

**Useful References**

'Man of High Fidelity: Edwin Howard Armstrong' by Lawrence Lessing. Published in 1956, by J B Lippincott Company of Philadelphia and New York.

'The Legacies of Edwin Howard Armstrong' by various authors. Published by the Radio Club of America. Library of Congress Catalog Card Number 90-63056, 1990.

John Shepard's FM Stations - America's first FM network, See: http://www.bostonradio.org/essays/shepard-fm

'Hugo Gernsback A Man Ahead of his Time' edited by Larry Steckler. Published by Poptronix Inc in 2007.

'The Gernsback Days' by Mike Ashley and Robert A W Lowndes. Published by Wildside Press in 2004.

Several histories of the Heath Company can be found on the internet. One is at: http://www.heathkit-museum.com/hvmhistory.shtml

A comprehensive list of all FM only radios, including the very few early 1940s radios covering only the 'old' FM band of about 40-48MHz, can be found at: http://www.somerset.net/arm/fm_only_list.html.

A useful list of links to the history of broadcasting in the US can be found at: http://jeff560.tripod.com/broadcasting.html

http://www.pat2pdf.org/ is a good patent website where you can download pdf versions of many original patents, including those of Armstrong and other radio pioneers.

See: http://semiconductormuseum.com/MuseumLibrary/HistoryOfCrystalDiodesVolume1.pdf for an interesting and informative history of germanium crystal diodes, including the 1N34.

# Obituary: Professor Russell Burns

We regret to announce the death of Professor Russell Burns who died on 4 November 2-11 at the age of 83.

Professor Burns graduated in 1948 with a first class honours degree in physics. Following post-graduate research he joined the Royal Naval Scientific Service. Subsequently he held various appointments in higher education in the UK and abroad and retired in 1989. He has been researching and writing on the history of electrical engineering for more than 40 years. Russell Burns was editor of the major work Radar Development to 1945, and author of the three comprehensive and well-researched IEE histories -

Communications: the Formative Years;
Television: the Formative Years;
Colour TV: the Formative Years;

He also wrote John Logie Baird, TV Pioneer, and The Life and Times of A D Blumlein, amid many other books, and well over 50 papers on radio, radar and TV history. Before his death he had completed a new book Lindemann, Churchill and Science at War which has yet to be published.

Professor Burns, an IET Fellow, has received the Kraszna-Krausz Prize, the IET SET Divisional Premium in 1993 and shared the Maxwell Premium in 1994. He was past chairman of the IET's History of Technology professional Group, Archives Committee, and the Science, Education and Technology Divisional Board.

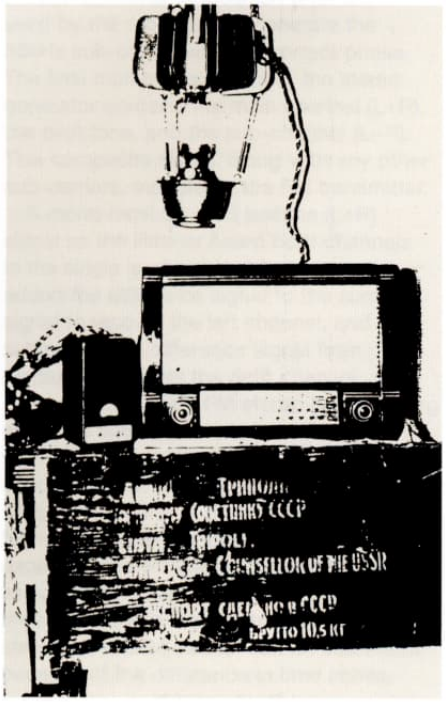
Many of the older members of the DEHS will remember the excellent talk on the Proximity Fuze that he gave in the late 1990s to what was then CHiDE. He will be greatly missed.

This obituary by Keith Thrower appeared in the December 2011 issue of Transmission Lines, the newsletter of the Defence Electronic History Society, and it is reproduced here by permission of the DEHS.

# Letters

**Dear Editor**
**Paraffin powered radio**
I'm indepted to an old friend, Peter Ward of Malvern who pointed me in the direction of this piece. He has always been interested in vintage technology, mostly vintage cars, motorcycles and vintage radio.

Peter served in the army as an NCO in the Field Security Section in Tripoli, Libya in the 1950's. As a field security officer, he





had a wide ranging brief, which allowed him flexibilibity in this work, including the use of his ancient motorcycles as personal transport.

One of his local contacts, Haj Ramadan said it was a pity that the English were not able to spread their point of view and news across the country like some other nations. Apparently his friend and merchant Haj Mohammed had got hold of a supply of 'magic' lamps from the Russians which could be lit to drive a radio and spread Radio Moscow and light in the middle of the desert.

Peter followed this lead up, and discovered that the initial supply of magic lamps had been sold, but another consignment was onboard ship in Tripoli harbour. He travelled with Haj Mohammed on his 1918 BSA motorcycle combination and after some negotiation and palm crossing with the Soviet ship captain, who wanted to buy the brass acetylene lamps from Peter's BSA, came away with a box containing the magic lamp, radio, and power supply.

The device was a thermopile on top of a paraffin lamp which provided about 2 volts into a vibrator power supply for a battery multiband radio. The picture shows the set up, and the Russian and English writing on the box may provide clues. This wasn't the first time that the thermopile has been used for radio.

In the late 1920s and early 30's the idea of solid state electricity from gas for radios was attractive in areas without mains electricity.

The Milnes company of Bingley in Yorkshire pioneered the use of thermopiles fired by gas to charge wireless LT accumulators in homes without electric mains. Their unit, like the Russian version only provided about 2 volts DC – enough to charge single nickel cadmium cells. By the 1930s, they got more ambitious and sold a combined LT and HT battery, which was charged in parallel by gas, and switched to series operation for HT. Voltages from 90 to 200 volts were possible using up to 150 small cells in test tubes with a clever switching system featuring a multi section leaf switch with only 2 positions–charge and run.

I have one of these units in my loft, and one day I will resurrect it because nickel cadmium cells grow old gracefully and if filled with new electrolyte, cleaned up and charged, will sing again.

Anthony Hopwood

**Dear Editor**
I have been a member of the BVWS for several years, and have seen the quality of The Bulletin go from strength to strength. This is no mean feat and is due to a dedicated editorial team – well done!

I usually read The Bulletin from cover to cover often several times. The technical articles are on the whole very good and often on par with publications such as Rad–Com. Of course the magazine cannot survive without input from contributors, no matter how small the article is, so get writing!

My 'shack' is full to the gunnels with a varying array of 1920s to 1960s radios which are all in working condition. I also have several 405 line televisions, including a very nice nine inch Pye, which produces a full, bright raster.

Thanks again for a great magazine.

Yours sincerely,
John Gregory

**Dear Editor,**
Reference the Mini Stereo/Mono Preamplifier constructional project (Tony Thompson, Winter 2001 Bulletin), I was interested in this and have the following observations:

• There are better op-amps available these days, optimised for audio use, but the LM381 is nevertheless a good choice, even if now obsolete. However, it is power-hungry! The LM381's rated 10mA is a lot to expect a pair of PP3's to supply. Having accepted this, Tony then more than doubles it with an LED (1k limiting resistor, from 18V supply, adds an additional 16mA assuming LED voltage drop is 2V). So his 'modest 20mA or thereabouts' is actually more than half due to the LED reminding to switch off when not in use! Given that the LM381 is specified for a supply of 9V to 40V, may I suggest connecting the LED in series with the battery (the circuitry thus running from 16V) and thus doubling battery life? There's even a saving of one resistor!

• The circuit as drawn won't give a true RIAA response, because the feedback network can't reduce gain to below unity in the non-inverting configuration, and in this circuit it won't even reduce to that. It will level off at a gain of 11. Whereas, the true RIAA curve falls off indefinitely at 6db/octave. So, it's not a true RIAA-equalised pre-amp. I agree that it is the same circuit that National Semiconductors indicate within the LM381 data sheet, but here they make no claim for it being to RIAA standards - it is simply given as a typical magnetic phono pre-amp (with the departure from RIAA characteristics perhaps making up for the deficiencies of a typical budget power amplifier/loudspeaker?).

• Finally, there is no DC-blocking capacitor on the output. The LM381 output will sit at around half the supply voltage, and with the passive output attenuator there could be a few volts DC at the output. Some amplifiers won't mind this at all. Others could have their input stage biasing seriously upset if there is no capacitor between the feed-in point and the first-stage grid. I've looked at typical table radio pick-up input coupling, and it's by no means uncommon for this to be the case (my own Ever Ready 5033 being such an example). After all, the radio's designers wouldn't expect a pick-up to put out a steady DC signal, so they would have no reason to provide DC blocking! Therefore, an outboard pre-amplifier must have zero DC on its output, to be universally compatible. I'd suggest 0.1uF with a downstream 1M pull-down would remedy this.

Best regards,
Peter F Vaughan

**Dear Editor,**
I read with interest the EF91 article in the latest edition; then about a day later I was searching my valve collection when I found the above. They are labelled EF91 and are branded RCA Electron tube, and are mounted on a B9A base. Only one has a batch code:

P
Made in England,
CX

The electrode structure is very similar to some EF80 samples with a perforated anode cylinder, I have not yet tried to "read" them in a valve tester. Both these valves have a screening plate/


pad extended down into the pin area.
Apologies for the poor photograph, I wonder what the members have to say about these?

Best regards,
Ed Dinning

**Dear Editor**
**Mystery item made by Cambridge Instruments Co Ltd England No. L-86875A**

The item shown in the Winter Bulletin is a tuning fork maintaining amplifier. I have a similar one serial No L - 8117A. It is an earlier model with brass terminals and a "VALVE WT AR4" in the socket. The four terminals at the top would have been connected to the coils of the electrically maintained tuning fork. Each coil has an external parallel capacitor connected across the terminals and marked with the frequency of operation (1000~ in my case). The output is available from the terminals marked "SECONDARY" and would probably have been used to drive an AC bridge. Does anyone have the tuning fork?

Best regards,
Geoff Tomlin

**Dear Editor,**
I'm not sure if other eagle–eyed readers spotted that the photograph captioned "the singing box of tricks" on page 58 of the Winter 2011 issue is in fact a very early theremin - an electronic instrument which gained fame in the 1960s when used by the Beach Boys on "Good Vibrations".

All the best,
Bryan McAlley

**Dear Editor.**
**Pye "Cruiser" update.**
In the Autumn 2010 issue of the Bulletin you kindly published my article " Shortwave on your transistor" which compared some of the first British transistor radios, Pye P444 and Perdio PR73, to incorporate limited shortwave coverage. In this I stated that the Pye P444 represented a transitional

Letters continued on page 45

# Pictures from Wootton Bassett

photographed by Lorne Clark

Sorting auction lots for display at 7.30 am

Stallholders waiting for loading time

Vernon's Avo spectacular

405 alive and well!

Russell and Steve


MADRIGAL


MADRIGAL
TRANSPORTABLE
ALL ELECTRIC
MAINS RECEIVER


59
57


Marconi V3 stored away since 1947

The hall was so full we had to use the café tables



Letters continued from page 41

design "before improved HF transistors made a different approach possible".

Perhaps you would now allow me to add some additional information, not available at the time, which has recently come my way, for the sake of completeness and accuracy.

It now appears that a model of the Pye P444 was produced which in fact offered extended coverage up to about 16 metres, similar to the Bush ETR 92 (which was covered in Robert Darwents excellent article, Winter 2010). This version of the Pye used an identical case to the P444 with a modified tuning scale, omitting the long wave but including two shortwave scales. Internally it used the IF and AF circuits of the basic P444 but incorporated a sub board just below the band switch which used an OC170 type diffused base HF type transistor in a modified mixer. It also had a large battery holder for six C type cells. This suggests that like the Bush ETR92 it was primarily for export but I do not know if it was available initially on release of the P444 or later in production.

Henry Irwin

**Dear Editor,**
**Come dear friends and investigate our hobby**

We vintage electronics enthusiasts are exceptionally fortunate for the wealth of information that is now available. I am sure that readers will agree that its ever growing expanse facilitates not only the opportunity for the expansion of one's existing knowledge but also provides immense scope for evangelising vintage electronics for the purpose of perpetuating our absorbing hobby.

Well done to the BVWS for producing what is certainly a well thought out and brilliantly illustrated periodical. *The Bulletin* incorporates an expanse of information and colour. Often, having read an article, I have thought to myself, "I never knew that;" or, "That was an excellent idea," and, "So that is how it can be accomplished." (No doubt fellow subscribers will identify with this so why not tell someone?).

Also, the internet has plenty to offer. The BVWS website along with others such as *Vintage Radio* and *Antique Radio* forums, offer a plethora of suggestions for repair and restoration together with ample scope for discursive participation, and the dates of forthcoming events. Indeed, most sites pertaining to our hobby are potentially useful.

And talking of forthcoming events, may we be always mindful of the date for the National Vintage Communications Fair together with other vintage electronics fairs. A must? Oh, most certainly! Moreover my friends, is there any reason why at least the NVCF cannot become an annual pilgrimage, not only for you but a few of your friends and relations also?

I will now say in closing to each and every one of you who has read this letter, "Seek ye opportunities, whenever such times arise, to enthusiast the merits of this wonderful absorbing hobby to those who have ears to listen and eyes to perceive, and long may the valve remain with us"

Philip K Booth,
Sheffield, South Yorkshire

**Dear Editor,**
**Osmor**

I'm researching the history of Osmor Radio Products Ltd, the well known coil and coil pack manufacturer. I wonder if any Bulletin readers have any early recollections of the company, especially from the pre- and immediate post-war years, or references to the history of the company that may have already been published.

Does anyone know, for example, when, where and by whom the company was formed?

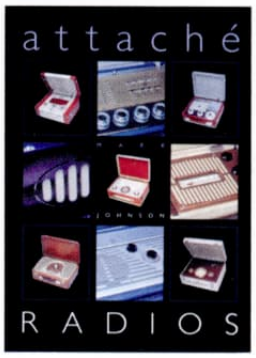
Please contact me at: stef@altera.com or 59 Faringdon Road, Stanford in the Vale, Oxon, SN7 8NN.

Stef Niewiadomski

# BVWS Books


## Out Now!

**Tickling the Crystal 5 More Domestic British Crystal Sets of the 1920s**
by Ian L Sanders.
Photography by Carl Glover
The final edition in Ian Sanders' thorough five volume set exploring GPO No. era British crystal sets.
Full colour throughout.
Strictly Limited Edition! only 500 copies printed
£5 discount for BVWS members
252 pages of GPO No. era British crystal sets and many previously–unseen models in print for the very first time. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC (rest of world £19)




**Attaché Radios**
*by Mark Johnson*
An 80 page colour paperback guide to the Attaché portable
- Detailed specifications
- 140 radios in full colour
- Over 200 additional photos of sales literature, trade ads etc.

£12.00 (+ £2.50 p&p UK) £3.50 EEC (rest of world £5.50)


**Obsession** Gerry Wells
Growing up in the 1930s, young Gerry Wells preferred wireless to toys. He had a postwar career as a radio and TV engineer designing and managing amplifiers, PA's and TVs. He now runs the Vintage Wireless and Television Museum from the home where he was born. This is the story of one man's dedication to wireless
£6.00 196 pages paperback


**Tickling the Crystal**
256 pages. Over 200 full-page photographs. £14.95 for BVWS members plus £7 p&p for UK, £13 EEC
(rest of world £19)


**Tickling the Crystal 2**
Limited, Only 750 copies printed. 208 pages. Over 125 full-page photographs. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC
(rest of world £19)


**Tickling the Crystal 3**
Limited, 500 copies printed. 240 pages of GPO No. era British crystal sets. Over 75 full-page photographs. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC
(rest of world £19)


**Tickling the Crystal 4**
More Domestic British Crystal Sets of the 1920s. 280 pages of GPO No. era British crystal sets. Over 115 full-page photographs. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC
(rest of world £19)


**Shareholders of the British Broadcasting Company** Lorne Clark
68 pages. For the first time, a comprehensive listing of all of the companies, large and small, comprising the British Broadcasting Company - the forerunner to the British Broadcasting Corporation. Illustrated.
£10.95 (+ £2.50 p&p UK) £3.50 EEC (rest of world £5.50)

Slipcase to house the first three volumes of Tickling the Crystal £9.95 Buy all three and get slipcase free! (postage £12 UK, £35 EEC, £55 US) BVWS members buy two and save £12 (postage £9 UK, £24 EEC £28 US)

Pound Cottage, Coate, Devizes, Wiltshire, SN10 3LG

BVWS Books

## Comments from BVWS Renewal Forms 2012

**Can the BVWS stock Tuning Drive Cord:**
Possibly, if we can find a supplier of the correct type. Any ideas?

**Have copies of Tickling the Crystal at the museum for sale:**
This is certainly possible. We will arrange it with the Museum Trust.

**Text too small in the bulletin:**
We could make the type face bigger, but it would impact on the amount of content. Alternatively we could increase the amount of pages in The Bulletin, leading to increased print costs and postage. This would have to be passed on to the membership.

**Please label all radios in auction with either ac, dc, battery, working and valves used:**
Definitely not possible. An inordinate amount of time is taken up in just lotting the items up and photographing them (Wootton Bassett). Ample time is allowed for viewing all items in the auction and personal research by reading Trader service sheets can help you gain better knowledge of sets. All items are sold as seen and not implied to be in any state of working order unless specifically stated at time of the sale.

**Would prefer an option on renewal to read 'name, town/city, email, occupation'**
We will look into this for next year's form.

**Can we have BVWS bank details so that we can renew/pay by bank transfer:**
Yes, but the problem is sometimes how to identify from our Bank statements "WHO" sent the money to us! You would not believe how difficult this can be. We can certainly do this if contacted first so we can give specific requirements.

**How about a yearly book/directory of suppliers for equipment, parts, servicaids, tools, materials etc.**
This would require significant effort in compiling and keeping up to date. We just do not have that effort. Anyone care to Volunteer ?

**Consider ideas that would generate interest in members displaying examples from their own collections. This is currently overlooked:**
Members are welcome to bring prized items from their collection to display at Harpenden in a small "Radio Show" display.

**Reintroduce the collectors guide at the NVCF:**
This was dropped due to the production cost of more than £600 for a "give away" booklet where the advertisement income was negligible. We think that money can be better used elsewhere. An alternative would be to add the cost onto the admission fee, but we suspect it would not be popular.

**Should be able to use a credit/debit card for a one year renewal:**
There is no reason why this cannot be done now. The 3 years only option was mandated long ago to maximise the payees benefit for the extra charge for the Credit Card service. See next year's renewal form.

**For those that want to stay overnight is there a list of reasonable priced hotels/B&B's close to BVWS London events:**
No. We suggest looking on the internet for B&B's etc.

**It would be a good idea to say what the Pat Leggat award is for i.e. best restoration or best article:**
The Pat Leggatt award is an award voted on by the membership for the article they most enjoyed Throughout the year. The Dixon-Nuttall award is a Committee nominated award for Best Restoration article.

**Can we use a debit card as well as a credit card to pay for our renewal:**
Yes either card types can be accepted.

**Can you put the make/radio information/ special features, on the calendar:**
Yes. It should have been there this year, but it does give you something to research. It will be on next year's Calendar.

**I have read about the archive and would like to be involved:**
Please contact the BVWS Archivist, Lorne Clarke directly. Details in the Bulletin Committee panel.

**The members database should include website details:**
This is possible and can be added to the renewal form.
You can request your website to be added to the BVWS website link page by e-mailing the webmaster – see Bulletin Committee panel.




## The Bulletin Back issues

All Bulletins and supplements are priced at £2.50 each + postage.

Postage: for individual Bulletins add £1, for all extra bulletins add £1 each. Cheques to be made payable to 'British Vintage Wireless Society'.

Mike Barker, Pound Cottage,
Coate, Devizes, Wiltshire, SN10 3LG
chairman@bvws.org.uk





# BVWS 2012 calendars available

You can obtain extra BVWS 2012 Calendars directly from Mike Barker (address on page 3) by sending a cheque for £5 (inc. P&P in the UK) made out to BVWS. The money raised will be donated to the British Vintage Wireless and Television Museum.


# 2MT Writtle – The Birth of British Broadcasting

Tim Wanders' book charts the full story of the early struggle to achieve a national broadcasting service in this country – from the famous 1920 broadcast of Dame Nellie Melba in Chelmsford, through Writtle's sparkling success to the birth of the BBC in 1923. It has been written for a wide readership, not just lovers of historic tomes and technical journals. The book also includes separate technical/historical appendices on the Writtle, Chelmsford and 2LO transmitters, the Dutch station PCGG, and early pioneers such as Grindell Matthews, Reginald Fessenden and David Hughes. It has new sections on the History of Writtle village and the Cock and Bell Pub. and charts the development of speech transmission during the First World War. It also covers the start of broadcasting in America, and provides non technical explanations for the mysteries of radio transmission.

22 years ago, Tim Wander published the first edition of '*2MT Writtle – The Birth of British Broadcasting*' - drawing on much previously unpublished archive material and photographs. The first print run sold out within a year. This completely rewritten new edition benefits from 21 years more research, including the internet and modern technology, and now has over 550 pages and 240 photographs, many previously unpublished. It is without doubt the definitive story of the early New street broadcasts and the 2MT station.

2MT Writtle. The Birth of British Broadcasting.
By Tim Wander.
*Laughter from the Earliest Days of British Broadcasting.*

To order ONLINE via PAYPAL - timwander@compuserve.com and see 2mtwrittle.com
The new edition is £18.95. For BVWS Members £16.50 – please include 'BVWS' and membership number on order. Postage and packing - UK £3.50. Europe and ROW £5.50

If you would like to order by normal mail please write to with a cheque for £16.50 plus post and packing. Payable to J Wander, to:
PO BOX 171, Royal Mail, Ryde Delivery Office, Nicholson Road, RYDE, Isle of Wight PO33 1BH.

# News and Meetings

**GPO registration Numbers**

Martyn Bennett is the custodian of the BVWS GPO Registration Numbers list. As many members know, the project of assembling this list was started in the early days of the BVWS and was carried on by the late Pat Leggatt. Members are strongly urged to help build the list, whenever they get the opportunity, particularly as it is something that will help with the identification of vintage wireless in years to come. The list is by no means complete and the GPO no longer have a record of the numbers granted to wireless manufacturers. The BVWS Handbook contains the current listings - one in numerical order and one ordered by name. Please let Martyn have any additions, or suggestions for corrections, by mail or over the phone.

Martyn Bennett, 58 Church Road, Fleet, Hampshire GU13 8LB
telephone: 01252-613660 e-mail: martyb@globalnet.co.uk

**2012 Meetings**
**4th March** Harpenden
**25th March** Golborne
**15th April** A celebration of 625 line television plus table-top sale at The British Vintage Wireless and Television Museum
**May 13th** NVCF at Warwickshire Exhibition Centre
**9th June** BVWS Garden Party
**10th June** Harpenden
**July 1st** Wootton Bassett
**23rd September** Harpenden
**7th October** Audiojumble
**18th November** Golborne
**2nd December** Wootton Bassett

**2013 Meetings**
**24th February** Harpenden
**1st June** BVWS Garden Party
**2nd June** Harpenden
**7th July** Wootton Bassett
**29th September** Harpenden
**1st December** Wootton Bassett

**The British Vintage Wireless and Television Museum:** For location and phone see advert in Bulletin.
**Harpenden:** Harpenden Public Halls, Southdown Rd. Harpenden. Doors open at 10:00, tickets for sale from 09:30, Auction at 13:30. Contact Vic Williamson, 01582 593102
**Audiojumble:** The Angel Leisure Centre, Tonbridge, Kent. Enquiries, 01892 540022
**NVCF: National Vintage Communications Fair** See advert in Bulletin. www.nvcf.co.uk
**Wootton Bassett:** The Memorial Hall, Station Rd. Wootton Bassett. Nr. Swindon (J16/M4). Doors open 10:30. Contact Mike Barker, 01380 860787
**Golborne:** Golborne: Golborne Parkside Sports & Community Club. Rivington Avenue, Golborne, Warrington. WA3 3HG contact Mark Ryding 01942-727428
**Mill Green Museum:** Bush Hall Lane, Mill Green, Hatfield, AL95PD
**For more details with maps to locations see the BVWS Website:** www.bvws.org.uk/events/locations.htm

# THE BVWS SPARES DEPARTMENT

NEW!

**DeoxIT D5 Contact cleaner / Lubricant £15.00 aerosol can**
**Not cheap – Just the BEST. Available at all BVWS events!**

**New manufacture high quality metallised polyester film capacitors**
**To replace all old paper types in vintage equipment**
**Ideally sized for re-stuffing**

All Capacitors are 630 Volt working
All prices are for packs of 50 components and includes Postage and Packing

| | | | |
|---|---|---|---|
| 0.001µF | £20.50 | 0.022µF | £20.50 |
| 0.003µF | £20.50 | 0.047µF | £25.50 |
| 0.0047µF | £20.50 | 0.1µF | £23.00 |
| 0.01µF | £20.50 | 0.22µF | £28.00 |

Only available in packs of 50 by post.
Available in smaller quantities at all BVWS events

## Electrolytic smoothing Capacitors
## Standard "old-fashioned" size
## 500 Volt DC working

8/8µF 16/16µF 32/32µF 50/50µF £6.00 each
16/32µF for DAC90A £8.50 each
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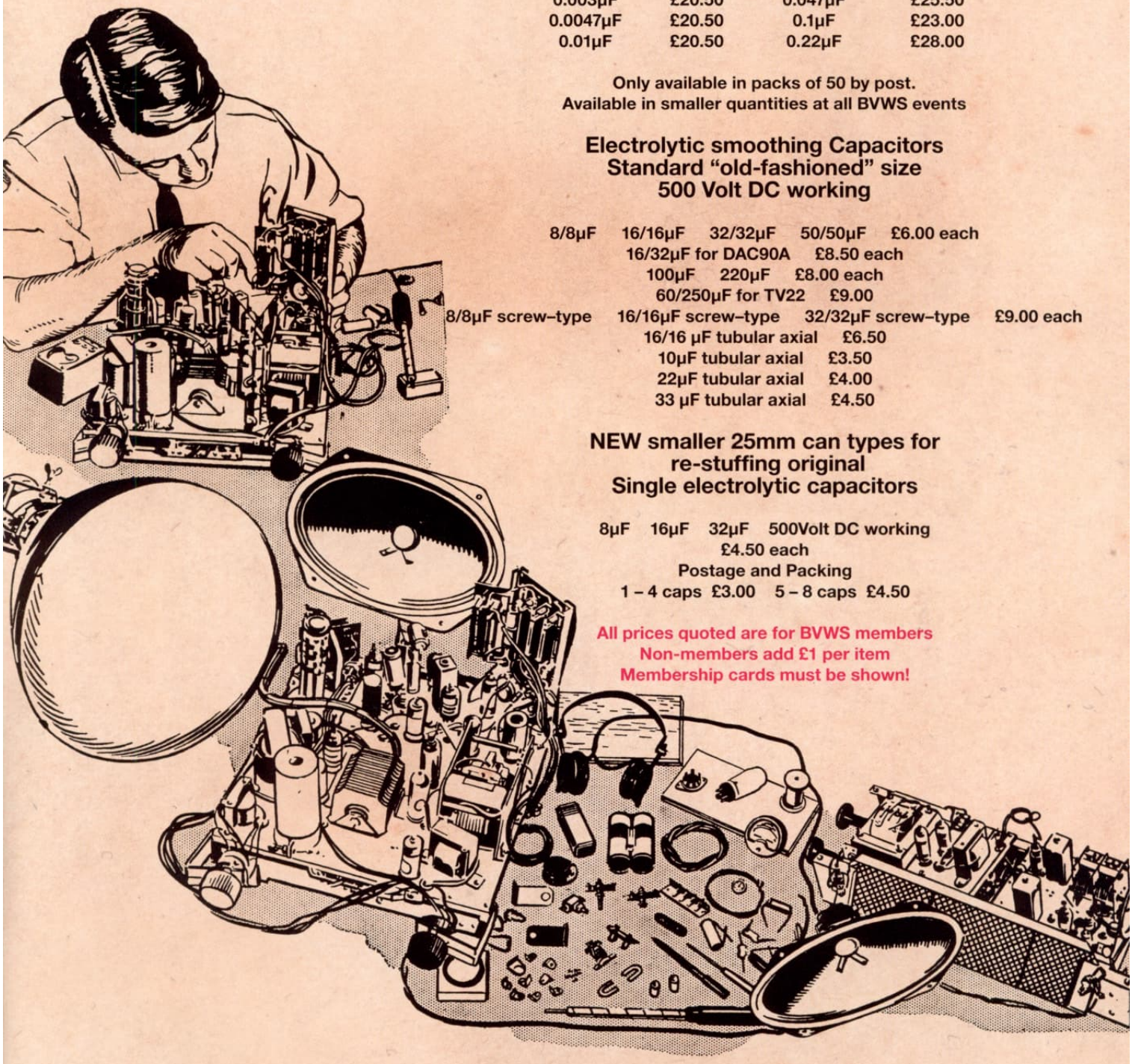
8/8µF screw-type 16/16µF screw-type 32/32µF screw-type £9.00 each
16/16 µF tubular axial £6.50
10µF tubular axial £3.50
22µF tubular axial £4.00
33 µF tubular axial £4.50

## NEW smaller 25mm can types for re-stuffing original Single electrolytic capacitors

8µF 16µF 32µF 500Volt DC working
£4.50 each
Postage and Packing
1 – 4 caps £3.00 5 – 8 caps £4.50

**All prices quoted are for BVWS members**
**Non-members add £1 per item**
**Membership cards must be shown!**



For non UK addresses, please contact Graham Terry for prices, (see below)
All orders should be sent (with payment made out to BVWS) to:
Mike Barker, Pound Cottage, Coate, Devizes, Wiltshire, SN10 3LG
Please allow 14 days for processing, but usually quicker!
The above Capacitors are supplied as a BVWS member benefit.
Anyone found to be reselling these items for profit will be expelled from the Society

BVWS wireless supplies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B.B.C.
U.S.A.
BRAZZA.
M
20