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*As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.*

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## Editorial Comment

# Ourselves

## The Past and the Future

**I**N this age of invention and discovery, when even centenaries are of comparatively common occurrence, wireless is still a sufficiently youthful science to make the celebration of twenty-five years of publication of a journal devoted exclusively to that subject a notable milestone in its history.

The story of *The Wireless World* is unique. Ours was the first wireless publication to appear and its origin owed nothing to the modern popularity of broadcasting, nor even to the wireless telephone which in those days had not yet emerged from the laboratory. Twenty-five years ago wireless telegraphy was only just beginning to attract the attention of the general public. A succession of serious disasters at sea, in which the loss of life was minimised in consequence of the use of this method of communication, demonstrated strikingly its possibilities. In quick succession followed the recognition of the value of overland wireless from a strategic point of view and plans were approved to form a British Empire chain of stations.

The progress of wireless received a similar speeding up during the war to that which was experienced with aviation and other modern inventions, and during the four years of hostilities wireless may truly be said to have come into its own, so that when peace came wireless was in need of no propaganda.

After the war the next step was the wireless telephone, but the idea of broadcasting followed almost immediately and eclipsed, at least in popularity, all other practical uses of wireless.

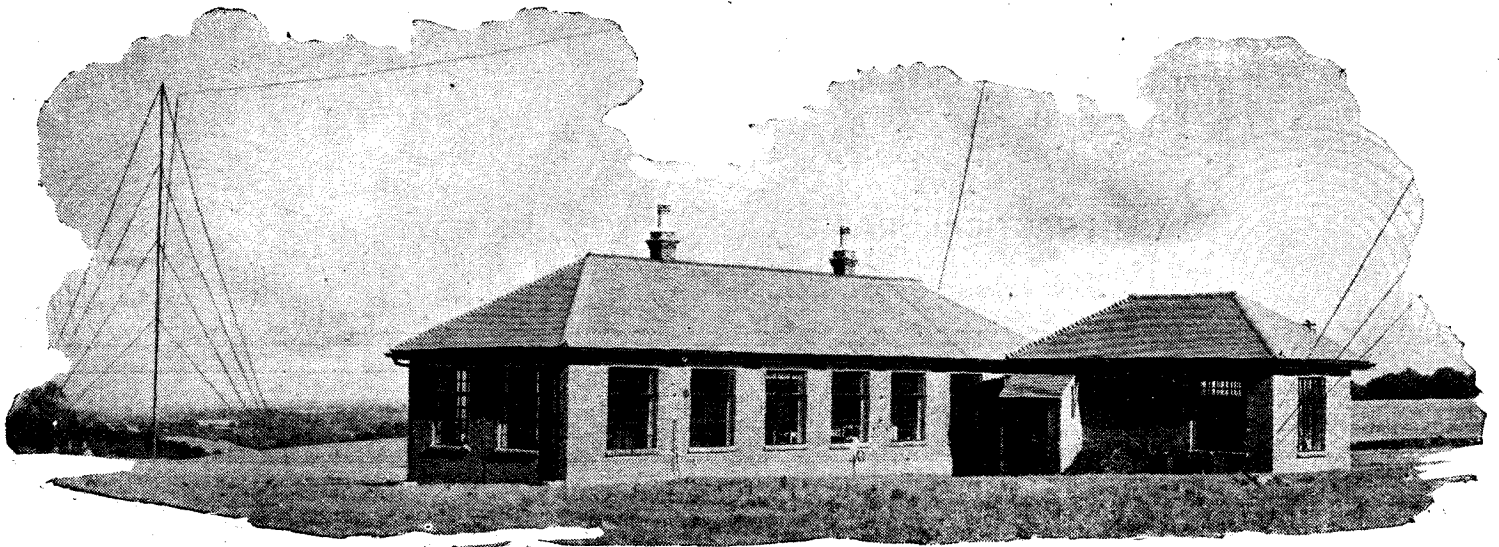
As a souvenir of our twenty-five years of publication we include in this

issue what may be described as a "Cavalcade of Wireless" and pages of past issues of the paper have been used to illustrate the progress of wireless invention and its applications over this period. In the lifetime of *The Wireless World* there have been many interesting phases of development involving remarkable changes in both the technical and commercial aspects. No less noteworthy in our own sphere of publishing are the changes that have occurred in wireless journalism and a fleeting retrospect brings to mind nearly a dozen wireless periodicals which came into existence with the advent of broadcasting, more than ten years after *The Wireless World*, but which one by one have retired from the field.

It has been our aim throughout the life of *The Wireless World* to maintain a consistent policy and to serve our readers by keeping them informed of every fresh development and placing in its true perspective before them each fresh contribution to wireless progress. In pursuit of this aim we have studiously avoided exaggeration and have never abused the credulity of our readers. We have valued our editorial independence no less in our readers' interests than in our own.

The future provides a horizon of limitless possibilities, for it is obvious that finality has in no sense been attained.

The present phase is one of consolidation rather than of development, although the material is available for extensive advances. Our endeavour for the future will be to maintain our policy of providing an educative factor in the study of wireless and promoting future development to the limit of our abilities.



# How the B.B.C. Relays America

METHODS AND EQUIPMENT IN USE AT THE  
TATSFIELD RECEIVING STATION

# America

By

M. G. SCROGGIE, B.Sc., A.M.I.E.E.

**N**OW that short-wave receivers are no longer the preserve of "experts," reception of American broadcasting stations does not give one the prestige that it did. When the ordinary non-technical licence-holder can pick up America direct merely by turning the knob of a set he bought at a shop there is evidently nothing supremely clever or mysterious in the achievement.

Yet owners of "all-wave" models who

have taken advantage of the recent series of "Five Hours Back" programmes to compare the results they can obtain direct with those received *via* the local B.B.C. station will admit that there may still be some professional "secrets"!

Not always. There are occasional lucky periods. On March 21st last, for instance, I heard reception of the "Five Hours Back" direct from the States on a standard domestic receiver so perfectly

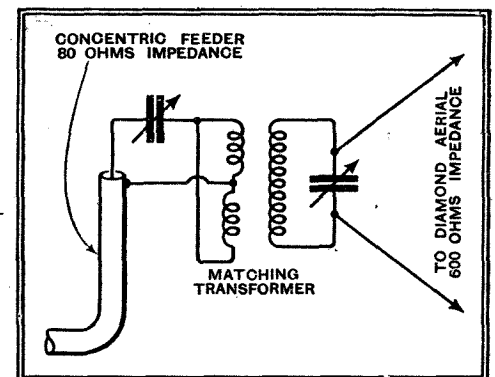


Fig. 2.—How the multiple aerials are linked to the receiving apparatus.

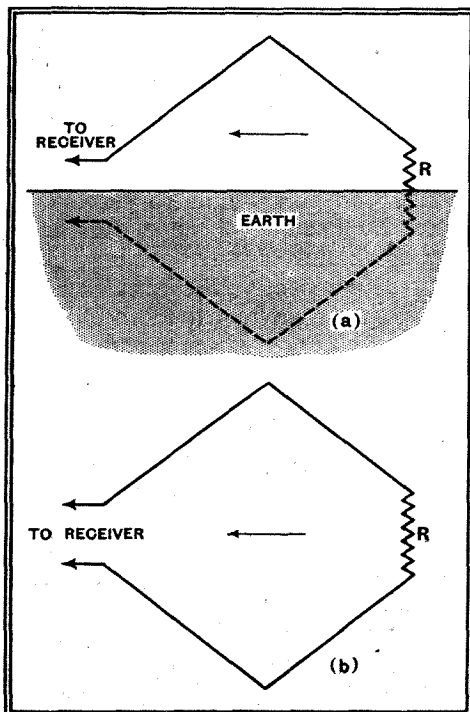


Fig. 1.—Special directional aerials: (a) shows the inverted V-type in elevation with the image portion dotted in to indicate its relationship with the diamond, seen in plan in sketch (b).

*ALTHOUGH* we recorded the use of multiple spaced aerials for transatlantic relays as long ago as 1927, the crude methods then in use had little in common with the highly developed and extremely dependable system in use to-day

that there was nothing for the B.B.C. to improve. But that is quite exceptional. There are other times when direct reception consists only of short gusts of distorted sound, whereas reference to the medium waveband proves that in some way the B.B.C. has been able to provide a relay which, if not quite of London studio standard, is at least a programme. What that way is will now be described, by the courtesy of the B.B.C., who arranged a special visit to their Tatsfield receiving station.

Readers will rightly have guessed that the situation of the receiving station has something to do with it. One does not have to go to Tatsfield to note that it occupies almost the highest point in south-east England—over 800ft. above sea level—and, for any district within easy reach of London, is singularly free from popula-

tion, with its inevitable accompaniment of electrical disturbances. The station stands on open ground, quite remote even from the tiny village of Tatsfield, and receiving conditions are excellent.

Next, as one would expect, the aerials are more ambitious than even the choicest example of the back garden or chimney variety. Among them are some very elaborate networks, but they do not happen to be the ones to be used. It is essential to be able to receive on practically any wavelength from 13 to 50 metres, which renders unsuitable many of the directional arrays used, for example, in the commercial beam services working on fixed wavelengths. An ordinary dipole is the simplest example of an aerial which gives a rapid falling-off in reception each side of the optimum wavelength. Most of the more elaborate systems, giving great magnification in particular direc-

**How the B.B.C. Relays America—**

tions, share this characteristic, and so are unsuitable for the purpose.

After considerable trial, two types of aerial have been found to combine good directional characteristics with wide wavelength response; there are the inverted V and the horizontal diamond. The object of using a directional aerial is, of course, not only to increase reception from the desired direction, but—much more important—to reduce reception from elsewhere.

**Alternative Aerials**

The horizontal diamond bears the same relationship to the inverted V as the horizontal dipole does to the vertical quarter-wave type; it responds to the horizontal component of the received wave rather than the vertical, and it does not depend upon the earth to form the other

The cause of fading is well known; when, as a result of various reflections, waves arrive by different routes, it is a matter of chance whether they assist one another or tend to cancel out. In short-wave reception they are liable to swing from one condition to the other in a period of the order of one second, but in an entirely irregular manner. Worse still, waves of slightly different frequency may fade quite independently of one another, so that the carrier wave may disappear while side-band frequencies are received strongly. The effect of this is equivalent to gross over-modulation, and is one cause of the distortion that is such a familiar accompaniment to bad fading. So far from helping matters, AVC, which relies for its operation on the strength of the carrier wave, causes the distorted modulation to be amplified to an abnormal volume. Clearly nothing that can be done along the lines already described is of any use when this selective fading is experienced.

It has been discovered, however, that whereas receivers with aerials only a few hundred yards apart may both be suffering from the same sort of bad fading, a c t u a l moment-by-moment records

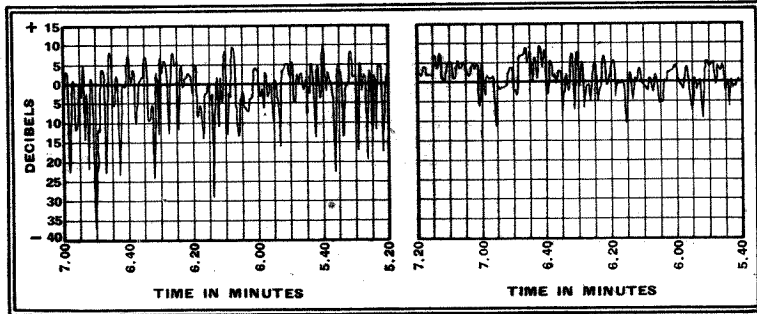


Fig. 3.—Graphs showing (on left) fluctuating signal strength of W8XK on a single aerial, and (on right) reduction in fading due to diversity reception over the same period of time.

half or image. Fig. 1 shows each diagrammatically, and it must be particularly noted that the viewpoint differs; the diamond is parallel to the ground, whereas the V rises up from it. Apart from this, and the fact that the dotted portion in the case of the V enjoys only a theoretical existence, the two are identical. Both receive most effectively from *approximately* the direction indicated by the arrow, while waves arriving from the opposite direction are absorbed by the resistance R. Actually the best angle is inclined to the plane of the aerial, and depends on its dimensions.

On their way from America the waves have been reflected several times between sea and sky, and the direction of strongest arrival may be inclined at 20 degrees or so above the horizon. At Tatsfield there are in common use two diamonds adjusted for different angles, and one V.

The chief problem in long-distance short-wave reception is fading. If one had to contend with no more than fading of the signal as a whole, the combination of a good site, an efficient aerial, a sensitive receiver and a well-designed AVC system would provide an effective defence against all except incredibly severe conditions. Even so, the periodical rise and fall of background noise would be disturbing. But there frequently exists a type of fading against which the best AVC is not only ineffective but positively detrimental.

of reception at these points would be entirely different. The more receivers the less is the probability that all of them are in the doldrums at any one instant. This looks as if, by combining resources, one could work on the insurance company principle of getting a steady average among fluctuating risks. Actually one can do better than this. An insurance company, naturally, is not allowed to collect only the

premiums and repudiate the claims, but a multiple receiving system can be arranged automatically to take only from the unit that at any instant chances to be giving the best yield.

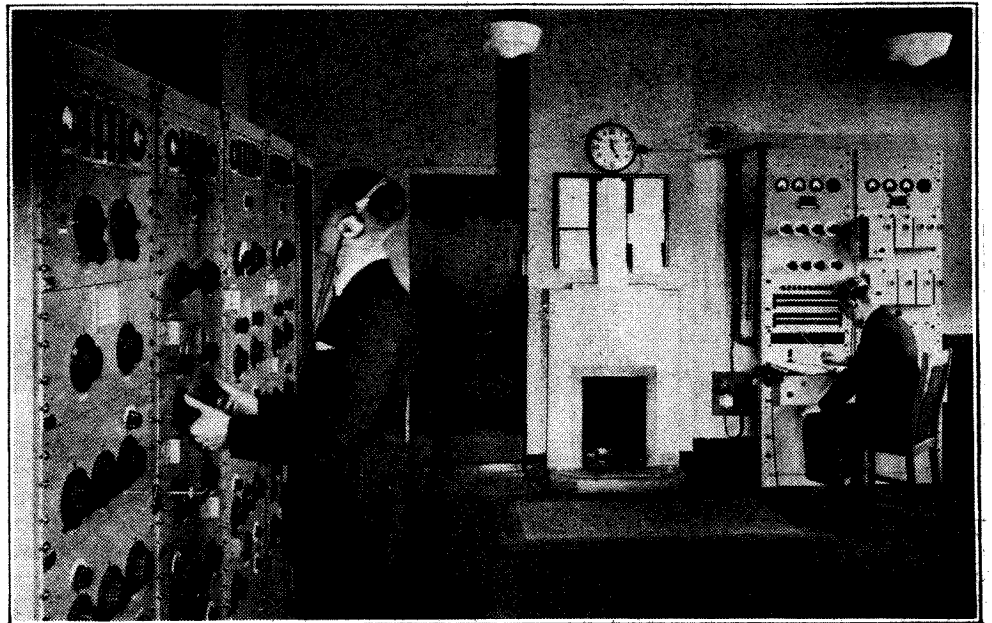
This is done in a very simple and ingenious way. Combining the HF outputs from the aerials, before amplifying in a common receiver, would be of no value, because the contributions would be as likely to cancel out as to add up. Or if the LF outputs were combined, the good reception *via* one receiver might be marred by violent distortion and noise from another, and the general result would simply be an average of badness.

What is done is to use a common AVC voltage for all receivers. Whichever receiver happens to be receiving the strongest carrier wave provides this AVC voltage, and the remaining receivers are more or less cut out of action by this relatively large AVC voltage applied to their HF and IF amplifying valves.

**Feeding the Receivers**

At Tatsfield there are four similar receivers, each of which can be linked to a different aerial. The aerials are something like five to ten wavelengths apart, and are connected by means of very tightly coupled matching transformers to concentric feeders spanning the distance from aerial to station (Fig. 2). The transformer covers a wide waveband, after the fashion of an over-coupled tuned transformer, and is balanced to earth by means of a centre-tap.

The receivers are mounted side by side on the usual racks. Each is a fairly normal superhet, with only one frequency changer (commercial signal services usually have two, but it is difficult to avoid stray beat notes with these when the receiver has to be tuned to any wavelength over a wide band). The principal departure from domestic practice is that the various condensers are tuned separately instead of being ganged. This,



General view of the receivers and relaying apparatus at Tatsfield.

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together with rather exceptionally good tuning coils, allows considerable discrimination—about 40 db.—against second-channel interference to be obtained with only a single preselector stage and no “tricks.” The relatively high IF of about 700 kc/s helps, too. It is actually about 700, because a somewhat different frequency is adopted for each receiver in order to avoid the beat interference which would be very likely to occur if all the oscillators were running at approximately the same frequency.

**Three Receivers in Use**

Separate first-detector and oscillator valves are used after the HF stage, then three IF stages, two second detectors—a diode for audio output and a triode for AVC operation—and LF amplifier. The output is then passed to the line amplifier and control panel for despatch to the control room at Broadcasting House. There is a local high-quality loud speaker for judging the result; and each receiver can be separately tuned by phones and then brought into circuit. Generally three are used at once for diversity reception. There is no attempt to provide means

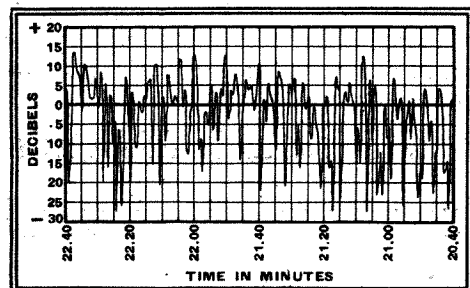
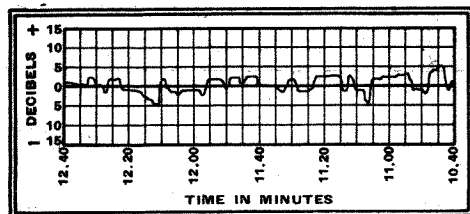


Fig. 4.—Illustrating the difference between rapid selective fading (above) and the slower and less acute general fading of signals from W3XAL; both received on a single aerial.



for a rapid switch-over between a number of fixed wavelengths; but it is possible to tune any disconnected receiver to another wave and then switch over to it if required.

The combining of the several IF outputs to give a common AVC bias is effected by switches, allowing the DC outputs of the separate AVC detectors to be paralleled as required. Similarly the audio frequency outputs of any or all of the receivers can be paralleled by switches. The receivers are provided with AVC voltmeters, and it is fascinating to watch these when the receivers are working independently and with the AVC lines disconnected. The random distribution of fading over the space occupied by the aerial systems is well shown, for there

seems to be no connection whatever between the movements of the three pointers, and it is very rarely that all three are at or near zero simultaneously. It is like other operations of chance, such as dice. There is one chance in six of scoring only one with a single throw, but only one chance in 216 of three dice all turning up a one at the same time.

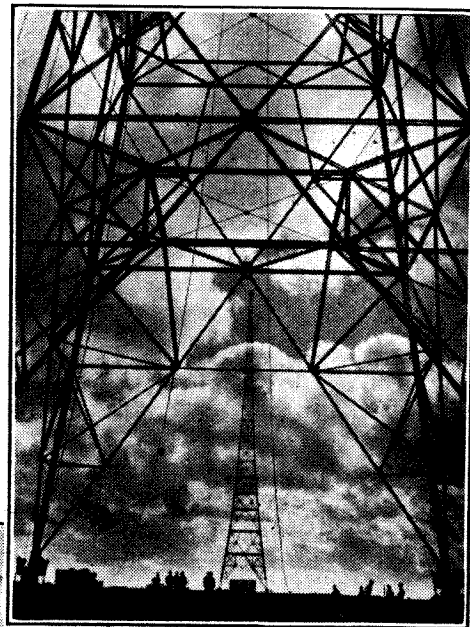
**Recording Signal Variations**

Even when the pointers are gesticulating wildly, they settle down to mostly quite small movements when the receivers are linked and the AVC is applied. A recording meter can be switched in for taking a continuous log of fading movements, and Fig. 3 shows samples from reception of W8XK; first with one aerial, giving fluctuations covering nearly 50 db., and then with diversity reception, which reduces the extremes to about 20 db. This, by the way, is a specimen of selective fading, which can be identified on the chart by its very narrow sharp crevasses and more rounded summits. General fading, in which the whole of the carrier and sidebands are affected simultaneously, is much less rapid and violent. The difference is easily seen in Fig. 4, which compares the two sorts of fading for single-aerial reception of W3XAL.

There are other receivers at Tatsfield, of

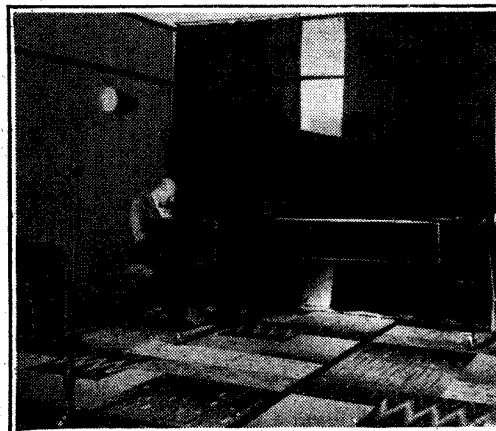
**BROADCASTS TO THE ARCTIC**

EVERY Saturday night the Canadian Radio Commission conducts a special broadcast, “The Northern Messenger,” for dwellers in the Eastern Arctic regions. This vast territory contains nearly one and a quarter million square miles, and it has a surprisingly large white population, consisting of the mounted police, the Hudson’s Bay Company’s agents, members of the Royal Canadian Signal Service, hunters, trappers, and so on. In addition, there are the Eskimos, who have taken very kindly to wireless. During the weekly broadcast news is sent out—one can imagine how



A distant prospect of the southern mast as seen from the base of its northern companion.

In the picture on the left the Music Director is seen giving a pianoforte recital.

**PALESTINE CALLING**

Three interesting views of the Jerusalem station, now operating on the wavelength of 449.1 metres, which it shares with North Regional, though no interference has been reported. The control room (on right) adjoins the talks studio in which an official can be seen reading a news bulletin.



course, for emergency relaying of home stations and for observation. The most important function of the station is frequency checking, and its equipment for detecting small departures of European broadcasters from the allotted channels is one of the most precise in the world. But that is another story, and one that has nothing to do with diversity reception.

eagerly it is awaited—and there is a regular service of messages from relatives and friends. One of the big difficulties of dwellers in the Far North is low-tension and high-tension current supply. One wonders how on earth they manage to keep their apparatus going with temperatures such as “forty-below.” But so much does the radio-link mean to them that they contrive to do it somehow.

# CURRENT TOPICS

## Events of the Week in Brief Review

### Radiolympia

THIS year's Radiolympia will be held from August 26th to September 5th inclusive.

The Berlin Radio Show dates are August 28th to September 6th.

### Encouraging Television Research

A TELEVISION section is to be a feature of the 34th Concours Lepine to be held in Paris in September next. The show is organised for the benefit of small manufacturers and inventors. Prizes are to be offered in a competition for the most effective television receiving apparatus.

### Her Name is Beruyl

DURING the British Empire Radio Union (B.E.R.U.) transmitting contest a Rhodesian amateur was presented with a baby daughter. He has decided to call her "Beruyl."

### A Lucky Strike

A TRAMWAY strike in Lille has revealed that the trams produce more interference with radio reception than any other "public nuisance." The local radio clubs are asking the authorities to fit adequate suppressors.

### Southend Amateurs Thanked

THE Mayor of Southend publicly thanked members of the Southend and District Radio Society, at the recent annual dinner, for their valuable work in maintaining, free of charge, suitable receivers in the homes of fifty-six blind persons, in addition to the big installation which the Society presented to the local General Hospital at a cost of nearly £700.

The Mayor (Councillor H. A. White) also presented the Society's silver challenge trophy to two members who exhibited the most meritorious workmanship at the Society's Annual Exhibition of home-constructed apparatus. The prize-winners, Messrs. Pugh and Leggett, were also awarded miniature replicas of the cup.

### Prizes for Reception Logs

THE majority of licensed amateur transmitters in the north-east of Essex are to take part in a special DX contest, and the Hon. Secretary of the Southend and District Radio Society is anxious to hear from

amateurs who would be willing to furnish reception logs for the month of May. Valuable prizes are being presented, including special awards for receiving stations only. The Hon. Secretary's address is: "Chippenham," Eastern Avenue, Southend-on-Sea, Essex.

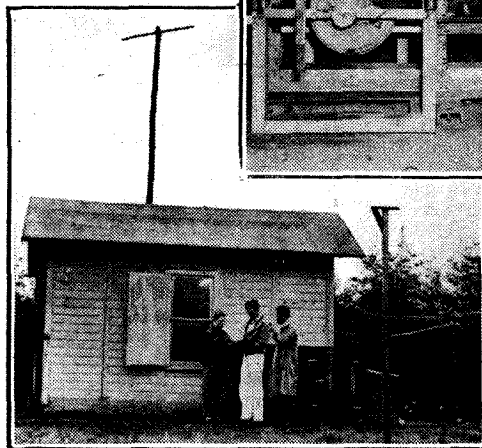
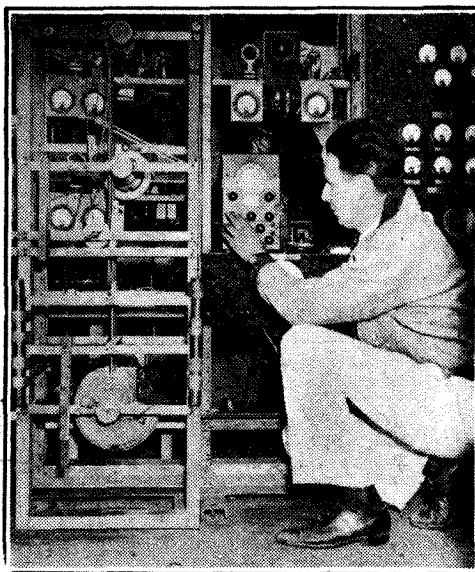
### Ionosphere Tests During Eclipse

A GROUP of Harvard scientists now *en route* to Siberia to observe the Solar eclipse on June 19th includes four members of the Radio Corporation of America's laboratories, who will study the effect of the eclipse on radio signals and who will also assist the Siberian Expedition of Cruft Laboratory at Harvard University in making measurements of the reflection of radio waves from the ionosphere in Russian Turkistan.

longer applies to amateur transmitters, who are now permitted by the G.P.O. to use aerials up to 150 feet. This concession is particularly appreciated by operators on the 84-metre band, who, unable to erect a half-wave (132 feet) aerial for this band, have not been obtaining the maximum radiation possible from their transmitters.

### Week-end 5-metre Tests

FIVE-METRE tests are to be carried out on Sunday from the top of Ashurst Beacon by Mr. W. Johnson (G2INP), who will be co-oper-



### Car Radio Triumph

A BILL to make car radio illegal in the State of Missouri, promoted by two prominent St. Louis citizens, has been strangled at birth, following opposition by the Radio Manufacturers' Association, the Electrical Board of Trade, and the Automobile Club of America. It was stated that not one accident due to automobile radio had been reported from forty-four out of America's forty-eight States.

### Longer Aerials

THAT old familiar licence clause: "The combined height and length of the aerial shall not exceed 100 feet" no

Signals that last only one ten-thousandth of a second are to be broadcast continuously for several years by the Carnegie Institution of Washington, from an experimental station at Kensington, Maryland, two views of which we show. The reception of these transmissions, which will be sent out on varying wavelengths, will be recorded and examined in an effort to get more conclusive evidence on the effect of the Heaviside layer on wireless signals.

ating with G5ZI. Transmission will be continuous from 09.30 till 16.00 using ICW and 'phone. Amateurs desirous of co-operating either in transmission or reception are asked to communicate with G2IN, 6, Denmark Road, Southport, as soon as possible.

### I.E.E.

A MEETING of the I.E.E. Wireless Section will be held at Savoy Place, Victoria

Embankment, London, W.C.2, on Wednesday next, May 6th, at 6 p.m.

Mr. H. A. Thomas, M.Sc., will read papers on "The Stability of Induction Coils for Radio Frequencies" and "The Electrical Stability of Condensers."

A short communication will also be read by Messrs. R. W. Sloane, M.A., Ph.D., and E. G. James, B.Sc., Ph.D., on "Transit Time Effects in Diodes, Saturated or Unsaturated, in Pictorial Form."

Dr. E. Mallett is to give the Faraday lecture on "Television: An Outline," at the annual general meeting of the Institution of Electrical Engineers on Thursday next.

### Editorial Appointment

MR. D. SISSON RELPH has been appointed Editor of *The Wireless and Gramophone Trader*. Mr. W. E. Miller continues as Technical Editor. Mr. Relph was formerly the Editor of *Wireless Magazine* and other journals.

### A Pioneer Retires

AFTER nearly a quarter of a century's service with the Marconi Company, of whose works at Chelmsford he was Assistant Works Manager and, later, Works Manager for many years, Mr. Herbert B. Tilley, A.M.I.E.E., has just retired.

### Lectures on Television

A SPECIAL course of four lectures on television is to be given by Mr. H. J. Barton Chapple, Wh.Sch., B.Sc., at the Polytechnic, Regent Street, London, W., on Mondays, commencing May 18th next, from 6.30 to 8 p.m.

The course, the fee for which is 6s., covers the various methods of scanning, ultra-short waves, types of modulation, the cathode-ray tube, electron multipliers, and big screen developments. The lectures will be illustrated by experiments, lantern slides, and demonstrations of modern television receiving equipment.

Mr. Barton Chapple is also giving a course of six lecture-demonstrations on television at the Norwood Technical Institute, Knight's Hill, West Norwood, S.E.27, on Thursdays at 8 p.m. The first lecture was arranged for yesterday. The fee for the course is 5s.