

The Inside Story of the British Broadcasting Experiments

How Success Came After Many and Long Experiments to Link America and Great Britain, by One of the Staff of 2AC at Manchester

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SO MUCH interest has been aroused by the recent American rebroadcasting tests that the following account of the preliminary experimental work which was necessary before the tests could

be conducted should be of some interest. It is probably not generally realized that the relaying of KDKA, the Pittsburgh station of the Westinghouse Electric & Manufacturing Company, was only rendered possible by a tremendous amount of experimental work between this Company and the Metropolitan-Vickers Electrical Company of Manchester. There was no mystery about the excellent results which have been obtained on 100 meters. These were in fact the culmination of plans which were made many months ago.

The Metropolitan-Vickers Company is in very close technical association with the Westinghouse Company, and several months ago it was agreed that a combined attempt should be made to relay the KDKA broadcasting programs in this country. The Westinghouse Company had been experimenting with short wavelengths around 100 meters and had found that they promised well for long-distance

reception, though of course this is all against the theory of excessive absorption on short wavelengths. In September, 1923, they commenced experiments with the Metropolitan-Vickers Company by transmitting their ordinary broadcast programs on 100 meters as well as on their normal broadcast wavelength of 326 meters. The Metropolitan-Vickers Co. built up a 100 meter receiver and listened to the transmissions at their experimental station at Altrincham in Cheshire.

WHAT 100 METER WAVES WOULD DO

IT WAS immediately apparent that the 100 meter transmissions came over the Atlantic better than the 326 meter wavelength. The chief improvements noticed were firstly, greater consistency of results, secondly, freedom from interference by spark stations, "mush" and static, and thirdly, the comparatively small amount of fading experienced. As regards consistency of results, the improvement was particularly noticeable, and it was found possible to receive signals much earlier in the night than was possible with the 300-500 meter American transmissions.

The Future—Which Way?

It is manifestly impossible for every radio listener to own a highly sensitive receiver. And it is also true that as radio grows older, broadcasting will be more used in politics, in government, and all branches of the national life. So it is that the long-visioned ones in radio have wondered how it is economically and electrically possible to bind together some of our powerful and important broadcasting stations located at strategic points in the country, so that an event of national importance could be broadcast nationally. Most of our readers know of the recent successful experiments which have taken place within the last six months.

Now there are two ways to link broadcasting stations. One is by direct land wire, and the other is by radio itself, using extremely short wavelengths. In this country, the American Telephone and Telegraph Company has done much with the land line method, while the Westinghouse Electric and Manufacturing Company has taken the opposite course and done a great deal of research with transmission over long distances with short waves. We described these experiments from the American angle in our February number. This is the English side of the story.

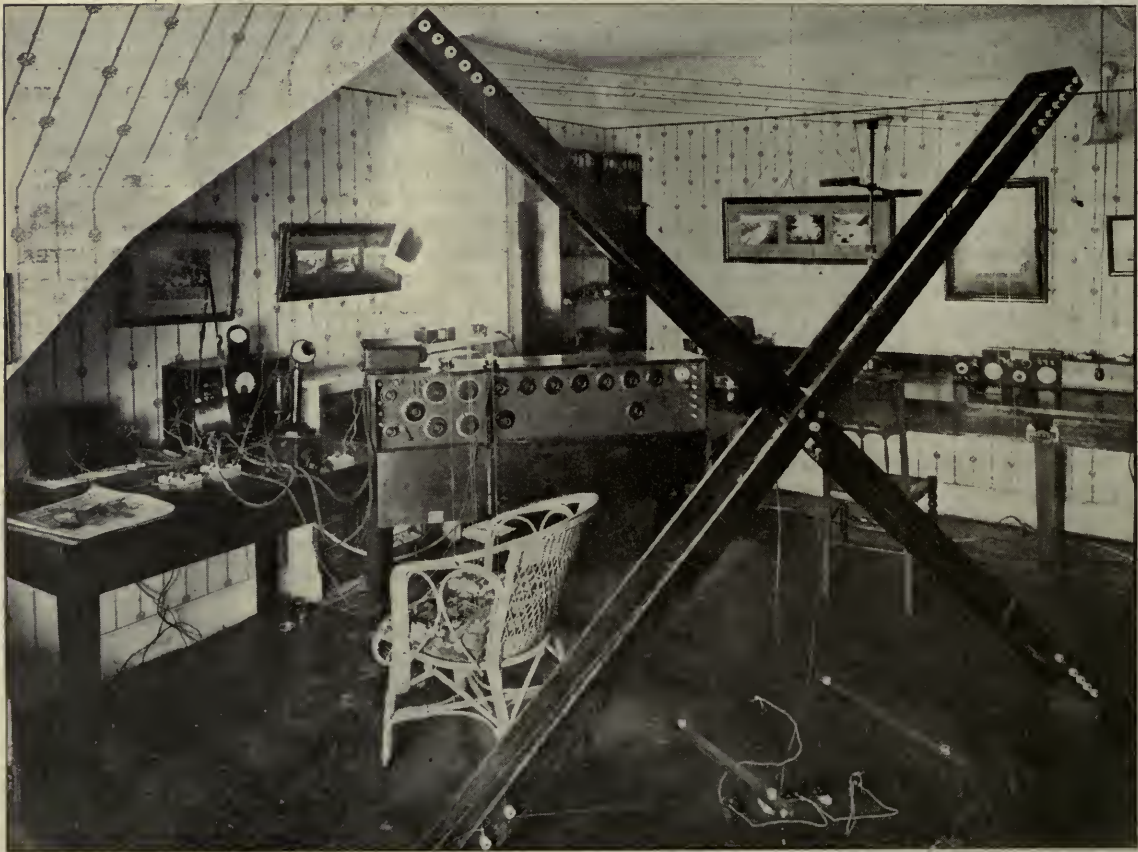
—THE EDITOR

The experiments being so far successful, the Westinghouse Company built a new transmitter operating at nearly 30 kilowatts input. This transmitter represents absolutely the latest radio engineering practice. It employs special high-power tungsten valves with an elaborate system of water-cooling, whereby quite a small valve can be made to handle an enormous amount of power. Most elaborate precautions are taken to prevent slight changes of wavelength which at the exceptionally high frequency of 3,000,000 cycles per second would have a very serious effect. The antenna system is designed to have absolute rigidity, as are the high frequency connections of the transmitter itself. The inductances are wound on rigid formers and as a final precaution the whole of the high frequency portion of the transmitter is mounted in a framework suspended by springs.

Statements have recently appeared in the press

to the effect that KDKA has been making no special effort to broadcast their signals over the Atlantic, and also that their 100 meter transmission is of lower power than that of a British Broadcasting Company station. When it is realized that KDKA has been working with Metropolitan-Vickers for months past, and that they built a transmitter specially for transatlantic work which is *probably greater in power than all the British Broadcasting Company stations put together* the inaccuracy of such statements will be appreciated.

The first tests on the new transmitter were made in October, 1923, and naturally it was found that signals were coming over a good bit more strongly than before. Other troubles became evident however, chief of which was "night distortion" which is caused by slight changes in the carrier frequency of the transmitter, together with changing propagation conditions. In many cases this distortion was



WHERE AMERICAN BROADCAST PROGRAMS ARE HEARD ALMOST NIGHTLY

The extremely sensitive receiver at the Trafford Park Laboratories of the British Broadcasting Company near Manchester. The six foot loop in the foreground is used constantly in receiving 94 meter waves from KDKA, and, recently, the 104 meter wave of WGY. A wire line connects this station with the operating room and studio of the Manchester station 2 AC

so bad that speech was rendered quite unintelligible.

It must again be emphasized that, working with wavelengths as short as 100 meters, a very much greater constancy of wavelength is required than with the 300-500 meter transmissions, and also this constancy is much more difficult to obtain.

Many experiments were carried out with a view to eliminating this trouble. These experiments were carried on usually in the early (or rather, late) hours of the morning after the American broadcast program had ceased, and special forms of modulation were employed for the purpose of analyzing the effect. Great difficulties were met, particularly at the transmission end, and these resulted in an almost continuous flow of cablegrams between the two companies. In the end, on December 27, 1923, a fairly good transmission through was achieved, and on the following day rebroadcasting of KDKA to listeners in Great Britain was an accomplished fact.

During the following seven or eight days the Metropolitan-Vickers Company carried out a series of rebroadcasting tests, so as to gauge the possibilities of their system as it then stood. The repeating was done from the Company's station 2AC at their research laboratories, Trafford Park, Manchester. An experimental $1\frac{1}{2}$ kilowatt transmitter was employed, operating at a wavelength of 400 meters. Reception was still carried out at the Altrincham Station. The two stations were connected by land-line.

mine the most satisfactory method of reception. During the whole of the relaying period, however, a frame aerial some six feet square was used for picking up the signals while the receiving set employed a number of high frequency stages varying from six to twelve according to the prevailing conditions of reception. After detection, the signals were passed through two stages of low frequency power amplification before passing them on to the line leading to the microphone transmission.

At the beginning of the week, the whole of the controlling and announcing from Altrincham was done over telephone lines, but this was found to be rather unsatisfactory since there was no suitable non-resonant room for speech purposes at the Altrincham station; hence these functions were transferred to



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CAPTAIN A. G. D. WEST

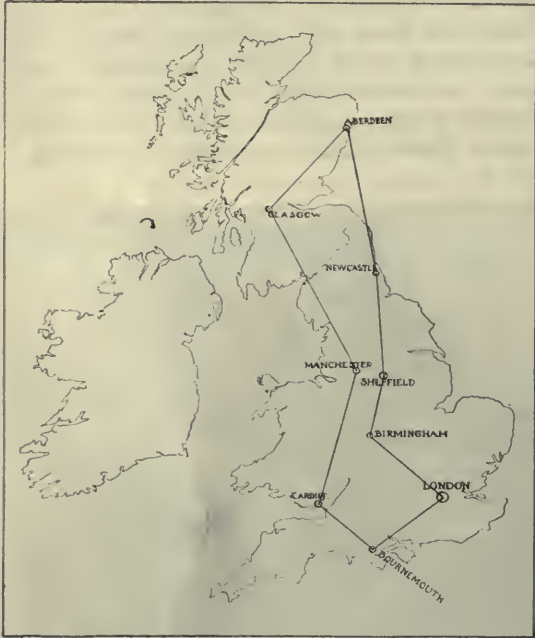
Assistant chief engineer of the British Broadcasting Company. Captain West has supervised the successful rebroadcasting of American programs from WGY and KDKA on a number of occasions. "We have some difficulty in regard to distortion," says Captain West, "The announcer is usually quite intelligible, but in some speeches, not a word can be understood, and this is perhaps when they are an "outside broadcast" . . . One of our chief troubles is from French amateur transmitters working on about 100 meters. Some of them spend their time tuning up and down for hours on end"

THE MANCHESTER EQUIPMENT

DURING the preceding two months many different forms of receiver and various antenna systems had been tried out, to deter-

Trafford Park before the end of the week. In order to keep a check on the quality of the landline transmission from 2AC, a 400 meter receiver was rigged up at Altrincham. The "control operator" was equipped with a pair of phones which he could connect at will either to KDKA direct or else to KDKA via 2AC and thus he could immediately detect any transmission or line faults.

A portion of the receiving station is shown in the accompanying photograph. The frame



THE NINE BRITISH BROADCASTING STATIONS are connected by land line to the central London station

antenna is seen in the foreground. Behind, to the left, is seen the control and announcing table and the low frequency amplifiers. Immediately behind the frame antenna is seen one of the receiving sets.

During the period of approximately one week the Metropolitan-Vickers Company succeeded in relaying the Westinghouse transmissions for an aggregate time of 18 hours. In two or three cases relaying commenced about 11.30 Greenwich Time, but the best results were undoubtedly obtained between the hour of 4 A. M. and 7 A. M. as had been anticipated from previous results. In fact one or two of these early morning transmissions were almost perfect in their reproduction—nearly as good as a first hand broadcast transmission.

ARLINGTON SIGNALS TWICE RETRANSMITTED

DURING the week a complete American program was successfully relayed right from the first item by the Westinghouse Band at 11:20 P. M. up to the relaying of the Arlington time signals at 3:00 A.M. The relaying of the Arlington time signals was in itself something of a novelty, since it reached the ears of British listeners through no less than three stages of transmission. The signals, which are the American equivalent of the famous Paris time signals, were transmitted from Arlington on a wavelength of 2650 meters at 10:00 P.M. New York time. They were picked up by the Westinghouse Company at Pittsburgh, 200 miles distant, and sent over the Atlantic to Manchester on the 100 meter wavelength, who received them and transmitted them for the third time on their 400 meter wave at 3:00 A. M. Greenwich Time. (Greenwich time is 5 hours later than that in New York).

Anxious to obtain all possible information and experimental data concerning the relaying, the Metropolitan-Vickers Company asked for reports, and got them. They were numbered first by hundreds and then in four figures. With scarcely an exception, they were all complimentary, most of them enthusiastically so. Many of these reports came from the Continent, some of them from as far off as Switzerland and even Italy. When it is considered that the power input at 2AC is somewhere about half the average power of a British Broadcasting Company station and that the actual relaying of KDKA was clearly heard at these distances, the results of the experiments were very gratifying. It has been possible to reply by post to only a very small percentage of the reports received, and the Metropolitan-Vickers and Westinghouse companies would like to take this opportunity of recording their thanks to all those listeners who have been good enough to send in their reports and comments.

A few details of the ordinary broadcasting activities of the Westinghouse Company may be interesting. In November, 1920, they opened the pioneer broadcasting station of the world, KDKA, at East Pittsburgh. The first transmitter was of comparatively low power—100 watts were delivered to the antenna. This was increased by stages to its present value of 1000 antenna-watts, corresponding to

a D. C. input of four or five kilowatts. The main studio at KDKA is situated half a mile from the transmitting station. There are also two other studios in the city, 14 miles distant, all of which are elaborately equipped. Land-line transmissions are an important feature; there are 45 permanent landlines covering an area of 225 square miles. These take in every church, theatre, public hall, and auditorium of any pretensions in the Pittsburgh section.

SOME CONCLUSIONS ABOUT SHORT WAVE BROADCASTING

IN CONCLUSION it is interesting to compare the results obtained with this 100 meter experimental transmission with those which might be expected with the ordinary 300-500 meter American broadcasting. As indicated earlier in this article it proved possible to relay the 100 meter signals for 18 hours during little

more than a week, whereas in all probability sufficiently good reception of the 300-500 meter signals for relaying purposes would not be obtained for more than 2 or 3 hours per week. Thus it may be claimed that these experiments with the Westinghouse Company have increased the chances of American relaying probably about ten times. Also they have rendered it practicable to start such relaying at about 11:00 P.M. during the winter months, as compared with the impossible hour (for most people) of 1:00 or 2:00 o'clock in the morning.

Of course perfection is not nearly reached, but some of the greatest difficulties which existed have been largely overcome, and with further developments the relaying of intelligence and entertainment from America may in the fairly near future become a matter of everyday fact.



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THE HOTEL SAVOY BAND

—a well known dance orchestra from a well known London hotel, whose excellent programs have been broadcast for the special benefit of American listeners from 2 LO and the other eight BBC stations