IN RADIO—*The Signal Must Be Good*

MUCH pioneer work in the propagation of directional radio waves and in the transmission of programmes in foreign languages has been done by the General Electric Company of New York. The following article, which is the text of a talk given by Boyd W. Bullock, Assistant Manager of Broadcasting, gives some indication of the work that has been done by this company in an endeavour to further the science of radio for peaceful purposes.

ONE of the vital considerations in international shortwave broadcasting—without question the most fundamental—is the problem of providing the intended foreign audience with a signal which is sufficiently good to enable consistent and satisfactory reception of programmes.

A good signal, of course, is of primary importance in the regular broadcast band at home—but when operating in the shortwave, or high-frequency, portion of the radio spectrum—over great distances—the problem is more complex.

In the first place, radio waves exhibit the characteristic of jumping off into space from the transmitting antenna and not returning to earth until considerable distance has been traversed. This behaviour becomes more pronounced and the effective distance greater as the frequency is increased, until, in the shortwave broadcast regions, "skip distance," as it is called, becomes a very important factor.

If "skip distance" for a given frequency remained constant, the problem of picking a frequency to reach a given area would be relatively simple. But "skip distance" varies widely for a given frequency—being affected by daylight and darkness, by the seasons, by such remote phenomena as sunspots, and by the direction (geographical bearing) of the line between transmitter and receiver.

All these seemingly unrelated factors resolve themselves into one basic influence, and that is the ionisation of the atmosphere, the degree of which is governed by the amount and quality of sun radiation through the atmosphere. Thus do daylight and darkness, the seasons, and sunspots enter the problem. Also direction of propagation of the radio waves—for, travelling east and west, they may traverse both daylight and darkness, while on a north-south circuit, they may move entirely in either day or night. All other directions involve varying conditions between these extremes. The general situation is that daylight decreases skip distance—and therefore effective range.

A frequency such as 15,330 k.c. (19 metre band) is good for broadcasting service to South America from Schenectady, N.Y., in the daytime—afternoon especially—but is not very suitable after dark. At night, frequencies in the 9000 k.c. (31 metre band) are much more effective. In the morning, the 21,000 k.c. (13 metre band) is best.

Moreover, the portions of the day during which the above frequencies are most suitable vary with the seasons of the year, since with the changing seasons, not only do the hours of sunrise and sunset change, but also the angle at which sunlight passes through the atmosphere. Even these fairly predictable variations occurring with the seasons have been upset somewhat, in the last several years, and the deviation ascribed to the influence of coincident sunspot phenomena.

The foregoing, with the exception of the local technical problems connected with the transmitter, are the natural physical conditions encountered by the broadcaster who is desirous of providing a good international shortwave signal on a consistent, year round basis. At the same time, he is up against another problem—also fixed by the laws of Nature—but a problem only because there are many other stations, at home and abroad, who utilise the shortwave and send their signals out into the same atmosphere.

Allocations

RADIO waves recognise no international boundaries, so in order to prevent utter confusion, the matter of allocation and register of frequencies is an organised international function handled by the International Radio Convention at Berne, Switzerland. This does not mean that broadcasters deal direct with the Berne Convention. In the United States, such matters are the province of the Federal Communications Commission. Broadcasters—and all other radio enterprises—must apply to the F.C.C. for frequency assignment and licensing. But the F.C.C. can assign only those frequencies made available to the U.S., and must register such assignments at Berne.

Both the Convention at Berne and the F.C.C. maintain engineering sections which continually study the complex and changing problem of frequency (and power) assignments—the purpose being to permit as many stations as possible to operate within the relatively limited bounds of the radio spectrum, without undue interference with each other. This is no arbitrary matter, but one fixed by the laws of Nature—so man is obliged to conform or spite his own face if he fails to heed.

Many stations, of course, may be assigned the same frequency, but in such a case it has been deemed that geographical separation and limited power (and perhaps restrictions on the hours of operation) are sufficient to prevent interference and confusion harmful to the services of the individual stations.

In numerous instances, such happy lack of interference has failed to result. In these cases, the authorities attempt to rearrange assignments to correct the trouble. Nearly everyone is familiar with cases of station interference in the "regular" broadcast band, and, if he has been sufficiently interested, can recall that certain steps were taken to prevent this interference. It is not always possible, with so many stations clamouring for their place in the ether, to completely solve the interference problem.

From the fact that the higher frequencies—those falling within the so-called shortwave region (1600 k.c. and up) and particularly those above 4000 k.c.—exhibit remarkable distance-covering ability, it is apparent that the problem of interference prevention becomes world-wide in scope.

Power Increase

SO much for a generalisation of the difficulties which must be overcome in providing foreign listeners with the necessary good shortwave signal. The experiences of one broadcaster who has been furnishing consistent shortwave transmissions to Latin America for thirteen years will provide specific illustration.

In February and September of 1925, W2XAF and W2XAD were first licensed to the General Electric Company as experimental shortwave broadcast stations. Ever since that time, both stations have transmitted programmes for the benefit of listeners in other countries. During this period, their schedules have grown heavier, and more and more programme features have been presented which were specifically designed for particular foreign audiences—especially our Latin-American neighbours.

In 1928, the assigned frequency of W2XAF was raised slightly to 9530 k.c., its present frequency. In 1929, W2XAD was dropped from 15,340 k.c. to 15,330 k.c. and at the latter figure its frequency has remained.

Both changes were required by the Federal Radio Commission (antecedent of the Federal Communications Commission) in order to conform with international agreements.

During recent years, W2XAF has operated with a power output of 25 kilowatts, while about a year ago, W2XAD went to 20 kilowatts from its previous 10.

By means of direct listener response and through such agencies as the offices of the International General Electric Company located in the foreign countries, a continuous and reliable check on programme reception has been possible. This study of reception has not only given data on signal strength and quality but has also provided information on the types of programme liked by the foreign audiences. Particularly have these studies been concerned with signal and programme for Latin-America.

Interference

UNTIL the latter part of 1936, the broadcasting from W2XAF and W2XAD brought constant evidence of strong, consistently received signals in Central and South America. Then reports began to come in of interference by a growing number of other shortwave broadcast stations. Some of these were local Latin-American stations, while others were European. The most consistently complained of was DJN, a station in Berlin, Germany, operating on 9540 k.c.—10 k.c. higher than W2XAF.

The nature of this interference was "side-band" interference—a form of trouble which occurs when two powerful signals are received which, although they may be working 10 k.c. apart on adjacent channels, still become mixed. This effect occurs because the modulating or voice frequency which is superimposed on the carrier frequency tends to widen out the carrier by an amount plus and minus the modulating frequency. Technically, a modulated carrier wave can be resolved into three component frequencies—one the fundamental carrier frequency, one this fundamental minus the modulating frequency, and the third the fundamental plus the modulating frequency.

It can be seen readily that when modulating frequencies go above 5000 cycles (5 k.c.), carriers separated by only 10 k.c. will cross up. Modern high-fidelity modulation involves frequencies at least as high as 8 or 9 k.c.

Then what could be done to reduce the new interference and restore the consistent programme reception which many letters from South America begged for?

Because of the difference in direction, DJN could cover South America effectively by using a narrow beam—only 15 degrees wide. Right away, the DJN signal was powerful, because most of its energy appeared to be crowded into this narrow beam.

As for the broadcasts from Schenectady, a much wider beam had to be used to properly spread out and cover the South American continent—with corresponding loss in signal strength even though higher power might be used in the antenna.

(To be continued.)

TWO hundred students of the New York University recently gathered before fifteen television receivers on the sixty-second floor of the R.C.A. Building, Radio City, to watch a demonstration given by their professor in the television studio fifty-nine floors below them. This marks the first occasion upon which television has been used as a medium of instruction in America.

N.Z. DX Club Representatives

Northland: R. A. Roycroft, 2H.Q., 21 Anzac Road, Whangarei.
Auckland: F. Newing, 316A., 59 Bannerman Road, Morningside, Mount Albert, Auckland, S.W.1.
Waikato: W. Norris, 620A., Christopher St., Tauranga.
Poverty Bay: A. Towers, 148 H.B., 409 Ormond Road, Gisborne.
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West Australia: H. Stephens, 100., c/o Railway Station, Katanning.
England: L. Orton, 14O., Kingsthorpe, Willowbank, Uxbridge.
United States: Irving H. Levy, 91O., Box 13, Cherokee Station, Louisville, Kentucky.

N.Z. DX Club Meetings

HAWKE'S BAY.
In the Club Room, above Wood's Tearooms, Waipukurau, at 7.45 p.m. on Wednesday, January 11.
V. L. KING (119H.B.), Branch Secretary.

NORTHLAND.
At 21 Anzac Road, Whangarei, at 7.30 p.m. on Monday, January 16.
R. A. ROYCROFT (2H.Q.), Branch Secretary.

AUCKLAND.
In the Society of Arts Hall, Kitchener Street at 8 p.m., on Wednesday, January 11.
F. NEWING (316A.), Branch Secretary.

WELLINGTON.
In the Club Rooms of the 1st Wellington City Rover Crew, 3rd floor "Times" Building, Kelburn Avenue, at 8 p.m. on Monday, January 9.
H. WICKENS (503W.), Branch Secretary.

WAIKATO.
In Hamilton on Saturday, January 14, 1939.
W. NORRIS (620A.), Branch Secretary.