

FADING

(Continued from page 1.)

WAVE INTERFERENCE.

In order to picture the process, let the reader refer to Fig. 3, where the two paths are represented. Let us suppose, to make the calculation easy, that the wavelength is 500 metres and the distance between the two stations

angle of the downcoming rays not constant.

The most obvious explanation of fading would be to ascribe it to the frequency-variation of the transmitter, but a little thought will show that it would be a poor station indeed which would be unstable by a full metre. An alternative theory, and one which has met with wide acceptance, is that rapid

Heavyside. The galvanometer deflections are in opposite directions. This result is one of particular interest to radio fans; especially since it indicates a possible solution of the fading problem.

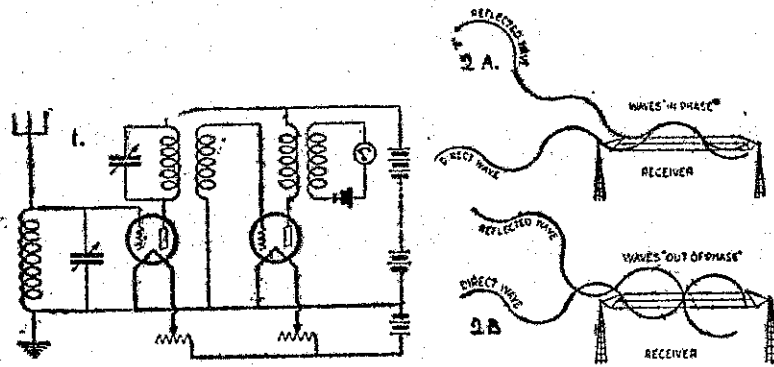
A COMBINATION ANTENNA.

It is not too well known that a combination of loop and aerial provides a simple means of eliminating signals

radiation. Nevertheless, there is no question but that it should be tried.

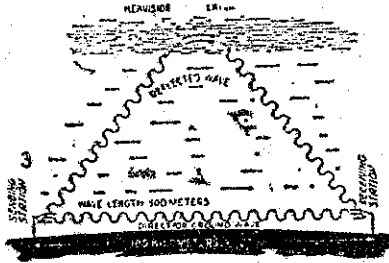
Dr. Appleton's researches have thrown considerable light on the causes, nature, and elimination of fading. His results are verified by experiments conducted over relatively short distances, not exceeding a few hundred miles; and it is uncertain whether or not the fading of a very distant station is to

at times. At 11.45 p.m. an orchestral (?) item was heard. This was similar to the Chinese orchestra heard from 2YA a few weeks ago. This is probably a Japanese station, perhaps JIPP, Tokio; it works on 85 metres. I could not get any call while listening; they were still on the air when I closed down at 11.50 p.m. Does anyone know this one? "An Japanese" was repeated at intervals on Thursday morning while listening to this stranger. At 7.30 a.m.

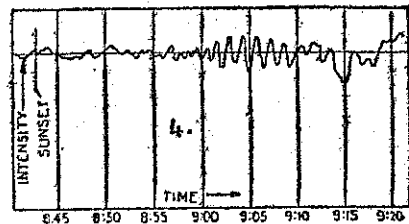


This diagram illustrates the circuit used by Dr. Appleton to measure the fading of signal strength.

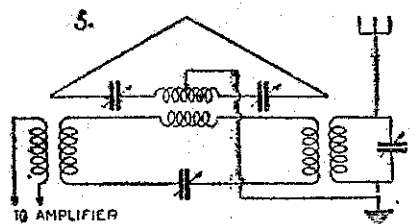
If the ground and the reflected waves reach the receiver's antenna in phase (fig. 2A), reception will be good, but if they arrive out of phase (as in fig. 2B), reception will be greatly lessened.



This diagram shows how a radio wave breaks up into a ground wave and a reflected wave, and the path each travels.



This curve illustrates the variations in the intensity of radio signals after sunset. The fading becomes more marked.



Combined Loop Aerial System for elimination of signals from one direction.

100 kilometres (100,000 metres); there will be, then, 200 waves in the direct path. If the reflected wave traverses exactly twice the distance, the two waves will be "in phase"; i.e., vibrating similarly at the receiver, as pictured in Fig. 2A. Since the crests of the waves coincide, the two waves will assist each other and the reception will be good.

Suppose, now, that the radio-station's wavelength is changed from 500 to 498.75 metres. It is easily calculated that we will have 200.5 instead of 200 direct waves, and 401 instead of 400 indirect waves. The extra half-wave changes conditions, as shown in Fig. 2B. The waves will arrive, "out of phase," vibrating in opposite directions, and tend to annul each other. If the wavelength be further decreased, we have another maximum of intensity, and so on.

Professor Appleton arranged with a broadcast station that its wavelength should be systematically and regularly varied through a small range, say, ten metres, in the period of half a minute. The coils used on the receiver were specially wound with high-resistance wire, so that broad, flat tuning was obtained. The results showed definitely the maxima and minima predicted by theory and further enabled the eminent investigator to place the height of the Heavyside layer at about 50 miles. He obtained also some results which indicated the presence of some triple-reflected rays. He also found that the

variations in the height of the Heavyside layer are the cause of fading. It will be shown later, however, that this view is untenable.

RECEPTION AT SUNRISE.

The effect of daylight was extremely well shown. The observations were taken respectively at 3.51, 4.47, and 5.12 a.m., and illustrated the type of fading at the transition period, from dawn to sunlight. The wavelength of the transmitter (375 metres) was gradually increased by ten. During this stage the intensity of the signal varied periodically, and the changes were exactly duplicated as the wavelength returned to its original value. Sunrise occurred at 4.04 a.m., and with it came an increase in atmospheric ionisation, a lowering of the Heavyside layer to a height of 30 miles or so, and a consequent "attenuation" (thinning out) of the reflected ray. The fading was less at this time.

It has been urged by some that the reflected ray, instead of being deviated vertically, as in Heavyside's theory, has suffered horizontal deflection instead. Appleton has shown that if the first theory be true, fading should be stronger on a vertical line than on a loop antenna; while, if the second be correct, the reverse should be the case. In an investigation of the question, he finds evidence decidedly in favour of

from one direction. The sensitivity of reception of the ordinary antenna is shown at the left, that of the loop in the centre, and their combination at the right. In a curve known as the cardioid. Employing a special device, Dr. Appleton found it possible to eliminate the ground ray entirely and study the indirect ray by itself.

The results appear quite conclusive. They show, primarily, that the intensity of the reflected ray is by no means constant; and that its variation is definitely allied with fading. This is direct evidence against the view that fading may be attributed either to the variation of the station's wavelength or to fluctuations in the height of the Heavyside layer. We must, instead, postulate varying absorption of the indirect wave as the cause of the intensity change.

During the course of the investigation it was determined that the reflectivity of the ionised layer is small—from 0.2 to 6 per cent.—hence it is easy to see how a small change here will produce a marked effect in the receiver. Dr. Appleton has shown that about 100,000 electrons per cubic centimetre must exist in the Heavyside layer to account for the observations. During the winter and during the night, when the ionising power of sunlight is at a minimum, the reflecting region becomes higher and more attenuated, and, while longer distance reception is possible, fading is more marked than in daylight hours or in summer.

Dr. Appleton has conducted some experiments with a view to eliminating fading. While he has attained considerable success, he feels that the system will not completely do away with this trouble. Briefly, he reasons thus: Since fading is shown to be due mainly to fluctuation in the intensity of the atmospheric ray, it should be possible, by eliminating this, to receive a fairly steady ground signal, even in the night-time.

"WOBBLING" OF THE REFLECTED WAVE.

He uses the same type of antenna system employed to suppress the ground ray, and finds, on the whole, signal reception much steadier. He ascribes his failure in obtaining complete success to the variation of the angle of incidence of the indirect wave, as mentioned before; i.e., while he may be able to stop a ray received at a constant angle, it is impossible to do this when the inclination of the ray is rapidly and irregularly changing.

Since the suppressed-atmospheric-ray system described above will not receive rays striking the ground in a given direction, it is also incapable of radiating waves in the same direction. If this type of antenna be used at the transmitting station, to eliminate the indirect ray at its origin, it may be possible to reduce or completely get rid of fading; but Dr. Appleton, in the absence of experimental evidence, is somewhat sceptical regarding the probable success of such a scheme, owing to the lack of symmetry of the

be attributed to the same causes. We shall look forward expectantly to seeing more of the brilliant results which are being obtained by this eminent investigator.

SHORT-WAVE WORK

MR. SELLENS HEARS NEW STATION.

I recently received a card from Mr. W. R. Coxon, the owner and operator of the short-wave station OA6AG, Perth, says Mr. Sellars (Northland). He gives his wave-length as 92.9 metres, power about 200 watts. He is now testing at 6.30 p.m., W.A. time, almost every night for a short time. 6WF, of the same city, according to latest advice, is now broadcasting their evening programme each evening, from 8 o'clock, on 164.5 metres.

On Saturday morning, December 10, ANE were giving a programme of music. Volume was very loud, but modulation could be improved. 2XAD and KDKA were heard in the afternoon, and RFN in the evening, giving some very good musical items. KDKA signed off on Sunday at 4.13 p.m., after transmitting items by the Boys' Radio Band, vocal and orchestral. 2XAF relayed a programme of music from the Waldorf Hotel, New York City, and signed off at 12.3 a.m. E.S.T. Both stations were heard on the speaker, but not as strong as at times. 4AE, Gore, 3AP, Ashburton, RFN, Russia, and 2AQ, Taihape, were also heard during the afternoon and evening. The latter station was very loud, clear, and steady.

On Monday morning at 7 a.m. 2ME gave their call and stated they were "going over" to 3LO, Melbourne. All announcements after this were given as 3LO, Melbourne, testing. Gramophone items were given and were heard very well. They stated that until further notice they would be testing each Sunday from 18.30 till 20.30, Greenwich mean time (7 a.m.-9 a.m., Monday morning, N.Z. time), on 32 metres. RFN was the only station heard during the evening on short waves.

NEW FOREIGN STATION.

On Tuesday morning from 6.28 o'clock till 7.30 o'clock a new foreign station was heard on about 31.5 metres at very fair volume, but decreasing as the time advanced. Several times I heard what sounded like "Allo! Allo! Allo! An Japanese. Sometimes after a slight pause, "An Japanese." There was not any music while I was listening, but just talk. Does any reader know who this is?

At 7.30 a.m. 3SW, Chelmsford, was heard testing. Speech was only just audible—sounded like a lecture first. A pianoforte item followed, which was a little better. RFN, 2AC, New South Wales, and ANE giving some good musical items, were heard during the evening.

The station "An Japanese" (?) was heard again on Wednesday morning till 7.40 o'clock. The last words spoken were "An Japanese." During the evening 2HM, New South Wales, and 7CW were heard. About 11 p.m. I came across another strange foreign station on about 35 metres. A man's voice was heard talking very rapidly and loud, with a woman saying a few words

the carrier of 5SW was heard, but not strong enough to get a speech or music. 2WW, New South Wales, and RFN were heard during the evening.

Friday morning found still another strange foreign station on about 42 metres. Broken English was spoken, but on account of Morse interference could not understand much. Some Greenwich mean times were given, and good night was said at 6.23 a.m., but the call was not heard. It must be well to the west of New Zealand to be saying good night when it is 6.23 a.m. here.

5SW was again too weak to hear more than their carrier. Not so many stations as usual, but three new unidentified ones.

THIS WEEK'S REPORT.

I have tried for 5SW, Chelmsford, recently, at 7.30 a.m., but this appears to be the end of the period of which it is audible here. The carrier can be heard, but only at times has any sign of speech or music been there.

A few weeks ago, when PCJJ was transmitting bi-weekly, they were often speaker strength up till about 7 a.m., after which the volume would go off very rapidly till 7.30, when signals were usually very weak. The special Christmas programme from England, to be heard here at 3.45 a.m. on Christmas morning, should be received well.

On Saturday, 17th instant, I was home too late for the American station, but heard PCLL, Holland, giving a good musical programme. They called Band-oeng (Java) during the time I was listening. 1AM, Palmerston South, and RFN were heard. A station on about 37 metres was on the air, but modulation was too rough to get the call.

2XAF were heard relaying dance music from the Rainbow Room of the Ynkton Hotel, New York, till 12.2 a.m. E.S.T. 1.30 p.m. on Sunday here. They were not as loud as usual 2AY and 2AT Wellington, 2AQ Taihape, and 7CW Hobart were testing. On Monday morning at 7 a.m., 3LO Melbourne, testing on 32 metres, put on some gramophone records. These were received very well. Their modulation is excellent. ANE, Java, was on the air early on Tuesday morning at good volume, and very steady. RFN was going in the evening. On account of being out on Monday and Tuesday evenings till late I was only listening for a few minutes.

CHELMSFORD AGAIN.

Wednesday morning 5SW, Chelmsford, went on the air about 7.30 a.m., and were a little stronger than some mornings. A man was talking till 7.50, this being followed by music, but all too weak to understand a word. During the evening 2AT Wellington, 2AB Wanganui, 1AR Auckland, 7CW Hobart, 2LG Goulburn, N.S.W., were logged.

The new stations reported last week have not been heard since. I have not been able to spare quite as much time as usual for listening, but hope to get plenty of DX during the holidays.

From broadcast station KFRC, San Francisco, every Tuesday evening at 8.30 a pianist plays modern and old-time numbers and listeners are asked to guess their names. The fan who correctly identifies the greatest number of thirty-six tunes played over the period of the contest is given a silver cup as a prize.



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