

## Heaviside Layer Theory

Research by Professor E. V. Appleton.

IT is announced that Professor E. V. Appleton, F.R.S., has been awarded the Morris Liebmann memorial prize for 1929 by the American Institute of Radio Engineers, for making the most important contribution to radio science during the last twelve months.

Professor Appleton occupies the chair of Physics at King's College, and has for the last five years been associated with the Radio Research Board in investigating the nature of the Heaviside Layer and its effect on long-distance transmission.

In the early days of wireless it was thought that signal waves could not travel freely through the ether except in a straight line. Other scientists held that, for some peculiar reason, the speed of propagation increased considerably as the waves travelled upwards, with the result that they were automatically bent downwards again towards the earth's surface.

### The Bending Effect.

IT is now definitely known that they are prevented from escaping into interstellar space by the action of the so-called Heaviside Layer, which is an area where the rarefied atmosphere is strongly ionized.

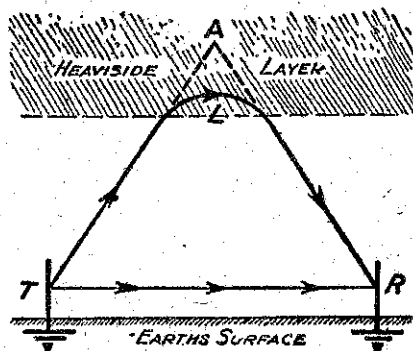
An ionized gas, containing a large proportion of free electrons, acts upon the waves in the same way as a metallic conductor. In other words it presents an almost impenetrable barrier in the outward direction, at the same time it reflects the waves back to the earth, more or less as a mirror reflects light.

The reaction of the ionized layer to the impact of a wireless wave may be briefly explained as follows: Owing to the extreme tenuity of the air in these regions, the free path of the active electrons is comparatively long. In fact, it

may extend over many alternations of the electric force of the field of radiation, i.e., of the wireless wave.

Such electrons will therefore be vibrated or oscillated by the incoming wave, without any loss or dissipation of energy, thus acting to retransmit the waves back in the direction of least resistance, i.e., downwards towards the earth.

According to our authority the action of free electrons should be regarded as one tending to increase the velocity



Illustrating Heaviside Layer Theory.

city of the upper part of the wave as it enters the Heaviside Layer, relatively to the lower part of the wave. This results in bending the whole wave forward, until it changes direction and emerges downwards, in much the same way as a ray of light is refracted or bent when passing from one medium to another of different density.

Whether the process is actually one of reflection or refraction is of little consequence. We know by observation that the result is to throw back the wave to earth, and so prevent its escape into outer space.

Professor Appleton has devoted considerable time and ingenuity to the problem of measuring the effective height of the Heaviside Layer above ground.

### Experiments with 6 BM.

One method that has been successfully applied depends upon an interference effect which occurs between the upper or space wave and the lower or earth-bound wave, owing to the different distances traversed by the two.

Suppose, for instance, that station T is transmitting to a receiver at R. The earth-bound or direct wave from T to R obviously travels a shorter distance than the space wave T L R received after reflection from the Heaviside Layer.

For a given working wave-length the difference between the lengths of the two paths may correspond to a certain number of complete waves, so that both arrive at the receiver in phase.

In actual practice this is seldom the case. There is usually a fraction of a wavelength over, and this gives rise to out-of-phase conditions at the receiver. Sometimes the two waves add together and sometimes they oppose each other, with the result that the signals fade periodically. Now if the working wavelength is deliberately and periodically varied between an upper and lower limit of frequency at the transmitter T, a "beat" effect is produced in the receiver R which depends solely upon (a) the difference between the two wave-length limits used, and (b) the difference in distance between the path of the space wave and that of the earth-bound wave.

The "beat" frequency can be ascertained by direct observations, whilst the difference between the two wave-lengths transmitted is known, as is the distance T R, i.e., the direct path of the earth-bound wave. By equating these known factors the length of the path T L R is first calculated, and the height of the Heaviside Layer is then determined by a simple process of triangulation.

### Day and Night Altitudes.

A series of experiments on these lines has been carried out between the Bournemouth B.B.C. Station and a receiver at Oxford, corresponding to a distance T R between transmitter and receiver of approximately 160 kilometres.

It was found that the difference between the two wave-paths T R and T L R amounted to 80 kilometres at night, corresponding to a height above ground of 85 kilometres for the Heaviside Layer. During the daytime, owing to the ionizing effect of the sun's rays, the layer expands downwards until it reaches a level of between forty and fifty kilometres above the earth's surface.

## Auckland Notes

THERE is universal satisfaction over this week's announcement in the "Record" that Auckland is to have a dinner music session from Tuesday next. Many of the more fortunate among us, who possess sets of the requisite power, have enjoyed regularly the 6 to 7 p.m. session supplied by 2YA, and we shall continue to do so, but on Monday nights only, when our own station is silent. On other evening meal times 1YA will provide in

thousands of homes that "atmosphere" at dinner which can be created only by that music which can only be supplied by a broadcasting station, with the best recorded music of the world at its disposal. The dinner music session at 1YA marks another distinctive progression in broadcasting service in the north, and the effect of its inauguration will soon be observed by increases of licenses, and more particularly by a marked growth of radio trade.

Using a couple of sets of headphones, a family can quite comfortably enjoy an evening programme, but the idea of sitting down to the evening meal with the 'phones over the ears is in itself so humorous that the effect of the new music session can at once be forecast. There will result a big demand for sets, large or small, which will operate loudspeakers, for the speaker is daily becoming a more and more urgent requirement. On the local market there are now several cheap efficient models of electric receivers, specially designed for local reception, and trade in these should be decidedly brisk.

One wonders, too, to what extent the dinner music session will be used in restaurants and hotel dining rooms. In even our most expensive hotels mechanical music has now replaced the two or three instrument "orchestras" of former years. Broadcasting, at the present juncture, will not replace this gramophone music, but it may well supplement it, and set a standard of dinner music which can be followed by the hotel instrument after 7 p.m. or when 1YA is not on the air.

### OVERTIME for 1YA once more on

Monday night. "Wrestling" was in progress, strenuous "wrestling," and listeners enjoyed the accounts of it quite as much as they marvelled at the pandemonium which broke loose in the hall and rattled many a speaker with its intensity.

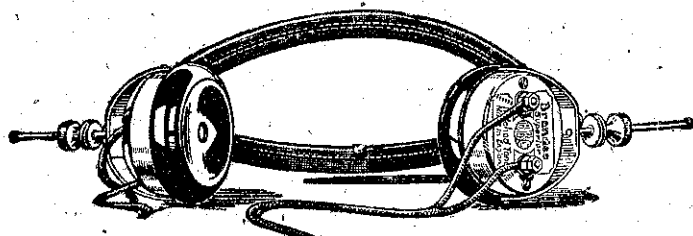
IT is a long time since we have had anything more enjoyable than the first section of "La Traviata," so ably introduced and so splendidly broadcast from records on Tuesday evening. On the following day quite a number of music lovers whom the writer met were most enthusiastic over their enjoyment of the preceding night's reception, and expressed the hope that such features in the programme would be provided regularly.

THOSE local listeners who complain of the fading here of 2YA should have been listening in to the Masterton relay of the Ranfurly Shield game between Wairarapa and Canterbury. Reception was absolutely perfect on the writer's set, and not a syllable of the excellent description was missed from the time 2YA changed from records to an account of the game already in progress. Both the announcer who detailed the game and the officials at the station are to be congratulated upon a most meritorious performance. Our brother and sister listeners in Canterbury must also have had a treat.

THE writer has heard no more regarding the proposal for an Auckland radio exhibition, but understands that the scheme is still "in the air." What we want is the scheme "On the air," and we hope to get it there, too.

# Brandes

The Name to know in Radio



Made in England

Price 15/-

OBTAINABLE FROM ALL RADIO DEALERS or  
INTERNATIONAL RADIO Co. Ltd., Ford Bldgs., Wellington