B.B.C. Engineer Summarises Knowledge on Fading

By Capt. P. P. Eckersley, Chief Engineer, British Broadcasting Co., in "The Wireless World."

With the keen interest that is at present being taken in the problem of fading, the following explanations of observed phenomena, by a wireless engineer, who by virtue of his duties is faced with difficulties attributable to this cause, should prove of great help to the experimenter who is endeavouring to investigate the subject.

THE phenomenon of "fading" has been known to wireless engineers for some time, but the advent of broadcasting has brought the subject into great prominence.

There may be those so fortunately situated in relation to one of the broadcasting stations who have never experienced fading, so, at the risk of redundancy, I will try and explain first what I mean by the term.

You are listening to a station 150 miles away when all at once the signals go dead weak. You fly to the reaction handle, but everything you do has no effect, when suddenly without warning the sounds burst out again. The number of people who have conscientiously soldered, tightened and tuned, and scratched a bewildered head, must be legion, as the number who write in, having satisfied themselves that **their** end is all right, and complain of the variability of the transmissions, is certainly considerable.

As a matter of fact, the transmissions by the British Broadcasting Co. are **not** variable, and, except where light and shade are desirable in musical items, radiation and modulation are maintained sensibly constant.

The cause of the variability lies, therefore, between the transmitting station and the receiving station.

THE question is, then, what is there to influence the attenuation of the waves so markedly and so variably? Why in certain places does London fade while other stations do not? Why is fading only noticeable at night, and why should night time signals be stronger than day time signals in certain places, and not in other places? Why should 2LO only be audible a quarter of an hour after sunset in Salamanca, Spain, and why should the Shetlands get us pretty uniformly, while people in the Victoria district (no! London, not B.C.) experience fading effects which are never noticed, say, in Hampstead? The answer is easy as far as I am concerned, and it simply is, **I don't know!**

BUT a general theory exists which I will give you, and which probably forms a basis on which to build the explanations of minor variabilities.

Firstly, in spite of all we have heard about the freedom of the air, wireless waves travel through the aether, which is the postulated medium for the transmission of all electro-magnetic waves. This medium is not in any sense of the word matter, in as much as matter is ponderable and can be analysed, weighed, felt and experienced by the human senses, as it were. The aether is perfectly non-conducting to electricity, and to our senses it is nothing. But floating about in the aether are minute particles which in various permutations and combinations form matter—air, water, earth, and so on. Now, if matter is conductive to electricity, it impedes the progress of electro-magnetic waves travelling through the aether which holds matter. Thus, if the air which is suspended in the all-pervading aether is conductive, it impedes wireless waves. It may come as a surprise to many to know that air can be conductive; it is not usually necessary to suspend the filament terminals of your set in a vacuum, but air **can** become quite conductive, and especially does it become so under the influence of sunlight. What happens is that the little particles called molecules in the air are made lively by the sunlight and split up into electrified units, which make possible the conduction of electricity.

Thus there may be drawn a rough sketch of the world with the sun shining full on one side, leaving the other in shadow. On the sunny side there occur electrified particles. On the dark or night side these particles recombine near the earth, while many others rise up to a height and are all huddled up together to form a sort of electrified layer, some 20 or 30 miles above the earth's surface. Daylight diffuses the layer which at night time forms above the earth. The layer was first postulated by Heaviside, and is often known as the "Heaviside Layer."

Near the sunrise or sunset region the diffusion is very great, owing to the sunlight being oblique to the air, and gradually towards the night side the air is cleared of particles, while towards the light side uniform diffusion sets in.

Now see what happens between two stations A and B on the night side. Some of the waves go direct, but many of the waves from A to B hit the layer and are reflected from it. The reflected waves are added to the direct rays, and therefore, as the reflective qualities of the layer vary, so the strength of the signal at B varies. It is as though the layer were a great mirror, and that, as it turns and changes and moves uneasily in its sleep, so the signal is reflected more or less, and so fading occurs.

If this theory is true, certain things could be proved as follows experimentally:—

(1) There should be no fading in the day time, but the signal should be uniformly weaker. This is **generally** true.

(2) There should be evidence of rays considerably inclined to the vertical. In direction-finding work the general principle of determining in the directing of the incident waves is to use a frame, the angle of the vertical plane of which can be varied. When the frame is at right angles to the oncoming waves no signals are heard, but this can only be so if the waves are arriving horizontally; any vertical component will affect the frame equally in any position, and no minimum will be found. This actually happens because a simple frame at night gives no reliable bearings due to the presence of the vertical component.

(3) Using a frame which combines so largely the direct and the vertical ray distortion should occur with speech. This is noticeable more with a frame than with a vertical aerial.

(4) Fading should be more noticeable at great distances from the transmitter than near to.

(5) Fading should be more noticeable over land than over sea, owing to the greater attenuation of the direct ray. This has been noticed.

FURTHER than this it is impossible to go, because obviously the whole phenomenon depends so largely upon casual happenings. Undoubtedly, though many of the freak ranges are influenced by casual electrifications forming giant reflectors just in front of the sunset, the extraordinary difference between the power required to drive a signal across the sunset or sunrise band, to that required when this electrified band is removed, is evidence of the justness of the theory, and many of the problems of East and West transmissions are bound up with the same idea.

Local fading (I mentioned that people were getting fading at Victoria, London, from 2LO) is due to something quite different. Perhaps the telephone service or the electric light mains are influencing factors.

ELECTRICAL LEAKAGES

TROUBLE IN AUSTRALIA

Action taken by officers of the Commonwealth Postmaster-General's department a few days ago to overcome interference caused by an electric current leak from one of the Tramways Board's power mains directs attention to a source of wireless interference to which, so far, much too little attention has been given (says the Melbourne "Argus"). Although concrete cases of such information are seldom proved, it is generally accepted that power leaks cause a large portion of interference experienced in large cities. When they occur, listeners usually blame either the broadcasting station for poor transmission or neighbouring amateur stations for causing interference, without realising that the real source of trouble is in their own electric tramway or lighting service, and perhaps in their own homes. It is surprising how wide the range of some interference from electrical devices extends.

IN recent experiments with supersensitive short-wave receivers, on wavelengths of about 20 metres, it has been found almost impossible to work while motor-buses and cars are running in the neighbourhood, the electrical waves set up by the ignition equipment being sufficiently strong to operate the sensitive receiving apparatus. Such interference is seldom if ever heard on an ordinary broadcast receiver, but interference from electric fans and other apparatus using electric motors, old-fashioned electric arc lights, battery chargers of the vibrating reed type, and violet ray machines is often so severe that it prevents reception.

A COMMON cause of trouble, and one usually difficult to detect, is a faulty contact between the socket prongs and the base of an electric lamp, or the socket contacts and ping of a radiator or electric iron. If such a fault exists an intermittent electric arc is set up at the point, and while this arc is burning it generally radiates powerful interfering waves. Proof of this can be had by turning off an electric light in the house. As the switch opens a momentary arc is caused, and a sharp click will be heard in the loudspeaker. The worst electrical interference I have ever heard occurs near the electric tram lines in Bendigo. Owing apparently to dirt on the rails, marked sparking occurs at the wheels of the trams in that city, and the resulting interference waves are so powerful that reception becomes impossible when a tram is in the neighbourhood.

WHICH is right—"cat's whisker" or a cat whisker"? A bunch of beginners (college boys) dilated on this argument recently. It was put to the vote, and "cat's whisker" was carried with one dissentient, who, though in a hopeless minority, was correct.

ANTARCTIC YARNS FOR RADIO KIDDIES

Many years ago (1902) a sturdy little bark nosed its way out of the East India Docks, London, and sped its way Southward Ho! bound for Lyttelton, New Zealand. It was the "Morning," Captain R. Scott's relief ship on her way to give aid to the "Discovery," which had sailed from the same dock a year previous. On board her was Mr. A. N. Pepper, then a young midshipman. At a future date the children of New Zealand will, through 2YA, hear all about her travels and all about that vast continent, South Victoria Land, its bird and animal life, and all the life of a South Polar Expedition. Mr. A. Pepper will give a series of "yarns" to the radio kiddies and tell them all about this wonderful dependency of New Zealand.