This is due to the fact that the field intensity is not only a function of the distance but also of the slope of the reflectrix at the point of reflexion and of the angles of departure i and of incidence i' on the ionosphere. In other words, the received field intensity depends on the frequency and on the height and ionization gradient of the reflecting layer.

It can be shown¹ that the power density received at ground-level on a plane surface normal to the wave-path considered is given by:

$$d_n = - \frac{P \operatorname{tg} i}{4\pi R^2 [\sin D/R] \times \frac{\operatorname{tg} \beta (\operatorname{tg} i - \operatorname{tg} i')}{\operatorname{tg} i (\operatorname{tg} i' + \operatorname{tg} \beta)}}$$

P being the total radiated power by the point-like isotropic radiator, R the radius of the earth and β the slope of the reflectrix in degrees.

Unabsorbed received field intensity can be computed in the same way for a multi-hop path. It is found that, in the case of a perfectly reflecting ground, when the reflectrix is almost parallel to the ground the energy may be received by an infinite number of paths and the field intensity may be almost double that due to a single hop mode.

We have represented in Fig. 2 the two paths followed by the waves to reach a point beyond the skip distance when $f' > f_c$. These waves reaching the receiver being out of phase, one can expect maxima and minima of the received field along the great circle passing through the transmitter and the receiver. It can be shown that these maxima and minima are quite close to each other near the skip zone limit and tend to be more and more distant from each other with increasing distance from the transmitter. Received field intensity is represented as a function of distance from the transmitter in Fig. 3.

This seems to indicate that even a slight alteration of the ionization or height of the reflecting layer is able to cause a serious fading at a point not too distant from the skip zone.

¹ Note préliminaire, Laboratoire National de Radioélectricité, No. 121 (October 1948).

'M-Mode' Propagation Possibilities

By D. LEPECHINSKY

Bureau Ionosphérique Français

THE E -layer ionization depending almost exactly on the sun's angle of elevation, the usual E -2,000-MUF (maximum usable frequency) charts are formed of contours of equal frequency surrounding the subsolar point (see Fig. 4).

Let us consider a radio communication great-circle path between points A and B . At the hour corresponding to the position of the path AB shown in Fig. 4, the ion density of the E -layer is a maximum near the middle of the path and decreases towards its ends. In these circumstances, a wave of a sufficiently high frequency leaving the transmitter A at oblique incidence penetrates the E -layer at a , is reflected by the F_2 -layer at a' , then comes down on the E -layer at M , but being unable to penetrate it there because of the higher ion density of the E -layer at this point, is reflected back to the F_2 -layer, which reflects it down again at b' . The wave then penetrates the E -layer at b , where the ion density is almost the same as at a , and reaches finally the receiver B . This mode of propagation is called a two-hop

' M -mode'. Multi-hop M -modes over-ride the E -layer in a similar way.

The chief advantage of these modes is the low attenuation suffered by the wave that follows them.

One can expect ' M -modes' to be particularly effective on long-distance transmission paths entirely situated in daylight, when normal field intensity at the receiver is low because of severe attenuation of normal multi-hop communication due to ground reflexion losses and to high absorption in the D -region, which has to be traversed several times by the wave before it reaches the receiver.

A practical method of prediction of the rather narrow frequency band normally propagated by the ' M -modes' and of the corresponding rather short intervals of time can easily be devised. A set of auxiliary curves permits the rapid location, on the great circle path joining the transmitter to the receiver, of both D -region penetration points and of the intermediate 'upper' reflexion points on the E -layer. A simple method of computation of the received field intensity and thus of the gain due to the ' M -modes' is also easily devised. Predictions of ' M -mode' propagation are now worked out by the Bureau Ionosphérique Français¹.

Outstandingly good reception obtained regularly in March 1949 at about 7.00 a.m. (G.M.T.) on about 19 Mc./s. between Saigon and Tananariff (Madagascar) and in May 1949 at about 6.00 a.m. (G.M.T.) on about 14 Mc./s. between Paris and Numea (New Caledonia), seem to be in close agreement with ' M -mode' predictions by this method for these transmissions.

Focusing effects and ' M -mode' propagation thus appear to have an important influence on the field intensity at the receiver, and it is felt that it is no longer permissible to neglect them in prediction work.

¹ Note préliminaire, Laboratoire National de Radioélectricité, No. 130 (May 1949).

AGE-GROUPING OF TSETSE-FLIES AS AN AID IN THE STUDY OF THEIR BIONOMICS

By F. A. SQUIRE

Department of Agriculture, Sierra Leone

THE following observations on *Glossina palpalis* R-D were made in Sierra Leone at Njala on the River Taia about 8° 5' N. and 12° 5' W. during the period July 1948-June 1949. Some five thousand flies were collected and examined. As it was not possible in the circumstances to adopt Jackson's¹ more elaborate method, a simplified system of age-grouping was devised. The catches were classified into three age-groups according to wing tear and colour: AG1 smoky wings; AG2 wings turning tawny; AG3 wings tawny and frayed. Monthly summaries were made and the percentage of flies in each age-group calculated; the ratio male/female (R) was recorded separately for each age-group; the total number of flies per man-hour (H) estimated; and the number of unmated females (V) was noted and expressed as a percentage of the females in AG1. The results are summed up in the accompanying table and graph.

Considering first the percentage of flies in AG1, it will be seen that emergence must continue fairly