It may be stated that there is now available an oral preparation which in suitable dosage consistently augments penicillin levels. The compound helps to conserve the consumption of penicillin where massive daily dosages are required, the economic implications of which are obvious. More important, some patients have difficulty in maintaining adequate blood levels despite intensive penicillin dosage. Ordinarily, following the administration of intravenous penicillin, it is not unreasonable to expect and obtain 0.1 Oxford unit/ml. of blood for every 100,000 units of penicillin administered (*12, 14*). It is not always possible to maintain this ratio in a given patient. With the conjoint use of enhancing agents such as caronamide, not only can the expected blood values for a given intravenous dose of penicillin be obtained, but multiples of these anticipated values can, in point of fact, be achieved (Table 1, Case No. 6). This can mean the difference between success and failure in the treatment of the refractory case of subacute bacterial endocarditis.

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Experimental Determination of the Gyrofrequency

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The basic magneto-ionic theory of wave propagation in the ionosphere in the presence of the earth's magnetic field, as developed by Appleton (*1*) and by Appleton and Builder (*2*), was confirmed to an approximation in the lower latitudes some years ago. More recently extensive ionospheric observations in high latitudes have become available for the first time. Pronounced peculiarities in character of radio wave components returned at vertical incidence from the ionosphere in high latitudes have stimulated testing of the basic theory in terms of this new experimental information. For example, Scott and Davies (*4*) have described multiple magneto-ionic refraction of the wave energy into three or more components in a high geographic latitude. The three major components described by them indicate that both the longitudinal and transverse modes of wave propagation predicted by the theory occur simultaneously in certain high geomagnetic latitudes.

Through the courtesy of the College Geophysical Observatory, University of Alaska, some 800 selected ionospheric records from that station have been studied. In each record chosen it has been possible to determine independently the penetration frequency of wave components corresponding to: (a) the longitudinal ordinary ray, (b) the transverse ordinary ray, and (c) the extraordinary rays for both longitudinal and transverse modes of propagation. In addition, height of maximum electron density for the ionospheric layer under study has been determined.

The purpose of this note is to describe the experimental evidence, to review appropriate aspects of the magneto-ionic theory, and to discuss peculiarities disclosed in an attempt to reconcile theory and experiment.

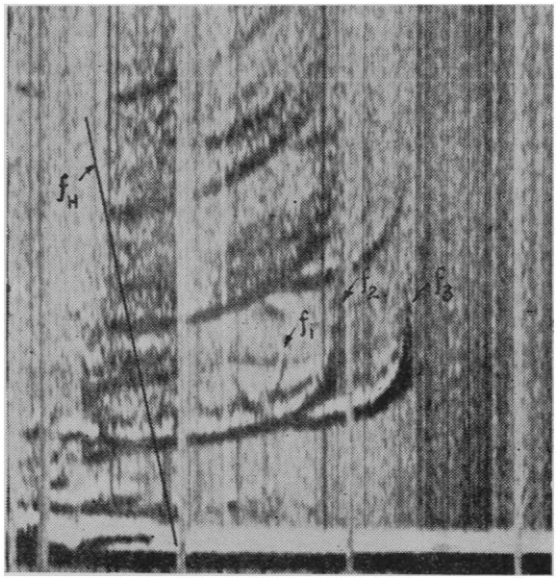

Fig. 1. Typical illustration of longitudinal and transverse modes of propagation occurring at the same time.

Consider Fig. 1, which is a typical ionospheric record taken at the University of Alaska. Ordinates are virtual height, increasing upward. Abscissas are wave frequency, increasing to the right. Penetration frequencies as noted in the figure are as follows: f_1, the longitudinal ordinary ray; f_2, the transverse ordinary ray; f_3, the extraordinary rays; and f_H, the calculated gyrofrequency for electrons in the earth's magnetic field. Experimentally, numerical values of f_1, f_2, and f_3 were determined from each record, as well as the height of maximum electron density, after the technique of Booker and Seaton (*3*).

The magneto ionic theory predicts, to a first approximation, that the relationship between wave components returned at vertical incidence from the ionosphere is as follows:

(a) For transverse mode of propagation—

$$(f_3 - f_2) = \frac{f_3 f_H}{(f_3 + f_2)} \qquad (1)$$

(b) For longitudinal mode of propagation—

$$(f_3 - f_1) = f_H \qquad (2)$$

The experimentally determined values were first examined in

terms of the change in precession-frequency with height for transverse mode of propagation in the sporadic E-layer. Fig. 2 gives precession-frequency as a function of height. Each

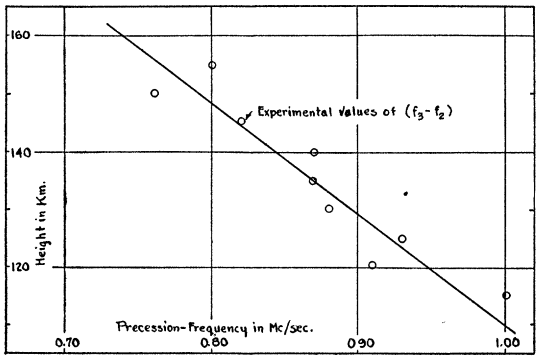

FIG. 2. Precession-frequency in the sporadic E-layer for transverse propagation, College, Alaska.

point of the diagram is the mean value of approximately 20 independent measurements. Clearly, the precession-frequency falls rapidly with increase in height, over the height range available experimentally.

Next, values of f_H were calculated for the transverse mode of propagation from experimental values of f_3 and f_2 for the

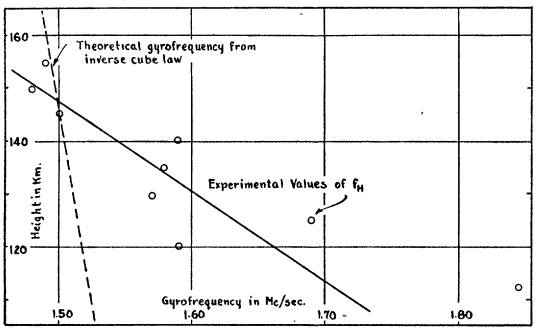

FIG. 3. Experimental values of gyrofrequency determined in the sporadic E-layer for transverse propagation, College, Alaska.

sporadic E-layer. In Fig. 3 these values of f_H are given as a function of height. The dotted line to the left in the figure is the theoretical value of gyrofrequency to be expected if the earth's magnetic field decreases inversely as the cube of the distance. Again, each point is the mean value of approximately 20 independent observations.

Evidently over the range of height involved the experimental values of gyrofrequency do not agree with theoretically expected values. That the slopes of the experimental and theoretical curves do not coincide is interesting. Since the magneticians have suggested that variations in the earth's magnetic field may be explained on the basis of a sheet of current flowing in a region of the atmosphere below a height of 100 km., the question may well be raised as to whether or not the observed departures of experimental from calculated values of f_H may be the result of induced magnetic field from such a current flow.

In order to examine the relationship between calculated and experimentally determined values of gyrofrequency over a more extended height range, Fig. 4 is presented. Each point in the diagram is the mean value of approximately 40 independent determinations. Generally speaking, the agreement between values of f_H determined by means of the longitudinal mode of propagation and those found theoretically is quite good except

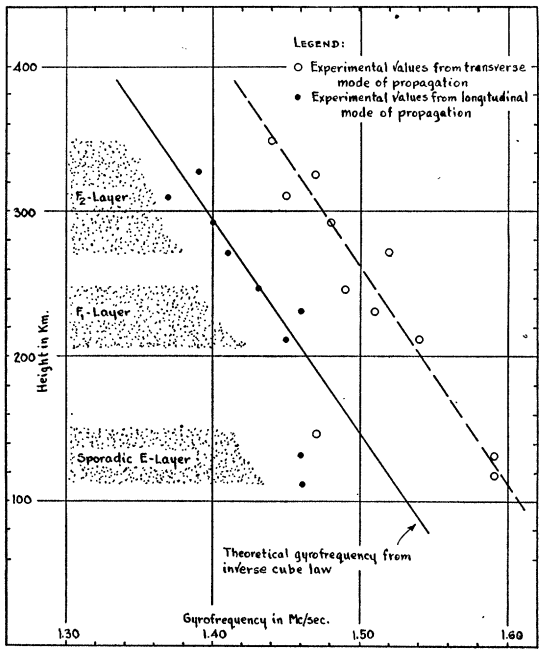

FIG. 4. Mean values of gyrofrequency determined experimentally at College, Alaska.

over the height range in the vicinity of the E-layer. Upon the basis of such agreement it can be said that the magneto-ionic theory for longitudinal mode of propagation is substantially confirmed.

However, the experimental values of f_H determined from the transverse mode of propagation lie consistently to higher values by about 0.08 Mc/second. While this difference is small, it appears to be real. Just why this constant difference exists between values of f_H determined experimentally from longitudinal and transverse modes of propagation is not clear. Perhaps the simplifications employed by Appleton and by Appleton and Builder in interpretation of the theory are responsible for this lack of correspondence. Some differential effect, possibly associated with the treatment of collisional friction, may be responsible for the discrepancy. Until an adequate explanation is decided upon it cannot be said that the magneto-ionic theory is in agreement with experimental results in high geomagnetic latitudes for the transverse mode of propagation.

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