A Comparison of Meteor Activity with Occurrence of Sporadic E Reflections

V. C. Pineo

National Bureau of Standards, Washington, D. C.

In a previous paper (*3*), the writer presented evidence to show that the character of the echo obtained from a trail of ionization produced by a meteor is different in character from the echoes frequently obtained on ionosphere recorders and described as sporadic E reflections. Since the presentation of that paper a statistical study has been carried out on the frequency of reflections obtained with the meteor equipment in operation by the Central Radio Propagation Laboratory of the National Bureau of Standards, and the frequency of occurrence of sporadic E reflections observed over the same interval with the automatic multifrequency ionosphere recorder operated by the laboratory.

By sporadic E, also sometimes called abnormal E, is meant what Lovell (*2*) referred to as long duration abnormalities in the E region as distinguished from what Appleton and Naismith (*1*) referred to as ionization bursts. In the scaling of sporadic E data from the vertical incidence ionosphere records, extreme care was taken to see that only reflections of the sporadic E type were scaled.

Evidence of a statistical nature has been found by some investigations which tends to show that meteors are responsible for sporadic E reflections (*1, 2*). These findings are not in general confirmed by the result of the present investigation.

The equipment used in this study consists of the Bureau's regular meteor equipment and the regular C2 automatic multifrequency ionosphere recorder.

The meteor-detection equipment comprises a transmitter emitting pulses at 27.2 megacycles per sec of approximately 50-μsec duration at a rate of 60 pulses/sec, a suitable receiver, and an automatic echo recorder employing a recording milliammeter. The equipment is fully automatic and capable of unattended operation. The maximum available peak-power output from the transmitter is approximately 16 kw at full plate voltage. For automatic operation the power is reduced; all the meteor data discussed in this report were obtained with approximately 8-kw output. The receiver-recorder sensitivity is adjusted to record any echo of 5 μv or more at the receiver input terminals. Circuits are included which afford some discrimination against noise and continuous wave interference. The transmitting and receiving antennas are identical half-wave dipoles one quarter-wave aboveground.

The meteor equipment was operated continuously over the period November 1, 1948, to April 30, 1949, inclusive, except for a few intervals when power or equipment failures occurred. Sometimes the recording was partially obscured by strong interference. In such cases, those echoes occurring during the clean portion of the record were counted to establish the hourly rate. The greatest interference was encountered during the day

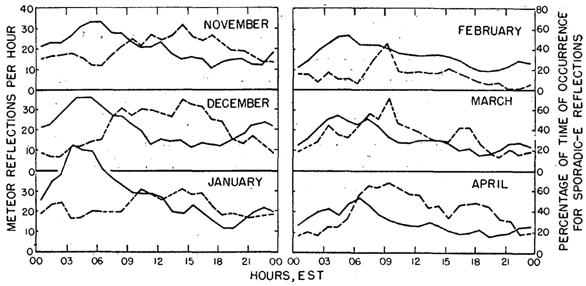

Fig. 1. Hourly rate of meteor reflections at 27.2 megacycles (solid line) and percentage of time of occurrence of sporadic E reflections (broken line) 1948–1949.

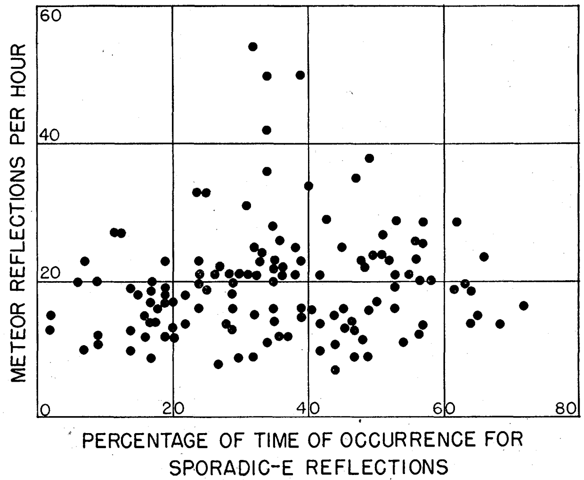

Fig. 2. Comparison of rates of meteor reflections at 27.2 megacycles and sporadic E reflections for single days, November 1, 1948–April 30, 1949.

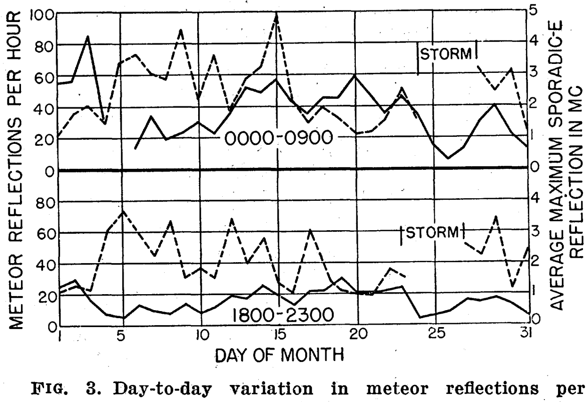

Fig. 3. Day-to-day variation in meteor reflections per hour (solid line) and average maximum radiofrequency at which sporadic E reflections were observed (broken line), January 1949.

and was due largely to other activities in progress at the observing site. During such times visual observations of a cathode-ray tube were made to supplement the automatic record. Every effort was made to keep the sensitivity of the equipment constant. The receiver-recorder sensitivity and transmitter power were checked and entered in the log book on a regular schedule. The data include a total of over 62,000 meteor reflections.

The ionosphere recording equipment comprises a transmitter emitting pulses of approximately the same characteristics of duration, repetition frequency, and peak power as those from the meteor equipment; a receiver; and a camera recorder. The antenna is a modified rhombus oriented so that the main lobe is directed upward.

The ionosphere recorder operated automatically, obtaining records of the ionosphere layer heights and critical frequencies every 15 min. Few records were lost from failure of equipment or other causes. During the period of observation 16,700 ionospheric records were obtained.

Data from the two recording devices consist of (a) frequency of occurrence of reflections from meteor trails as indicated by the distinct and characteristic short duration echoes observable on an oscilloscope screen, and (b) the frequency of occurrence of reflections from E layer heights commonly interpreted as sporadic E reflections (E_s), as well as values of fE_s (maximum E_s reflection frequencies in megacycles) for each hour. The ionospheric records during the period were scaled independently of the reductions of the meteor data. The majority of the scalings of these ionospheric records were performed by an observer having no knowledge of the meteor data. Thus, as far as possible, effects of personal prejudice in the scaling of the records were eliminated. The results are presented in Figs. 1, 2, and 3.

Fig. 1 shows the diurnal variation of the frequency of occurrence of meteor reflections as compared with the percentage of time of occurrence of sporadic E reflections throughout the day. Average values are presented for each of the months in the period from November 1948 to April 1949. The meteor reflection rates exhibit characteristic maxima at about 0600 EST, while the E_s exhibits maxima around midday. It is possible that the E_s curves are biased by the diurnal variations of absorption. If so, the effect is to lower the occurrences during midday when absorption is at maximum. If corrections were to be applied to the curves to correct for this effect, they would result in increasing the midday maxima and could not bring the two sets of curves into better agreement. The absorption at the 27.2-megacycle frequency used for obtaining meteor reflections is, of course, very low and could not be expected to alter the curves noticeably.

A scatter diagram of percentage of time occurrence for E_s plotted against the meteor reflection rates is presented in Fig. 2. Lack of any appreciable correlation between the two quantities is evident. The data for January, which were the most continuous for any of the months under consideration, are plotted in Fig. 3 to show the day-to-day average broken down into dichotomous groupings from 0000 to 0900 hr and from 1800 to 2300 hr. In this case, the average value of E_s at any hour is used instead of the percentage of time occurrence. Lack of any similarity between these two curves is apparent. Interest attaches to the high hourly rate of meteor reflection in the morning hours during the first part of January—a result of the Quadrantid shower.

These data seem to warrant the conclusion that the frequency of occurrence of sporadic E reflections is unrelated to meteor phenomena, at least to those which can be detected at 27.2 megacycles. Of course, it may still be argued that sporadic E reflections are caused by meteors having such low energy or other characteristics that they escape detection by the radiofrequency used. This, of course, would require that the distribution of these hypothetical particles have a different frequency of occurrence from the distribution of those that are detectable. As far as is known there is no theoretical basis for such an assumption.

References

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Polymers from Chicle

W. Schlesinger and H. M. Leeper

Research Laboratory, Wm. Wrigley Jr. Company, Chicago

Two polymeric unsaturated hydrocarbons are found in plants—caoutchouc (rubber) and gutta (gutta-percha). Formally, both are considered to be derived from isoprene and are believed to differ in the spatial configurations of the carbon atoms around the double bonds (*1, 4, 5*), caoutchouc being the *cis-*, and gutta, the *trans-*configuration for chain continuation.

Recently, publications have appeared in which attempts to find both caoutchouc and gutta in material obtained from the same plant source were unsuccessful (*3, 6*). In one of these publications (*6*) chicle is reported to contain only the isomer corresponding to gutta.

Studies in this laboratory have indicated the existence of both types of hydrocarbon in commercial chicle. X-ray (*2*) and infrared absorption spectrum data[1] confirm the identification of the two polymers isolated with caoutchouc and gutta. Outlined here are methods used in this laboratory for separation of the two polymers.

Chicle used was the commercial product selected from lots believed to be as nearly as possible "pure," i.e., the product of a single species of tree. This chicle was melted, strained, and centrifuged in the molten state to remove bits of bark, stones, and similar impurities. The molten centrifuged chicle was cooled and allowed to stand at room temperature for about 1 week before benzene extraction.

For separation of the polymers, 1600 g of centrifuged chicle was treated with 2400 ml of thiophene-free benzene and allowed to stand for 24 hr at 30°–35° C with occasional shaking to insure complete dispersion. This mixture was then centrifuged to separate the transparent yellow-brown benzene solution from the insolubles. To the benzene solution was then added, with stirring, 4,800

[1] We are grateful to Baird Associates, Inc. for infrared absorption spectrum curves on these materials.