ON THE TYPES AND DISPERSIONS OF WHISTLERS AS OBSERVED IN CZECHOSLOVAKIA

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1. INTRODUCTION

According to the results published hitherto whistlers have not been observed below a geomagnetic latitude of 20°, which agrees with the basic Storey's theory [1]. Whistlers are commonly observed from this boundary up to a geomagnetic latitude of 65°. The observation of whistlers above this latitude has been regarded as exceptional [2, 3]. The region of common observation of whistlers can be divided into two parts according to the results of observations [4] — regions of low and high latitudes. The region of low latitudes is characterized by the fact that propagation occurs along one pronounced path; such whistlers are often produced by a tweek [5]. Long whistlers do not occur nor do echo trains or multiple whistlers. The dispersion values for short whistlers are 30 to 50 sec 1/2. Short whistlers at very low latitudes (around 20°) were found to be connected with the electron density in the F2-layer of the ionosphere [5]. In these latitudes the whistler propagation path lies for the most part in the F2 layer or relatively close above its

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Shorter Contributions

The dispersion actually decreases with decreasing critical frequency of the F2 layer and during the night there is a decrease of up to 50% in the dispersion. In the region of high latitudes both short and long whistlers and long echo trains occur, and the whistlers have rather a swishy sound, i.e. the path along which they propagate is not very pronounced or there is a number of paths differing from one another. The dispersion values for short whistlers are 40 to 100 sec\(^{1/2}\). Whistler-producing atmospherics are usually observed only before long whistlers. Multiple whistlers and nose whistlers can also be observed [6]. The individual components (individual traces — Fig. 6) of a multiple whistler are in a certain mutual time relation [11]. If the dispersion of the components is equal, it is assumed that the multiple whistler originated from a multiple lightning discharge and propagated over one path (Fig. 1a). If the dispersions of the components differ and if their values are not in the ratio of 1 : 3 : 5 : 7 ... or 2 : 4 : 6 : 8 ... as in the case of a whistler and its echoes, it is assumed that all the components of the whistler originated from a single lightning discharge and propagated over different paths. As seen in Fig. 1b, in this case the traces of the multiple whistler, projected on the time axis, must intersect in one point, i.e. at the time of the origin of the whistler-producing lightning discharge.

2. MEASURING PROGRAMME AND TECHNICAL DATA

In Czechoslovakia, observations of atmospheric whistlers were included only later into the IGY-programme of the Geophysical Institute CAS. First observations were carried out at the ionospheric station of the GI CAS in Průhonice \(\lambda = 14^\circ33'E, \varphi = 49^\circ59'N, \lambda = 97^\circ18', \varphi = 49^\circ54'\) at the end of 1957, and regular observations began in 1958. From March 1958 the observations were carried out regularly, according to the programme recommended, at two-minute intervals from the 5th and 35th minute of each hour. After September, 1958, the observations were extended to regular schedules from 20:35 to 20:45 UT according to a joint observational programme with stations in the GDR and GFR. In this extent, measurements were carried out up to the end of 1959 and the chief aim was to study the actual occurrence of whistlers. From this point of view, the observations were evaluated and published [7, 8, 9]. The receiver used had a frequency range of 500 Hz to 15 kHz and the input sensitivity was of the order of 1 \(\mu\)V. The antenna was a horizontal 70 m long wire, 10 m above the ground. Some of the observations were evaluated directly, but for the most part they were recorded on a tape recorder.

Up to now the sonagrams of samples of whistlers have been made from different times of the day from each month in 1959 and a part of 1958. Analysis has shown that many whistlers represent a type which occurred during a certain time interval, most frequently throughout the night, so that something can be said as regards the question of types here observed, the dispersions can be determined and our results compared with observations at other parts of the world, in particular with respect to the geomagnetic latitude of the place of observation.

3. RESULTS OF MEASUREMENTS

By its geomagnetic latitude, Průhonice belongs more to the region of higher latitudes and this is suggested by most of the types of whistlers hitherto found. Short whistlers, long whistlers with generating atmospheric and echo trains have been observed (Figs. 2, 3, 4)*). Multiple whistlers and whistler pairs are frequently observed, the sound of whistlers being in most cases swishy, while pure-toned whistlers (i.e. with a narrow trace on the sonagram) occur rarely. The largest number of echoes for both short and long whistlers is 6, while in high latitudes up to 20 echoes can be observed [11]. Polar creep [4, 10] was not observed. Another important phenomenon of higher magnetic latitudes, the nose whistler [6], was not observed in 1958 and 1959. This was due to the frequency range of the receiver, the upper limit of which was 15 kHz as recommended for the IGY. However, a nose frequency of 17 to 20 kHz can be assumed for the geomagnetic latitude

*) See Supplement p. 104a, b.