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Section 4. Whistlers and Related Phenomena

The direction finding technique has been currently used for the study of the propagation mechanism of low- and medium-latitude whistlers and also of the dynamics of the magnetospheric and ionospheric plasma. An analysis has been made for observations made with the goniometers at Kagoshima and Ohgata, and several useful results for daytime low-latitude whistlers; (1) Whistler azimuths are not confined to the magnetic meridian plane, being the manifestation of the overlapping of trapping cone for ducted propagation with the transmission cone. (2) Ducts are located in the high latitude region of the equatorial anomaly, but they lie widely in longitude at a specific latitude. (3) The L value of a group of ducts shifts towards a lower value, probably synchronous with the temporal movement of the anomaly. The drift can be explained by the westward electric field at the equator of the dynamo origin. The ducted propagation is also evidenced for nighttime whistlers. A more coordinated goniometer experiment at four stations was carried out in February, 1979, and we hope that we will be able to obtain the movement of ionospheric exit points of whistlers in latitude and in longitude. As for the medium-latitude whistlers, we have carried out a coordinated measurement for them at Moshiri. The measurement consisted of a new direction finding and a real time whistler analyzer, supplemented by the normal routine-based sampling observation. Analysis were made for daytime and nighttime whistlers. The characteristics of daytime whistlers (especially the distribution of exit points, the frequency dependence of exit points) are compared with our theoretical prediction on the characteristics for ducted and non-ducted pro-longitudinal mode propagation in the presence of the equatorial anomaly, and we have suggested a higher possibility of ducted propagation. The properties of nighttime whistlers are compared with the ray-tracing calculations in a typical nighttime model, and it is found that many characteristics can reasonably accounted for in terms of ducted propagation. An experiment to confirm these points and to get further information on the dynamics of the magnetospheric plasma will be done in Jan. and Feb. 1980. We have investigated the errors in the direction find-

ing of both types, goniometer and field-analysis-method.

The variation of the occurrence rate and dispersion of whistlers at Moshiri and Sakushima (Toyokawa) during the two solar cycle Nos. 19 and 20 has been studied. We have attempted to interpret the longitudinal difference in the daytime whistler activity at low latitude in terms of the source activity and propagation effect. The propagation characteristics of artificial VLF waves through the equatorial ionosphere have been studied by means of data obtained on board the FR-1 satellite at 750 km altitude over Latin America. Large latitudinal variations have been found in the vertical component of the wave normal, and they are interpreted in terms of the presence of the equatorial anomaly based on ray-tracing calculations. A study has been made on the deduction of L value of whistlers and electron density of the inner plasmasphere by using the nose whistlers ($f \leq 70$ kHz) observed at Moshiri.

A computer-aided analysis is carried out to deduce the natural radio noises whistlers and VLF/ELF emissions immersed in the artificial noises such as local noises and power-line harmonics.

The development of a new locating system for atmospheric sources within 200 km has been continued since the summer of 1978. After the test measurements on 48 MHz and 78 MHz, a frequency of 74 MHz was chosen for locating lightnings at short distances. And the horizontal and vertical field strengths on this frequency were measured to obtain the basic data for the design of VHF direction finder. A VHF direction finder was constructed and field-tested. The obtained data showed good agreements with the radar data.

The cooperative research program with Chulalongkorn University of Thailand was carried out from Sep. 27 to Oct.16, 1979. From this result, it may be concluded that it is possible to observe simultaneously the atmospheric between Thailand and Japan. Moreover, it is also found that the measurement of the propagation time difference between Bangkok and Toyokawa is a useful method for the atmospheric in South-East Asia which cannot be fixed exactly by the direction finding network of our Research Institute.

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