ACTIVITY REPORTS

Section 1. Propagation of Atmospherics and ELF Radio Noise

Research carried out by the first section can be divided into two groups at the moment; one is SAO's group which is chiefly concerned with research on the ELF atmospherics and the other is the VLF atmospherics group led by KAMADA. In order to carry out the research of ELF effectively, a prefab shown in photo 1 was built in March 1965 in the area of the Sand Dune Laboratory attached to Tottori University. Various kinds of observations have been started, or are now being arranged, in the hut. Photo 2 shows the apparatus installed inside it. Besides, a very large area amounting to 16 hectares in the Sand Dune was borrowed, and horizontal loop aerials, vertical rod aerials and induction coil (solenoid) aerials were recently built there so that useful observations can be carried out successfully.

U. S-Japan cooperative work on ELF electromagnetic phenomena, which has been discussed since 1965, has started this academic year. The first seminar was held on October 6-12 1966 at Gamagori, Aichi. Seven foreign workers attended there.

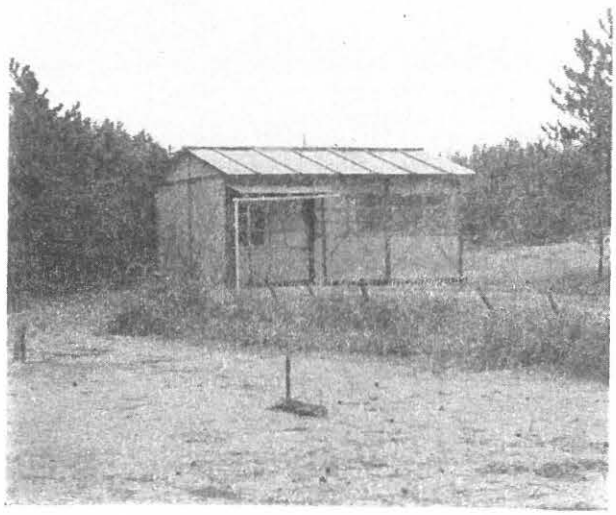


Photo. 1 Tottori Observatory

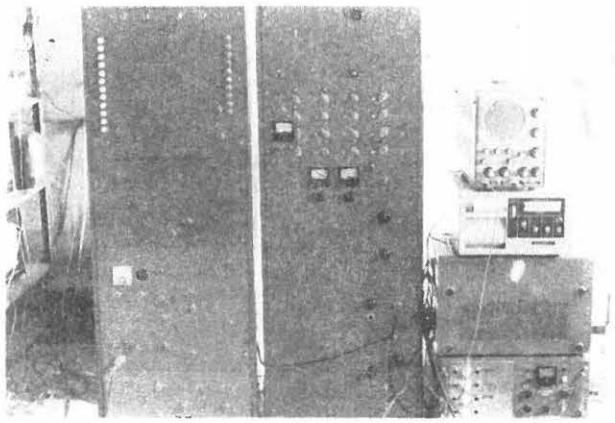


Photo. 2a Time signal generator and waveform recorder for ELF

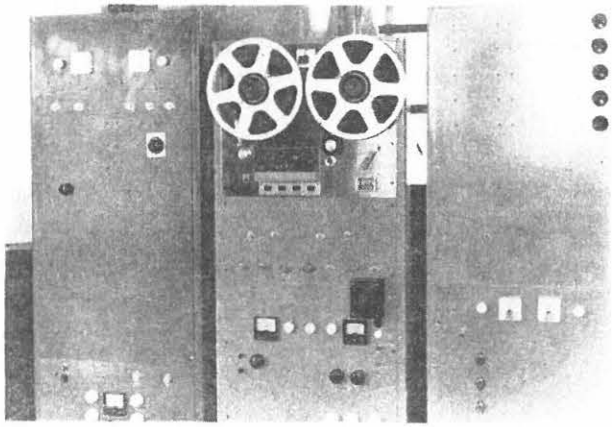


Photo. 2b Receivers for the measurement of integrated field intensity of atmospherics and waveform recorder for Schumann resonance

This conference was successful in discussing details of observations and measuring techniques for slow tails, Schumann resonances and geomagnetic micropulsations.

Concering cooperative observations of the slow tail and the Schumann resonance, it was decided that the first observations should be carried out on four days in February 1967. Papers dealing with the ionospheric reflection of ELF radio waves, taking into consideration the existence of the earth's magnetic field and the theory of radio wave propagation with an imposed magnetic field, were presented at this conference by SAO[1] and YAMASHITA[2] respectively. In order to promote our mutual understanding or methods of observation and measurement, Dr. W. L. TAYLOR and Professor C. POLK visited our Tottori Observatory after the conference. For

the same purpose, SAO visited United States of America from October 25 to December 3.

In regard to the various observations at our Tottori Observatory, the integrated field intensity at frequencies of 600, 260, 100, 30 and 8 c/s are being carried out continuously as before. However, the use of one solenoid aerial for all frequencies was suspended, and separate solenoid aerials for each frequency were built for the purpose of improving the sensitivity at their respective resonant frequencies. The 600 c/s channel is expected to be changed to 570 c/s, 600 c/s being the tenth harmonics of the power line frequency.

As for the resonant frequency of Schumann resonance, it is known that it shows a diurnal or seasonal variation about the normal mean frequency, so tentative observations of the integrated field intensity at frequencies of 7.4, 8 and 8.6 c/s, and 5.5-11 c/s have been started.

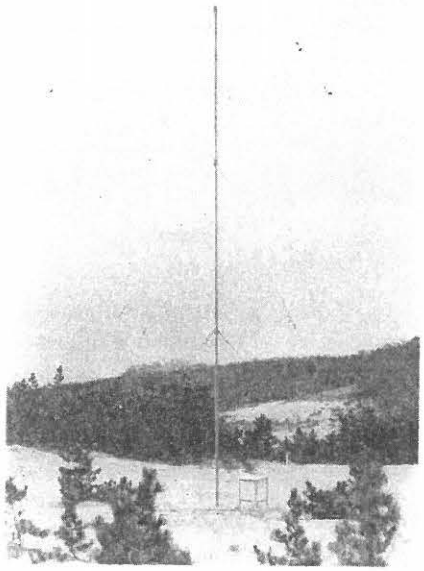


Photo. 3 15m vertical rod aerial

A 15 m vertical rod aerial (refer to photo 3) was built quite recently for the purpose of receiving the slow tail waveform, whose field strength is smaller than that of VLF atmospherics. At the same time, it was necessary to build a receiving apparatus with a higher sensitivity, because the attenuation in the wave propagation is great in the slow tail frequency band. The visigraph, which is a sort of direct recording electromagnetic oscillograph, is employed as a display system. This instrument is very useful in recording slow tail waveforms having rather rapid field changes.

Two horizontal loop aerials were buried under the ground. the large one having a total length of 700 m and 40 turns, the small one 300 m and 20 turns. The measurement, with these aerials, of the wave signal radiated from the magnetosphere is

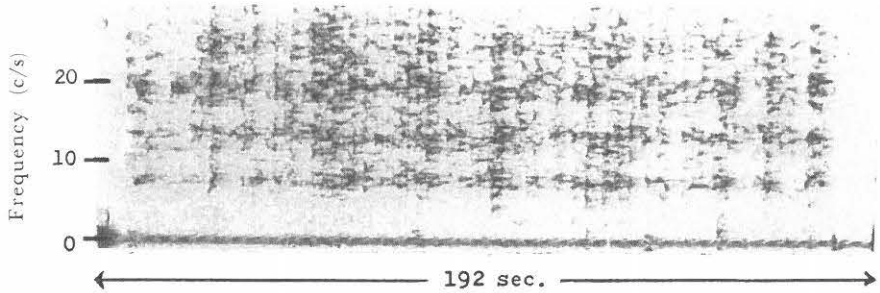
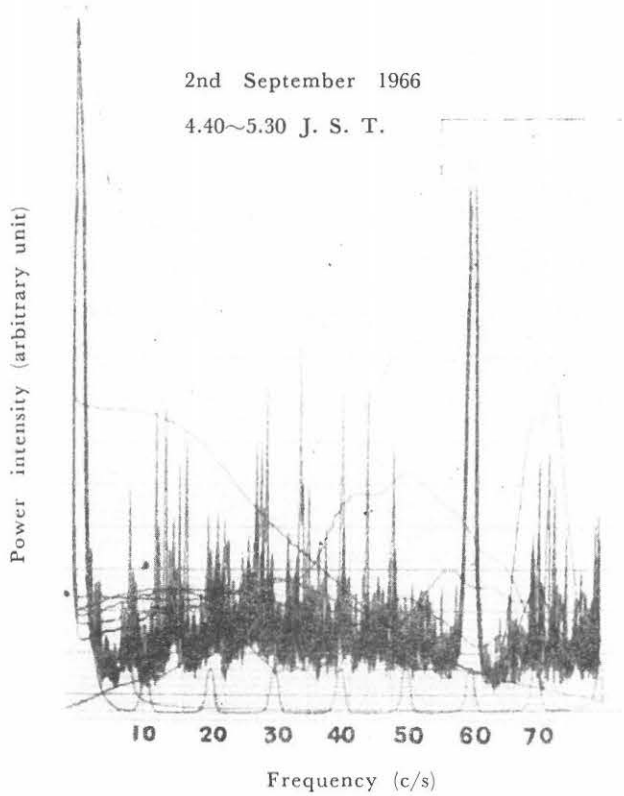


Fig. 1 Sonagram ($10^h\ 30^m$ J. S. T. 15th September, 1966).

planned. The sonagram in the Schumann resonance frequency band (refer to Fig.1) may give us some information as to the physics of the ionosphere and the magnetosphere. Interesting patterns can be found in Fig. 1 which was observed by horizontal loop aerial.



Flg. 2 Power frequency spectrum in the Schumann resonance range

Equipment which is available for the measurement of the quasi-power frequency spectrum was developed by JINDOH. It is necessary to measure the power frequency spectrum to discuss the frequency spectrum of the random noise. Thispower frequncy spectrum is obtained by sweeping the frequency continuously, so this may not be correct from the purely mathematical point of view. But it is thought that it gives some information of the power frequency spectrum of ELF atmospherics. Spectra in the Schumann resonance band and in the slow tail band are shown in Figs. 2 and 3, respectively. It is quite interesting that harmonics up to 4th order can be recognized in Fig. 2.

SAO investigated the effect of the solar activity on the electrostatic potential gradient at the earth's surface. In paticular, he analysed data relating to the potential

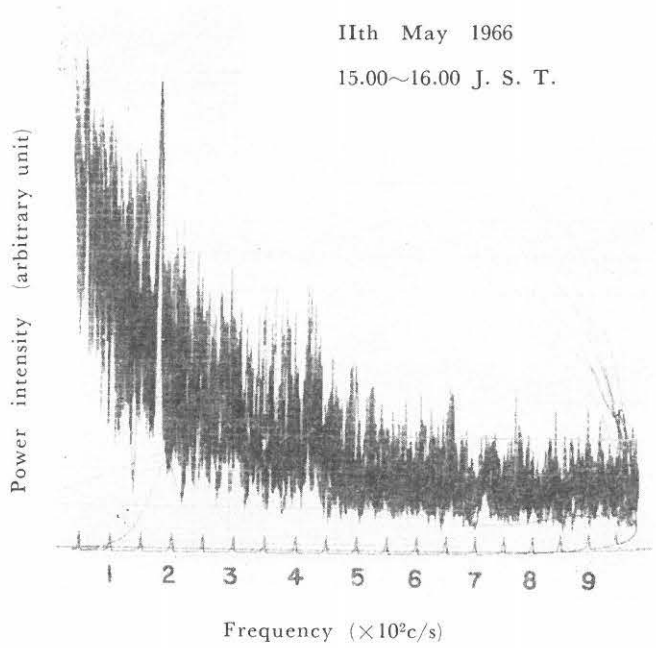


Fig. 3 Power Frequency Spectrum in the slow tail range

gradient in the Arctic region, and a close correlation between the solar activity and the potential gradient was found.[3] A similar correlation based on observations over a long time interval was previously reported by another worker, but this present analysis related to a shorter time scale.

The VLF atmospherics group is carrying out two routine observations. The one is the measurements of the integrated intensity of the components on 2, 4, 6, 10, 21 and 27 kc/s of VLF atmospherics and the other the amplitude-frequency spectrum of VLF atmospherics. These data are reported in the 'IQSY Data on Atmospherics, Whistlers, VLF Emissions and Solar Radio Emissions'.

The VLF atmospherics group is interested in the characteristics of the spectrum of VLF atmospherics propagated through the ionosphere; the study of the changes in cut-off frequency and the shift of spectral pattern during sunrise, sunset and the sudden ionospheric disturbances. These changes may be considered mainly due to the changes of the lower ionoshere, so that they are quite useful for the research of the lower ionosphere.

KAMADA took part in the 7th Japanese Antarctic Research Expedition from Nov. 1965 to Mar. 1966 and observed the latitude effects of the intensity of VLF atmospherics and the spectrum of atmosperics in the south polar region.

At the Kagoshima Space Center, University of Tokyo, his group is also carrying out the measurement of the natural radio noise in the ionosphere by using the

observing rocket. So far, we were successful to observe the spectrum of radio noise from 1 to 60 kc/s in the ionosphere to the altitude of 300 km. The data analysis is now being carried out.

— Kazuo SAO —

Publications (1966-1967)

(1) Sao, K. : Ionospheric Reflection Coefficient of the ELF Radio Waves, (in Japanese), J. I. E. C. E. of Japan (1967) (in press)

(2) Yamashita, M. : Propagation of ELF Radio Wave to Great Distances below the Anisotropic Ionosphere, J. A. T. P. (1967) (in press)

(3) Sao, K. : Correlation Between Solar Activity and the Atmospheric Potential Gradient at the Earth's Surface in the Polar Regions., J. A. T. P. (in press)

(4) Kamada, T. and Kurahashi, K. : Observation Results of VLF Noise Spectrum by K-9M-19 Rocket, this volume.