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Section 2. Source of Atmospheric and Atmospheric Electricity

The present study in this section aims at a comprehensive understanding of electrical aspects of the atmosphere from the ground surface up to the lower ionosphere, the range sometimes called the 'electrosphere'. The electrical state in the atmosphere is conditioned by ionization process, which involves, in addition to the violent electrical phenomena as occurring in thunderstorms, the actions of radioactive emanation from the earth crust in the lowermost part of the atmosphere and of cosmic or solar radiation in the upper part of it. On the other hand, the electrical state is closely related with the content of submicron aerosols that much diminish the concentration of small ions liable for the electrical conductivity of the air. These considerations were discussed in the activity report in the last issue, so the practical activities in 1972 are described in the following.

(1) In March 1972, Takagi and Toriyama came back from the four months cruise of the research vessel, Hakuho-Maru, Ocean Research Institute, University of Tokyo. During the cruise they measured atmospheric electric field, electrical conductivity, space charge density, concentration and equivalent size of condensation nuclei. The cruise extended across the Pacific Ocean to the coast of Chile, and gave a great deal of information on the ocean atmospheric electricity. The period from January 31 through February 22, 1972 was assigned for the Fourth Intensification Interval (X-4) of Atmospheric Electricity Ten Year Program by the International Commission on Atmospheric Electricity, IAMAP, IUGG, when Hakuho-Maru was cruising on the eastern Pacific. The electric field or the air-earth current was measured at many places over the world by using balloons, airplanes or vessels as well as on ground-based stations, and the coincidental data are being reduced and compared with each other, along with the results from the world-wide atmospheric network, to obtain the global nature of atmospheric electricity.

(2) Two large size balloons of 5,000 m³ capacity were launched at Sanriku Balloon Center, Institute of Space and Aeronautical Science, University of Tokyo, in June 1972. One is for the measurement of stratospheric electricity, and the electrical conductivity, densities of positive and negative small ions and rough mobility spectrum of them were observed. Another was equipped with a receiver for ELF atmospheric, the waveform of which was recorded without noises originating near the ground surface. The data analyses are now going on.

(3) From July to September 1972, Ishikawa and Iwata had stayed at Tübingen University, Weissenau, Germany under the International Cooperative Research

Program by the aid of Japan Society for the Promotion of Science. They compared the performances of electric field sondes of Japan and of Germany by simultaneous balloon flight of several times. This is a necessary procedure for the determination of absolute values of the ionospheric potential, and consequently for the investigation of its global distribution, from which we may conclude how the thunderstorm activity or the Sq current system in the ionosphere contributes to the global atmospheric electric current system, i. e. so-called global circuit.

During the visit to Europe, they attended the 17th URSI General Assembly held at Warsaw, then visited some of research institutes in Swiss, France and Poland, and discussed urgent problems on atmospheric electricity with many scientists.

(4) This year we have acquired a receiving set for 1680-MHz radio sonde. At the same time with some of balloon flights in Germany, we also released small balloons equipped with electric field sonde here in Toyokawa. This may rather have been significant as preparation for the coincident observations in both countries in the following two years.

The receiving set is a useful tool for in situ measurement to investigate the physical state of the stratosphere. It will be utilized in successive years for measuring, for example, conductivity, densities of ions and aerosols as well as electric field.

(5) During forty days in July and August 1972, thunderstorm observation was carried out at Imaichi Observatory as in the past years in cooperation with members in section 5. This summer we were interested in the origination of VLF atmospheric, and the waveform of atmospheric propagated to the distance 300 km was recorded at Sakushima Observatory coincidentally with the observation of thunderstorms occurring in Imaichi area. Thus the waveform of rather short range atmospheric is discussed in connection with the lightning discharge mechanism.

(6) In November 1972, Ishikawa attended CIAP (Climatic Impact Assessment Program) Conference held at Cambridge, Massachusetts, U. S. A., for discussing the effect of SST fleet flight expected in the near future. We have to learn the present aspects in the stratosphere and then estimate the future. The expected increase of aerosols, in which we are interested as relating to the electrical state, will be an important problem as well as the decrease of ozone content for man and biosphere.

(7) Continuous observation of atmospheric electrical parameters, such as electric field, air-earth current, electric conductivity, densities of small and large ions, density and size distribution of aerosols, and that of meteorological elements, such as velocity and direction of wind, temperature, dew point, pressure, rain, insolation, visibility and sky brightness, which were all started last year, are now fairly under way at Sakushima Observatory. Measurements of phase and intensity of Loran-C 100 KHz and of VLF station signals also get into smooth running in order to investigate the electric parameters in the lower ionosphere. A microwave link connecting Sakushima Observatory with the Institute in Toyokawa has been in operation since April 1972. The data obtained at Sakushima are sent to and processed at Toyokawa, by the aid of computer system as occasion demands. This kind of measurement is not only to

be resolved into basic relationships between elements from their complicated behavior, but also to be accumulated over long range in order to see the effect of the solar activity or the change associated with deterioration of the environment.

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— Masumi Takagi —

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- Takagi, M. and M. Kanada : Global Variation in the Atmospheric Electric Field. Pure and Applied Geophysics, **100**, 44-53 (1972).

