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AN APPEAL FOR AN AERO-PHYSICAL OBSERVATORY IN JAPAN.

By S. TETSU TAMURA, Ph. D. Dated Washington, D. C., March 9, 1906.

It is well known that the progress of meteorology has seemed very slow. Within the past century the world has seen electricity, chemistry, and other special branches of science emerge from their previous uncertain and indefinite condition, but dynamic meteorology is still wandering in fog and darkness. Thousands upon thousands of observations at the earth's surface have told us much, but still the fundamental mechanical problems have not yet been solved. Although the importance of the exploration of the upper atmosphere has been recognized ever since the days of Pascal, yet very little is known of this vast mysterious ocean of air. Meteorologists are now fully convinced that the atmospheric phenomena at the earth's surface depend, in great measure, upon the thermal and electrical as well as the dynamic conditions of the upper atmosphere. So long as this upper region remains unexplored meteorology will not only be unable to enter into the group of exact sciences but will fail to do its full service for the promotion of human welfare. Hence, a number of mountain observatories have been established in Europe and elsewhere and many balloon and kite ascensions have been made for sounding the depths of the upper atmosphere. The balloon ascensions of Gay Lussac and Biot in 1804, of Barral and Bixio in 1850, of Glaisher in 1862, and Berson in 1894 furnished many important facts relative to the physics of the atmosphere. Since this last date unmanned balloons, carrying only very light self-registering apparatus, have been brought to great perfection, and extreme heights of eleven or twelve miles have been reached that would otherwise have been inaccessible. By this mode of research Hermite, Besançon, and Teisserenc de Bort in France, and Assmann, Berson, and Hergesell in Germany, have done a great service to meteorology. Beginning with October, 1902, daily balloon and kite ascensions were made by Assmann and his associates at the Prussian Aeronautic Observatory, while Teisserenc de Bort's great work in his famous observatory at Trappes, near Paris, dates back to 1890.

The kite experiments in atmospheric electricity made in America by Benjamin Franklin in 1753, and by Joseph Henry in 1840, are now classic. Most important contributions to

meteorology by kite flying have been made by Messrs. Rotch, Fergusson, and Clayton, of Blue Hill Observatory. The United States Weather Bureau in 1898 temporarily maintained seventeen kite stations, and is now completing the Mount Weather Research Observatory, where the temperature, moisture, and movement of the air at great heights will be ascertained by means of balloons and kites, while other researches on the sun's heat, atmospheric absorption, atmospheric electricity, terrestrial magnetism, and seismic phenomena will be conducted.

In Japan, too, the importance of the study of the upper air was recognized soon after the organization of our meteorological service in 1875. Since that time the specialists at the Central Meteorological Observatory at Tokyo and at provincial stations have undertaken many technical expeditions to high mountains in order to investigate the phenomena of the higher strata of the atmosphere. For the establishment of the first Japanese mountain observatory we are indebted to our illustrious Prince Yamashina. For the site of this observatory his imperial highness chose Mount Tsukuba, that remarkable mountain which stands alone on an extensive plain, and which, moreover, lies in the tracks of the cyclones of very intense character. Since its opening, in 1902, it has been of great service to observational meteorology in Japan.

It is evident, however, that the atmospheric data observed at mountain stations are very much affected by the local topography and the disturbing elements of the mountain mass and surface. A discussion of the observations made in the free upper air during balloon ascents from Munich, and those made simultaneously at neighboring mountain stations, shows important differences between them. Hence, it becomes vitally important for each civilized country or nation to establish on its own soil an aero-physical observatory, like those at Trappes, Blue Hill, Berlin, Lindenberg, and Mount Weather.

The scientific problems to be investigated at such a research observatory are manifold, and include the following:

(1) The distribution of temperature in the upper atmosphere; the thermal conditions in cyclones and anticyclones; the distribution and condensation of atmospheric moisture; the distribution of pressure in the upper and lower atmosphere: these are problems of paramount importance, and must be investigated by ascensions of balloons and kites.

(2) The absorption of solar heat by the atmosphere, which must be measured by means of the pyrheliometer and actinometer; the dissipation of solar light and heat as determined by the polariscope; the detailed analysis of the sunbeams as carried out by means of the bolometer and spectrometer. To all these there should be added apparatus for studying the conductivity and emissivity of the land and water, the snow-fields and the forests of the earth's surface.

(3) The discovery of the remarkable properties of radium has opened up a field of research relative to the ionization of gases, and this has led to a complete revolution in our ideas relative to atmospheric electricity. By means of an Exner's electrometer and Benndorf's self-registering apparatus the potential should be measured. To make systematic observations of dissipation and radio-activity of the air under ground, we need the Elster and Geitel instruments. Corresponding measurements of the ionization should be made with the Ebert ion-counter, and the Gerdien conductivity apparatus.

Japan feels the direct influences of the Pacific Ocean and the Asiatic Continent, and also those of the tropical and polar ocean currents, so that meteorological as well as climatic conditions in Japan are very complex. Very often a continental cyclone, which appears to originate in the Asiatic Continent, and a typhoon, which comes from the Tropics by way of the Philippines and Formosa, pass over Japan simultaneously, bringing great complexities in the weather. In spite of all

these difficulties, however, the storm tracks and other meteorological conditions have been very carefully investigated by eminent Japanese meteorologists. Japan¹ has just established a new weather service in Korea and Manchuria, and is said to be intending to extend the service to southern China. These are all for immediate practical daily forecasts; but the exploration of the free upper atmosphere by balloons and kites has not been touched. This vast upper ocean of atmosphere, the study of which is exceedingly important for further advances in the physics of the atmosphere, as well as in the prediction of the weather, must remain entirely unknown to Japanese meteorologists until they are able to investigate it.

Japanese meteorologists do not generally possess all the expensive instruments and apparatus that are found in the United States and Europe. In the whole of Japan there is probably not a complete set of modern apparatus for the study of atmospheric electricity, such as those of Elster and Geitel, Ebert, Benndorf, or Gerdien. Japanese physicists and meteorologists have relied on their own hands and brains, but we have now come to the age when international cooperation in science is progressing rapidly and our scientists should be provided with laboratories and observatories containing powerful instruments and apparatus. It is sad, indeed, to hear from Japanese meteorologists that they have no hope of establishing an aero-physical observatory similar to those mentioned above.

I have been asked if I can induce some worthy American patron of science, or some institution, to establish an aero-physical observatory in Japan, or somewhere on the other side of the globe. What we should want at first would not necessarily be a great observatory, such as Mount Weather, but a small one, or several such, where we can observe with kites the conditions of the upper atmosphere, and can also study the atmospheric electrical phenomena by using the Ebert, Elster and Geitel, and Benndorf apparatus. Such work is entirely new in Japan, but good physical assistants and materials can be obtained at small cost. It will require only a few thousand dollars to establish such an observatory in Japan.

All Americans remember gratefully that the Smithsonian Institution, of Washington, which has done wonderful service for the increase and diffusion of scientific knowledge in America, was founded by a foreigner, an Englishman, James Smithsonian, in the beginning of the nineteenth century. May not Japan receive similar encouragement from foreign countries or institutions? Scientific research is becoming more and more international and cooperative; it soars far above the differences of race and national policy. The results of the meteorological investigations that are carried on in an aero-physical observatory in Japan will be directly beneficial to the whole human race as well as to that country. The world's meteorology will receive far greater benefits indirectly than will Japan directly. Our atmosphere must be studied as a unit. When the atmospheric conditions in the upper and lower strata become thoroughly known over America, Europe, and Asia, then, and only then, can meteorologists establish the true theories of cyclones, anticyclones, floods, and droughts on a firm observational basis. We must remember, however, that at present the atmospheric conditions in the upper atmosphere over the Eastern Hemisphere of the globe are entirely unknown, and the final solution of our complex aero-physical and dynamical problem is still far away.

All nations send their naval and merchant vessels to Japanese ports where we do our best to forewarn them of dangerous storms. A storm-warning service blesses all nations alike. Its signals represent an international cooperation for the benefit of all mankind.

For these reasons I appeal confidently to the American patrons of science for the funds necessary to establish a modern aero-physical observatory in Japan.

WEATHER BUREAU MEN AS EDUCATORS.

Mr. Albert Ashenberger, Observer, Mobile, Ala., under date of January 20, reports that he delivered a lecture on weather forecasting before the faculty and students of Springhill College, Springhill, Ala. Special reference was made to the methods of long-range forecasters.

Mr. S. S. Bassler, Local Forecaster, Cincinnati, Ohio, reports that on December 15, 1905, he read a paper on "Weather proverbs and prophets" before the Ladies' Literary Club of Norwood, Ohio.

Mr. Al. Brand, Observer, Evansville, Ind., reports that about 30 members of the Men's Club of St. Paul's Church visited the Weather Bureau office on the evening of January 18, and listened to a talk by the observer on the instruments and work of the Bureau.

Mr. Frederick W. Brist, in charge of the office at Thomasville, Ga., under date of January 23, reports that on the 17th a class in physical geography from the Thomasville High School visited the office, and that its members were instructed in the construction and use of the various instruments and in the method of making forecasts from the daily weather maps.

Mr. Allen Buell, Observer, San Antonio, Tex., under date of January 31, 1906, reports that at various times during the school year he has given extemporaneous lectures to the pupils of the schools on meteorology in general and the methods and work of the Weather Bureau. Such lectures have been given in most of the higher schools in the city.

Mr. Norman B. Conger, Inspector, Detroit, Mich., under date of January 12, 1906, reports that the class in physical geography in the High School, 35 in number, visited the Weather Bureau office and listened to the usual informal talk on the instruments and work of the Weather Bureau.

Prof. H. J. Cox, Chicago, Ill., under date of January 16, 1906, reports that a popular lecture on "Weather and weather forecasting," illustrated with lantern slides, was given in Chicago as follows:

November 3, West End Woman's Club; November 16, Hyde Park Men's Club; November 21, Chicago Woman's Aid; December 1, Neighborhood Settlement, in Ogden Park Hall.

The Chicago Press Club visited the office November 14; an informal talk was given on instruments and forecasts.

Classes from schools have visited the office as follows:

October 19, Waller High School; October 20, Chicago Normal School; October 21, West Division High School; December 4, Oxford Preparatory School for Boys; December 8, Chicago Normal School.

Professor Cox reports, under date of January 30, that on January 26 he lectured at Michigan Military Academy, Orchard Lake, Mich., to an audience composed of faculty, students, and a few invited guests.

Mr. W. H. Fallon, Observer, Grand Haven, Mich., states that the class in physics of the local high school visited the office in sections on the 11th and 18th of December; the students were given instruction relative to the theory and use of the various meteorological instruments, the construction of weather maps, and other Weather Bureau work.

¹For the condition of the Japanese weather service, see "Recent advances in meteorology and meteorological service in Japan." Popular Science Monthly, February, 1906.