year. Fig. 1 shows the relation between the average monthly rainfall and the average monthly number of thunderstorms.[1]

AN INDEX OF METEOROLOGICAL ITEMS IN THE JESUIT RELATIONS.

By Rev. F. L. ODENBACH, S. J.

("The Jesuit Relations and Allied Documents," Burrows Brothers, Cleveland, Ohio, is a reprint, in about 73 volumes, of the accounts by the French Jesuit missionaries of their travels and explorations in Canada and the Northern and Northwestern States of the United States, from 1610 to 1791. The reprint includes both the original narrations and an English translation thereof. From the exhaustive general index Father Odenbach has culled all entries relating to the weather or meteorological phenomena.—*F. O. S.*)

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[1] Such graphical representations have obvious advantages, but they are likely to be misleading to the student unless he is careful to find out in each case just how much the diagram includes and what it omits. The present diagram, for example, is based on monthly averages. We can not select a point midway between two months and say that this represents conditions on the 15th of the month, or on any other definite dates The only points on these curves that have any significance are those that fall on the vertical lines. The intervening portions of the curve serve to guide the eye, and to indicate the correspondence between the change. in the two elements considered.—*F. O. S.*

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Mr. H. H. KIMBALL, Librarian and Climatologist.

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MOUNT TSUKUBA METEOROLOGICAL OBSERVATORY. WHAT DOES METEOROLOGY NEED FOR ITS FUTURE ADVANCEMENT?

By S. TETSU TAMURA, Department of International Research in Terrestrial Magnetism of the Carnegie Institution, Washington, D. C.[1]

Since the time of Pascal it appears to have been recognized that the exploration of the upper strata of the atmosphere is one of the most important investigations for the advancement of cosmical physics. So long as this vast mysterious ocean of atmosphere remains unexplored, modern meteorology must remain at a standstill; for the meteorological phenomena at the earth's surface depend, in great measure, upon the thermal and electrical as well as the dynamic condition of the whole atmosphere. Hence, many balloon ascents and kite experiments have been undertaken and a number of mountain observatories have been established in Europe and elsewhere.

In Japan, too, the importance of the meteorological survey of the upper atmosphere was recognized soon after the organization of our meteorological service in 1875. Since that time specialists at the Central Meteorological Observatory of Tokio, and also at provincial stations, have undertaken many meteorological expeditions to high mountains in order to investigate the phenomena of the higher strata of the atmosphere. For instance, to Mount Fuji (3720 meters) in every summer since 1889; to Mount Gozaishodake (1200 meters) in the summer of 1888; to Mount Ontake (3060 meters) in 1891; to Mount Ishizuchi (1980 meters) in 1894; and to several other mountains whose heights range from 3000 to 740 meters. But these expeditions were usually undertaken in the warmest season of the year, since any long stay on the summit was impracticable in winter. For the establishment of our first Japanese mountain observatory, we are indebted to our illustrious Prince Yamashina. For the site of his observatory His Imperial Highness has chosen Mount Tsukuba, that remarkable mountain of Japan which stands lonely on an extensive plain, isolated from all mountain ranges, and which, moreover, lies on the tracks of the cyclones of a very intense character.

Mount Tsukuba is on the eastern coast of Japan, 40 miles north-northeast of Tokio. The mountain is quite conical in shape and its summit is divided into two peaks, the East Peak and the West Peak, which are one-half mile apart, the west peak being the higher. Though only 2925 feet, or 870 meters, in height, Mount Tsukuba has a commanding view over Musashino, the most extended plain in Japan. And grand, indeed, is the view from the top of this mountain. The city of Tokio and other innumerable towns are dimly visible. Hundreds of miles distant, the snow-capped summit of Mount Fuji, the volcanic peak of the Asama, and the holy mountains of Nikko form a striking panorama. To the south nothing may be seen, except the vast surface of the Pacific Ocean and the infinite space. Mount Tsukuba is covered with pines and cryptomerias, and its summits are dotted with shrines and legendary antiquities, the largest shrine of which is sacred to Izanagi and Izanami, the first god and goddess of the mythological Japan. The legend is that Izanagi and Izanami constructed this mountain as a bulwark against the waves of the Pacific Ocean, which they had forced to retire to the other side of Kashima, formerly an island in the sea. This tradition is in accordance with the fact, recently verified by our geologists, that the east coast of Japan has been gradually rising during many centuries.

Amidst such legendary shrines and poetic regions, on the very top of the west peak, our prince-scientist established his meteorological observatory in 1901, and, with its companion base stations, it has been open for work since the first of January in 1902. The geographical coordinates of the observatory are

$$\varphi = 36^\circ\ 13'\ \text{N.}$$
$$\lambda = 140^\circ\ 06'\ \text{E.}$$
$$H = 870 \text{ meters above sea level.}$$

The main building of the observatory is built of massive wood on a huge stone foundation and is covered with zinc plates as a protection against moisture. This building contains an instrument room, workshop, office, parlor, and rooms for the staff. The observatory is perfectly equipped with meteorological and seismological instruments of the latest design.

A few yards north of the building stands an iron tower (11.6 meters high), on the top of which an anemometer rests, or rather, is set in motion. Prince Yamashina's self-registering anemoscope, Robinson's anemometer, Jordan's sunshine recorder, and also Richard's anemograph for the registration of the vertical component of the wind have been installed upon the upper platform of the tower. West of the building stands a thermometer shelter, in which thermometers, psychrometers, with Assmann's ventilation arrangement, a hair-hygrograph, and a thermograph of large model are placed. Under this shelter ten earth thermometers, with perfect arrangement, are buried at different depths below the earth's surface, that is, to the depths of one-half and one decimeter for the measurement of the surface temperature, and to the depths of one-half, one and one-fifth, and two meters for the measurement of underground temperatures. On the roof of the main building may be found a lightning rod, wind vane, self-registering rain gage, an ordinary rain gage, and an anemometer. The instrument room is elegantly equipped with meteorological instruments, the most noteworthy of which are Richard's barograph of large model, self-recording pluviometers, amemometers, and a mercury barometer (so-called mountain barometer). These instruments are put on stone piers.

It is worthy of special mention that macro and micro-seismographs have been installed on a granite pier, which is founded upon a gigantic rock. One of them is the famous horizontal pendulum seismograph, devised by Prof. F. Omori, the illustrious seismologist in Japan. All seismographs, including Gray's conical pendulum instrument, and Ewing's horizontal pendulum seismograph, record ordinary or strong earthquake motion, but fail to give reliable records of very small and slow motions of pulsatory oscillations. Professor Omori has adopted the conical pendulum and constructed the seismograph that is capable of giving the records, not only of ordinary earthquakes, but of very small or slow movements of the earth accompanying earthquakes or due to distant earthquakes, of small pulsatory oscillations, and of slow changes of level.

In the International Seismological Congress, which was held at Strassburg in 1901, Professor Omori pointed out the importance of seismological observations on high mountains. While no other country or observatory has as yet undertaken seismological observations on a mountain as high as Mount Tsukuba, Prince Yamashina has equipped his observatory so perfectly with seismological instruments. Since their installation, many seismic phenomena of curious character have been observed, the most extraordinary of which were the slow horizontal movements of the earth's crust in January of 1902. The horizontal motion of a micro-seismic nature that was east-west wise began on the 4th of that month at 11:09 p. m. and lasted until the next day. Again motion of the same nature began on the 12th and lasted until the 15th. The seismograms of January 12–15 show that these movements began

[1] The author was formerly fellow in mathematical physics at Columbia University, under Prof. R. S. Woodward, and at Clark University, under Prof. A. G. Webster.