High Hopes for Research on Mt. Fuji

Rising to an altitude of 3,776 meters, Mt. Fuji is Japan's highest mountain. For many years the Mt. Fuji Weather Station located at its summit has played a significant role as a base for weather observation. In recent years the station was made available for use by general scientists, which has led to a host of new research taking advantage of the benefits of its high altitude. **Katsumi Asano**, professor emeritus at the University of Tsukuba and chairperson of Valid Utilization of Mt. Fuji Weather Station, discusses the significance of research made on Mt. Fuji.

In 1932, the temporary observatory of the Central Meteorological Observatory, the predecessor of the Mt. Fuji Weather Station, was established atop Mt. Fuji and year-round weather observation commenced at the site. Since that time, meteorological data such as temperature, atmospheric pressure, precipitation and humidity have been collected there. In 1964, a weather radar was installed at the site to instantaneously detect typhoons approaching Japan; a measure taken in response to the great damage from the Isewan Typhoon (Typhoon Vera) that hit the country in September 1959 and left more than 5,000 people dead or missing.

However, because of the development of weather satellites and technologies that enable collection of meteorological data from remote areas, the Japan Meteorological Agency stopped using the weather radar for observation in 1999, and since 2004, the station has been unmanned.

Currently, meteorological data at the summit of Mt. Fuji are collected automatically by the meteorological equipment installed in the Mt. Fuji Weather Station. However, it must be stressed that this highest point of our land is the perfect site for a variety of research that utilizes the benefits of the high altitude, as well as for weather observation.

In other countries, an array of achievements has been made by research conducted in high-altitude bases, such as the Mauna Loa Observatory in Hawaii (3,396 m) which is noted for greenhouse gas observations, the High Altitude Research Station Jungfraujoch (3,578 m) in Switzerland, which conducts astronomical research, and the Monte Rosa Laboratory (4,559 m) in Italy, which is famous for high altitude medicine.

Moreover, a participant in the construction of the Mt. Fuji Weather Station says that proper maintenance will permit another 100 years of problem-free usage of the building itself, remaining resistant to the severe climate conditions where the average low temperature is -15°C and average wind speed is as high as 15 m/sec.

Treatment of Altitude Sickness

With this as the background, we established Valid Utilization of Mt. Fuji Weather Station, an NPO with more than 200 members, including researchers and mountaineers. The organization began observation and research at the Mt. Fuji Weather Station after receiving permission to use the facilities from the Japan Meteorological Agency in the summer of 2007, when the station became available for summer research work by the private sector.

For two months between July and August of 2007 and 2008, nine and thirteen research studies were respectively conducted at the Mt. Fuji Weather Station, on themes including high-altitude medical sciences, atmospheric chemistry, ecology and training and cosmic radiation. In the area of high-altitude medical sciences, my research group has been studying the application of acupuncture for the treatment of altitude sickness. Every year, about 50,000 Japanese overseas go to altitudes of more than 6,000 meters, either for mountaineering or for business, and their mortality rate exceeds 2% each year, which is quite high. Mt. Fuji attracts about 400,000 climbers every year, and several die of cardiac failure or other causes. One of

COURTESY OF SHIZUOKA SHIMBUN

Its utility as a weather radar system (from 1964) superseded by satellite technology, Mt. Fuji Weather Station today serves as a base in the summer months for research in numerous scientific fields, as well as for (unmanned) meteorological observation.

COURTESY OF YOMIURI SHIMBUN

A researcher sends electric current to a needle inserted into the thumb of the author as part of an experiment to measure the degree of oxygen saturation in the blood.

the major causes of death at high altitudes is severe disorders caused by low oxygen, or altitude sickness. At a height of more than 3,000 meters, the lower atmospheric pressure reduces the amount of oxygen in the blood by 60% compared with when the person is on level ground. The stress caused by the severe condition triggers hyperactivity of the sympathetic nerve, leading to the onset of altitude sickness. However, the stress can be effectively controlled by stimulating energy centers, which puts the parasympathetic nerve to work. This led us to assume that stimulating energy centers would alleviate altitude sickness. So we conducted an experiment with twelve examinees lodging in the Mt. Fuji Weather Station. For each examinee we inserted a needle into the *goukoku*, an energy center located at the base of the thumb, sent electric current to the needle several times a day, and measured degree of oxygen saturation in the blood. We obtained a positive result from this experiment, which suggests that stimulating a power center might alleviate the symptoms of altitude sickness.

We also conducted an experiment for verifying the effectiveness of high-altitude training, which many athletes have been undergoing in recent years. Many of these athletes go overseas for training because there is no appropriate venue in Japan. In each of the past two years we used eleven examinees, who stayed at the Mt. Fuji Weather Station for two nights, and measured fluctuations of their physiological responses and physical working capacity. The results showed that their arterial blood oxygen saturation, a parameter for oxygen intake potential, increased after they climbed Mt. Fuji. The experiment also showed improvements in their heart rates and blood lactate levels, which indicate the degree of fatigue. These results indicated that Mt. Fuji may provide altitude training effects over a short period and that the mountain could serve as a site for training those traveling to high altitudes or for judging their fitness for high-altitude environments.

Atmospheric Chemistry

In the area of atmospheric chemistry research, groups of scientists from Waseda University and the Tokyo University of Science observed volatile organic compounds (VOCs), such as toluene and benzene, and substances such as aerosol (suspended particulates) contained in the atmosphere. These substances are said to be closely related with air pollution and climate change, but many points remain unknown regarding how much of what substances are generated, and from where. Mt. Fuji's advantage in observing such substances lies in the fact that data can be collected without direct influence from automobile and factory fuel emissions because the mountain is located away from metropolitan areas. Moreover, the summit of Mt. Fuji extends into the free troposphere, the atmosphere between an altitude of one kilometer aboveground and the stratosphere. In this layer, substances travel long distances without being subject to land surface frictions. In fact, black carbon generated by a fire in Siberia, and yellow sand from China were each observed at the summit of Mt. Fuji. Since substances generated on the Eurasian Continent are carried from west to east by westerly winds generated in the mid-latitude of the northern hemisphere, Mt. Fuji, located at the eastern edge of the Eurasian Continent, is the optimum site for such observation.

International Appeal

Because of these advantages, Mt. Fuji also draws a great deal of attention from overseas researchers. In each of the past two years, scientists from the National Central University of Taiwan visited the site to observe mercury concentration. This year, scientists from the ABC-Pyramid atmospheric observatory (5,079 m) in the Himalayas plan to observe aerosol on Mt. Fuji. Moreover, the Lulin Baseline Station in Taiwan (2,862 m), ABC-Pyramid atmospheric observatory, Mauna Loa Observatory in Hawaii, and Valid Utilization of Mt. Fuji Weather Station will begin collaboration this year in networked observations. Real-time meteorological data from the respective sites will be transmitted and shared online among the laboratories.

Other research conducted on Mt. Fuji includes observation of cosmic radiation exposure. Cosmic radiation intensity grows stronger the higher one goes because the atmospheric layer becomes thinner. This has raised concerns about the effect of cosmic radiation on the health of aircraft crews. In relation to global warming, measurement of CO_2 concentration and investigations on permafrost have also been conducted at the site.

Based on all this evidence, it is clear that observations and research conducted at the Mt. Fuji Weather Station are directly related to human lives. In July 2007, we held the World Eco-Science Network Conference in Tokyo, which was attended by members of representative high-altitude laboratories from all over the world, including Valid Utilization of Mt. Fuji Weather Station. The conference concluded with the release of the Declaration on the formation of a global environmental watch network, under which the laboratories will collaborate for protecting our planet's future. We are determined to continue research for passing on a better global environment to coming generations by making use of the geographical advantages provided by Mt. Fuji and through cooperation with laboratories in other countries. HJ

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