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Physics in the HAWAIIAN ISLANDS

By S. A. Korff

AT HONOLULU, on the island of Oahu in the Hawaiian island group, the University of Hawaii has an active Physics Department. The faculty there consists of four persons of professional grade with differing research interests. Professor Willard H. Eller, former chairman, is at present devoting most of his time to building up the instruction in electrical engineering. The present chairman is Professor Iwao Miyake, whose chief interests are in electronics and acoustics. The system of rotating department chairmanship is used. Professor K. Watanabe is principally interested in the spectroscopy of the extreme ultraviolet, and Professor Walter Steiger is interested in geophysics and solar physics. This latter field has received a large impetus of late in connection with the forthcoming International Geophysical Year.

A number of interesting research projects make use of the unique facilities and physical situation of the islands. For example, the pineapple growers and sugar planters have formed the Pineapple Research Institute and the Experiment Station of the Hawaiian Sugar Planters' Association. These groups actively support a Department of Meteorology, which in turn conducts extensive research in both meteorology and hydrology, two fields of obvious immediate interest to the sponsoring organization. The U. S. Geological Survey operates the Hawaiian Volcano Observatory, where Drs. Gordon A. Macdonald and C. K. Wentworth have been continuing the interesting work given its strongest impulse by the famous late Dr. T. A. Jaggar, one-time chairman of the department of geology at Massachusetts Institute of Technology, and Research Associate of the University of Hawaii. At the Marine Biological Laboratory, a jointly sponsored organization on Coconut Island off the north coast of the island of Oahu, both the Universities of California and Hawaii join in studying a number of problems in this field. The physics department cooperates in one of these, namely a study of the factors influencing electrofishing, in which the effects upon fish of pulsed direct current are under investigation.

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A bill has just been prepared for Congress to establish in Honolulu a Geophysics Institute (similar in some respects to that which has done such a superb job in Alaska) to be operated and staffed by the University of Hawaii. In this bill, Congress is asked to appropriate funds for the Institute building. The unique position of the islands, located as they are in the center of the Pacific Ocean, and in the center of the famous "ring of fire" surrounding this ocean, makes them an ideal site for geophysical work. If such an Institute comes into being, it will probably also house the cosmic-ray monitor, planned cooperatively by the University of Hawaii and the University of California, during the International Geophysical Year. Such cosmic-ray monitors measure the cosmic-ray intensity continuously over a long period, and record the fluctuations, which are of the greatest interest in helping to understand the connections between these rays and geophysical and solar physics phenomena. Solar physics would benefit, especially if present plans for a coronograph and for a solar flare patrol are activated. The Institute would presumably also operate the facilities on Haleakala, which we will describe later.

We may summarize the situation by saying that there is a considerable demand for the proposed Institute among the several branches of geophysics already represented. If it becomes a reality, it will stimulate much more research of this nature, which is of interest to many branches of the Government as well as to science, and will attract to the islands many world-renowned geophysicists for visits and research.

Another interesting feature of the Hawaiian Islands is the situation regarding high-altitude facilities. The two largest and easternmost of the islands, Maui and Hawaii, are both high islands. Hawaii itself, the largest of the group, is the locale of two giant volcanoes, Mauna Loa, 13 679 feet and Mauna Kea 13 784 feet above sea level. From the point of view of cosmic-ray work, these altitudes are already appreciable. However, from the point of view of geophysics, these mountains are truly remarkable. Mauna Loa is by many definitions the largest mountain in the world. It rises unbroken from a base some 18 000 feet below sea level, on the floor of the Pacific Ocean at one of the regions where the ocean is deeper than average. The slopes are

Directional antenna system on summit (10 025 feet) of Mt. Haleakala, Island of Maui. Building at right of antenna houses receivers and other equipment. Antenna system can be rotated about vertical axis passing through center of structure. Antenna forms receiving unit of a Lloyd's mirror arrangement, using reflecting surface of the ocean below, and permitting good resolution for radioastronomy studies of radiation received from stars and other sources in the galaxy. Built by Grote Reber, with cooperation of Hawaiian Telephone Co. and University.

Building housing physics (and other) departments at the University of Hawaii at Honolulu.

gentle, the summit being 22 miles in horizontal distance from the nearest point on the coast, giving a maximum average slope of about 1 in 8.8. In appearance the mountain is not spectacular, as this gentle slope extends in all directions to the sea. Yet in cubic volume it is estimated at 10^4 cubic miles. Making the same assumptions, i.e., that it is a single mountain, and bounding it on the bottom and sides by plane surfaces, Mt. Rainier comes out to be 147 cubic miles. Many fascinating problems in isostasy arise because of this huge mass standing on the ocean floor, which we do not have the space to review here.

There is a road of sorts to the summit of Mauna Loa. The road is good gravel to about the 5000-foot level at Kulani, and then becomes progressively worse with increasing elevation. The last few thousand feet of altitude interval are negotiated with difficulty with four-wheel drive power wagons, the rough lava blocks tearing the tires to bits rapidly. The highest point reached by paved road, power and telephone lines is at the Park Headquarters, at about the 4000-foot level, not on the Kulani road. At the top there is a meteorological shelter but no housing. Visitors usually take two days for the trip and bring tents.

A road also exists on Mauna Kea, taking off from the saddle road which crosses the island between the two peaks, and which reaches about 6500 feet in a paved state. The Mauna Kea road then climbs up, petering out at about the 10 000-foot level. The summit, being more difficult of access and not appreciably higher, has never been the scene of scientific work other than geology and surveying.

On the island of Maui, the dormant volcano Haleakala reaches an altitude of 10 025 feet. This island, the second largest of the Hawaiian chain, is shaped roughly like a distorted figure 8, the mountain Haleakala occupying the larger and eastern loop, Puukukui on the other loop reaching 6788 feet. The airport is in the saddle between the two peaks, and is reached in 35 to 45 minutes from Honolulu by several regular flights each day. A paved road and a power line run to the summit of Haleakala. At the summit are a number of installations, a communications and short-wave unit of the Civil Aeronautics Administration, a television transmitter, an experimental antenna system erected by Grote Reber for studying galactic radio noise, the National Park Summit House, and a projected installation of the US Air Force. The National Park ranger headquarters, and a lodge serving excellent meals, are at about 6500 feet. The physics department of the University of Hawaii is at present considering the summit as the possible location of a solar flare patrol station, and as a place where a cosmic-ray monitor may be installed for the International Geophysical Year observations. To ascertain the advisability of putting a solar station on the summit, an observing program is now under way to obtain a set of records of the average cloud cover, atmospheric transparency, and visibility. The arguments for placing a cosmic-ray monitor there are that the solar flare patrol will be operative and will give warning of the times when interesting cosmic-ray fluctuations may be expected. Further, because of the longitude of the islands, just above 156° west at Maui, the observer on this island will have a full two hours additional coverage for possible flare outbreaks after the West Coast stations have shut down, and three hours or more after Sacramento Peak and Climax have seen their sunsets. Further, there have been times when an interesting event on the sun was missed because both Sacramento Peak and Climax were cloud-covered. It is unlikely that Haleakala would be covered at the same time. The normal trade-wind clouds in the Hawaiian area form at or near the inversion layer, usually about 6000 feet. Such clouds gather around the mountains, and it is not unusual that the interval from about 4000 to 8000 feet is in the cloud. However, the summits of the big peaks are almost always in the clear, and that of Haleakala is usually above the cloud layer. Detailed observations are at present in progress to obtain accurate statistics on the percentage of cloud-cover on Haleakala. With this information it will be possible to estimate the probability of successful operation. At present, it appears that this site promises an unusual and important addition to the world-wide chain of stations for geophysical research.