University; *Longitude and Latitude,* G. M. Clemence, U. S. Naval Observatory; *Glaciology,* William O. Field, American Geographical Society; *Oceanography,* E. H. Smith, Woods Hole Oceanographic Institution; *Rockets,* J. A. Van Allen, Princeton University; and *Publications,* Executive Secretary of the United States National Committee.

Of particular interest to members of the American Alpine Club will be the glaciological and cosmic ray programs, for William O. Field, Dr. Serge A. Korff, and Dr. Terris Moore, President of the University of Alaska, with the assistance of the Office of Naval Research, the Office of the Quartermaster General, the U. S. Air Force, and the Regents of the University of Alaska, established the Mount Wrangell Observatory for cosmic ray and other affiliated scientific studies on the summit of Mount Wrangell, Alaska.

CHRISTINE L. ORCUTT

COSMIC RAYS AND MOUNTAIN OPERATIONS

Since about the year 1900 it has been known that even the most carefully insulated electroscope would slowly lose its charge. This effect was thought to be due to ionizing radiation from ubiquitous traces in the earth of radioactive minerals of radium, thorium, and uranium. In the year 1912, an Austrian physicist, Dr. Victor F. Hess, carried an ionization chamber aloft in a balloon in an effort to get away from the local effect. He found that the radiation *increased* as he went to higher and higher elevations and he postulated that these rays come from outside the earth. Later work indicated that the rays come from all directions, bearing no relationship to the positions of the heavenly bodies or the Milky Way, but seeming truly cosmic in origin.

From these first experiments of Hess to the present day a tremendous amount of research and ingenuity has gone into the ever-expanding field of investigation of cosmic rays. The primary radiation impinging on the top of the atmosphere is extremely energetic, being composed of atomic nuclei, mainly of hydrogen and helium, having a speed very nearly that of light. These nuclei collide with air atoms, causing extensive showers of nuclear, mesonic, electronic, and photonic debris. But the atmospheric absorption is such that at sea level the intensity is very low, being approximately one cosmic-ray particle per minute passing through a horizontal area of one square centimeter. The over-all energy the earth receives is thought to be roughly equivalent to that obtained from starlight.

In order to get above much of the absorbing sea of air so as to measure greater cosmic-ray intensities, laboratories have been established on numerous high spots in many parts of the globe. However, the earth's magnetic field has been found to have a filtering effect on the charged radiation, deflecting primary particles with low energies away from the equatorial region. The nearer the geomagnetic poles one goes, the lower is the minimum energy required for a primary particle to enter the earth's atmosphere. For some time Professor Serge A. Korff and his Cosmic Ray Group at New York University have felt the need of a station having both the desirable features of high elevation and location as far north as possible. The mountains of Greenland and the Canadian Northwest Territory are neither high enough nor easily accessible enough, and it was therefore felt that the best location for such a station would be found in Alaska. Consequently, pioneer work was carried out in April 1952 by Dr. Korff and Dr. Terris Moore, President of the University of Alaska and bush pilot extraordinary. They flew over various peaks in the Alaska and Wrangell ranges and chose 14,006 foot Mt. Wrangell, a dormant volcano, because of its proximity (43 air miles) to Copper Center, on the Richardson Highway, and because its snow-filled crater formed an extensive, nearly level field for aircraft landing, air-drop operation, and laboratory installation.

Both men were well qualified for this work. In 1951 Dr. Moore had flown personnel and supplies to a climbing and surveying party under Bradford Washburn. He had made numerous landings and take-offs at 10,000 feet on the Kahiltna Glacier, along the west buttress route to the south peak of Mt. McKinley. Dr. Korff has led many cosmic ray expeditions and is an internationally recognized authority on Geiger and proportional counters. Both Dr. Korff and Dr. Moore are experienced mountaineers. Dr. Korff has scaled El Misti in the Andes as well as mountains in the Alps and our own Rockies. Dr. Moore has Western China's 24,900 foot Minya Konka to his credit, as well as Chimborazo in the Andes, and Mt. McKinley in Alaska.

After the better part of a year devoted to preparations and plans, the mountain group assembled in early June 1953 at Copper Center, a small town about 150 miles northeast of Anchorage. Besides Dr. Korff and Dr. Moore, the group included Philip Bettler and Charles ("Bucky") Wilson, physicist at the Geophysical Institute of the University of Alaska, Robert Goodwin of Anchorage, an experienced mountaineer who had scaled Mt. McKinley in 1952, Arthur Beiser and the author, both members of the N. Y. U. Cosmic Ray Group. Bettler and Beiser had been particularly active in expediting the reams of paper work involved in setting this project in motion. Most valuable assistance was also given by Robert Haymes of N. Y. U., Lieut. Sidney Morris, U.S.N.R., and by Capt. Robinson Bridges, O.Q.M.G.

Since an airplane of this type* had never before, to our knowledge, been successfully landed and taken off at a 14,000-foot elevation, it was deemed advisable to have a ground party at the summit before the first landing was attempted. A suitable snow shoulder was chosen west of the summit at 8,500 feet elevation, and Dr. Moore ferried equipment and personnel there, 300 lbs. per flight. After three days of snowshoeing (most of one day was spent sitting out a storm), the climbing party reached the top and Dr. Moore performed the first successful landing. During the following operation of a month and a half this feat was repeated three dozen times with passengers and equipment. The Piper Super-Cub with a 135-horsepower engine is well suited for these extreme conditions.

Several days after the establishment of the mountain-top camp, two great air-drop operations were carried out. Fifteen tons of fuel, food, and equipment were released on parachutes from a giant cargo plane. Included in the drop were two prefabricated Jamesway huts, gasoline drums, motor generators and converters, canned food, lumber, plastic sleds, and other equipment. The plastic sleds for moving heavy cargo proved to be among the

*A Piper Super Cub, equipped with ski-wheel combination landing gear.

most useful items on the mountain, being rivalled only by snowshoes, snow shovels, and sun glasses.

The next five weeks were spent in setting up the two huts on a cinder ridge kept free of snow by volcanic steam and in digging out dropped equipment which was constantly being snowed under. Other work included towing loaded sleds across the great snowfield to the building site, constructing furniture, and improving interior facilities while violent storms raged outside. Though the mean air temperature hovered at about 150°F., there were some mild, windless days when one could walk comfortably without a shirt. Five degrees below zero was the coldest recording during storms. The weather on the summit during the summer was found on the average to permit five flying days per week.

The present station consists of two Jamesway huts. The larger one, 16 feet by 16 feet, has four bunks, two book or utility shelves, a table, a space heater, and a gasoline cook stove. The smaller hut, with a floor area of 16 feet by 12 feet, houses the motor generators and converters. Additional electric power from a wind-driven generator will soon be available for charging batteries. Also available are three radios: one all-wave receiver, a small aircraft transceiver for emergency communication with the C. A. A. monitoring station at Gulkana, and a walkie-talkie set with which to advise people at Copper Center as to the weather on top and as to the feasibility of landing the plane.

The establishment of this station was time consuming beyond initial expectations and limited scientific work to making meteorological observations, exposing nuclear emulsions to the local cosmic radiation, and testing clothing and equipment. It is hoped during the summer of 1954 to install and operate cosmic ray recording apparatus, as soon as the electric power supply can be sufficiently stabilized. Investigations in high-altitude biology, volcanology, meteorology, and materials research on clothing, housing, and performance of machinery are all feasible from this station. Moreover, its location is well suited for arctic indoctrination courses.

Before leaving the station in early August, Messrs. Goodwin, Bettler, Wilson, and the author climbed the four individual peaks of which the summit is composed and which rise 200 to 400 feet above the great snowfield. From one of these we could look directly down into the great steam jet of the presently active side crater. On another peak we found a long, steep red clay bank, kept free of snow by volcanic steam and embellished by curious worm-like ice crystals. Here we found lichens growing on steam-warmed rocks—quite a surprise so far north at 14,000 feet elevation!

In summary the 1953 Mt. Wrangell operation resulted in a new northern high-altitude research station, and showed that the establishment and operation of such a laboratory on inaccessible mountains is both possible and practicable with the aid of aircraft.

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EDITOR'S NOTE: Mr. Neuberg, a member of the New York University Cosmic Ray Group, has carried on scientific research on expeditions to the Rocky Mountains, Alaska, Greenland, and the Galapagos Islands.

OCCURRENCE OF TWISTERS ON MOUNTAIN RIDGES

1. OBSERVATIONS

Twisters of great intensity were observed during an ascent of the Watzmann, a mountain in the northern limestone belt of the Alps, south of Berchtesgaden, Germany, on August 1st of this past summer.

The ascent of the Watzmann was made from the North by way of the Watzmann House (5,500 ft. altitude), from which point, already above the tree line, a sharp ridge rises to the Hocheck (8,000 ft.). Beyond this peak the ridge remains essentially horizontal for some 1,000 yards, then descends again to 6,000 ft. Consequently, this ridge, essentially straight, extending in a north-south direction, flanked toward the west by a great and rather smooth-sloping shelf of bare rock and toward the east by a precipice of many hundred feet, resembles a shed roof of rather symmetrical lateral profile.

On the day of the ascent, a fairly steady wind was blowing from the west, i.e., normal to the extent of the ridge and up