are of importance to engineers and others in private industry. Engineers can get exact geographical information of a piece of ground, as to its elevation, latitude and longitude, that would cost large sums of money if this work were to be carried out by the individual.

The survey engineers have been engaged for a number of years on a "triangulation plan" of the 3,000,000-odd square miles of the United States, setting bronze markers at various points in order to fix the basis for a system of topographical maps which will be available to any engineer or scientific man.

Mr. Lushene will call to his aid another branch of science, the radio, in helping him to simplify his observations and calculations. With the aid of a radio, complicated scientific observations, ordinarily taking two or three nights, can be completed in a single night.

Longitude determinations, which are made by comparing the time from observations on the stars as they pass the meridian at the field stations with the time signals sent from the U. S. Naval Observatory in Washington, are exceedingly accurate. This comparison gives the difference in time between the seventy-fifth meridian and the field station, and the difference in longitude thus becomes known.

A single observing party is all that is now needed in the field, while before the radio came into use, it was necessary to have two observers, one at a point whose longitude had previously been determined and the other at the new station. The stations had to be placed within a reasonable distance of a telegraph line, for otherwise great expense would be involved in connecting by wire the telegraph line and the observatory.

This meant very little freedom of choice in the location of the longitude station, and the triangulation often had to be expanded in order to make connection with the astronomical station. With the radio there is no restriction as to the location of stations except that high mountain peaks are not used for longitude determinations because of the difficulty of carrying the instruments to the top. In general, stations are used to which the automobile truck that carries the astronomical instruments can be driven.

The radio is of value not only to the geodetic engineer in the determination of longitude, but for the same purpose to the navigator of a ship. To-day the navigator can use an ordinary pocket watch, receive his time signals by radio and be able to determine his longitude with greater accuracy than previously, when he had to depend on the constancy of the rate of the chronometer.

## THE AGRICULTURAL EXPERIMENT STATIONS

FUNDS for the support of the agricultural experiment stations "are being carefully safeguarded and, to an increasing extent, restricted to intensive and productive research," according to the annual report of the Office of Experiment Stations, made public on November 6 by the U. S. Department of Agriculture. The report states that 1,000, or more than 15 per cent., of the 7,000 or more distinct lines of agricultural investigations in which the stations are now engaged are carried on in cooperation with the department, thus extending the scope and increasing the efficiency and usefulness of the work.

The report shows that federal, state and other funds, amounting to about $18,000,000, of which $4,340,000 was available from federal sources, were expended by the experiment stations in the year ended June 30, 1931, in a wide range of agricultural research.

Stations in Alaska, Hawaii, Porto Rico, Guam and the Virgin Islands report progress in efforts to diversify the agriculture of these regions and to make it more profitable and self-sustaining. The appropriations for these stations for the year were: Alaska, $85,300; Hawaii, $45,200; Porto Rico, $59,200; Guam, $30,200, and the Virgin Islands, $30,300. The Virgin Islands station received in addition $16,700 from other sources for use in expanding its work to meet emergency conditions on the islands.

An important event of the year affecting the Alaska experiment stations was the transfer of the station which has been in operation at Fairbanks since 1907 to the Alaska College of Agriculture and School of Mines, thus giving the local institution greater participation in the experimental work.

Coordination of the work of the former federal experiment station in Hawaii with that of the University of Hawaii is reported to be proving satisfactory and to be resulting in a widening of the field of activity and an increase of interest in the work.

The report points out that Congress recently extended to Porto Rico in a modified form the Hatch, Adams and Purnell Acts. The acts provide that the work of the existing experiment stations and the activities of the U. S. Department of Agriculture in the island shall be coordinated by the Secretary of Agriculture and conducted jointly and in collaboration. Preliminary steps were taken to bring about this coordination.

The Guam station reports continued success in efforts to bring about diversification of the agriculture of the islands and to develop extension work. Following the establishment of a civilian government in the Virgin Islands, and in view of the serious economic and food conditions in the islands, the experiment station suspended some of its usual activities and devoted its energies to encouraging the people to plant and cultivate gardens as a relief measure.

Steps were also taken to improve the bay-oil industry and to reestablish the growing of cotton.

## A NEW HARVARD OBSERVATORY

ACCORDING to an article in the *Harvard Alumni Bulletin* the Harvard College Observatory will have in the near future a new astronomical observing station on Oak Ridge in the town of Harvard, Massachusetts, 27 miles northwest of Cambridge. The station will be on a ridge at an altitude of 600 feet, the highest point between Mt. Wachusett and the sea. The site is the gift of Mr. and Mrs. Alfred C. Fuller, of Belmont.

At this station the new 60-inch reflector telescope, the largest astronomical instrument in the eastern part of the country, will be the most important part of the equipment, but five or six of the observatory's photographic telescopes will be moved from Cambridge to the new station. Four photographic telescopes and the visual telescopes will be retained and operated at the headquarters on Observatory Hill, Cambridge.

It is estimated that telescopic power will gain on Oak Ridge a whole magnitude beyond that obtainable at the present site in Cambridge. This difference in brightness corresponds to a doubling of the number of stars within the reach of the various photographic telescopes.

The construction on Oak Ridge will include the building and turret for the 60-inch reflector, three buildings for the other telescopes, and a central building containing dark room, clock room, working library, storage and quarters for one or two observers. Also two or three separate cottages will be constructed for those members of the staff who will remain permanently on Oak Ridge. The architects are Coolidge, Shepley, Bulfinch and Abbott, of Boston.

The new site for the Harvard Observatory has been made imperative by the decision that the northern-hemisphere station should be equipped with a large reflecting telescope comparable to the one almost completed for the southern station in South Africa.

A dozen possible sites have been examined by the Harvard astronomers during the past six months, and the Oak Ridge station was selected as the best in eastern Massachusetts. The land comprises more than thirty acres of woodland; the woods will provide protection against wind, dust and stray light from neighboring villages, farmhouses and highways.

Some of the equipment will be in position at Oak Ridge and systematically operated on the regular photographic observing programs before next July. The three patrol cameras, which nightly photograph large sections of the sky to record the positions and brightnesses of the million or more stars that are within their reach, will be part of the Oak Ridge equipment.

It is probable that the 60-inch reflector, which should be ready for installation in fifteen months, and for operation a few months later, will be operated in part by members of the staff living in Cambridge, who will drive to the country for their observing assignments.

Beside the 60-inch reflector, the instruments at Oak Ridge will include the 24-inch reflector and the 16-inch Metcalf doublet; the 16-inch is employed steadily on the photographing of faint variable stars in the Milky Way.

## A JUNIOR NOBEL AWARD

THE stimulation of research by engineers under thirty years of age is the main purpose of the Alfred Nobel prize granted this year for the first time in honor of the illustrious civil engineer. The prize-winning paper, "Arsenic Elimination in the Reverberatory Refining of Native Copper," is the production of Mr. Corbin T. Eddy, assistant professor of metallurgy at the Michigan College of Mining and Technology, who has conducted most of the first part of that institution's research into the copper-cuprous oxide system, with the ultimate aim of evaluating various methods of eliminating from native copper such impurities as arsenic, silver, iron and oxygen, and of formulating more precisely than has yet been done the effect of each impurity on the physical properties of copper. Study of the copper-silver system, the second step of the program, has begun under the general direction of Professor A. T. Sweet, department chairman, with Professor Eddy, Professor Drier and Research Engineer Tolonen participating.

The process of copper elimination analyzed in the prize-winning article, which was delivered before the 1931 meeting of the American Institute of Mining and Metallurgical Engineers, was for decades an unregarded method, until revived by Michigan copper men some years ago. It is the method now regularly used by them in the reverberatory refining of native copper.

Papers eligible for the award included all those written by men under thirty years of age which were published in the journals or transactions of the American Institute of Mining and Metallurgical Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Western Society of Engineers and other similar organizations. The offering of this junior award is intended to stimulate the increasing production of reports which are both theoretically sound and also valuable to key industries.