their bearings in order to return to their aircraft carrier or base.

The device consists of a mirror, a lens, and a small star map showing each star in its correct position in relation to the rest of the stars. By adjusting the mirror so that it reflects images of the actual stars in the sky onto the stars on the printed sky map, and looking through the lens, the pilot can determine his field of vision. Then by referring to a special graphic chart and to his watch, he can automatically read his exact location in latitude and longitude.

By using this new instrument, it is expected that pilots will be able to make the necessary calculation in a matter of seconds. Now it takes several minutes to perform the figuring, and an error made by a tired pilot may have serious results.

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PHYSICS

Post-War Betatron

Plans for a 250,000,000-volt machine to open new fields of research by bringing cosmic ray effects into the laboratory.

➤ PLANS for the post-war construction of a 250,000,000-volt betatron, also called the rheotron, the most powerful X-ray and atom-smashing machine ever built, which will open wholly new fields to scientific research by bringing cosmic ray effects into the laboratory, were announced by Prof. G. M. Almy of the physics department, University of Illinois.

The new betatron will be similar to the 225-ton cyclotron, another type of atom-smasher, in size, shape and method of operation. It is constructed so that a powerful magnet surrounds the doughnut-shaped accelerating chamber. One of the distinguishing features of the machine is that it whirls electrons, the lightest constituents of the atom, while the cyclotron whirls the deuterons, or heavier parts. It does this operation in one "kick," while the cyclotron requires many "kicks." In the betatron the magnetic field changes, while in the cyclotron it remains constant.

Three betatrons have already been designed by Prof. Donald W. Kerst of the University of Illinois. Two of the machines, one having an eight-inch accelerating chamber and producing 2,500,000 volts, and the other having a 20-inch accelerating chamber and producing 20,000,000 volts, are located at the University of Illinois. The third betatron, much larger than the first two, produces 100,000,000 volts and is located at the General Electric Company laboratories in Schenectady.

"The first 2,500,000-volt betatron proved the idea workable. The 20,000,000-volt betatron in its two years of operation has made several valuable contributions to the knowledge of atoms, electrons and X-rays, and has opened the possibility of its use for the deep treatment of cancer by sending the electrons directly into the body of the patient, a whole new field of high energy physics," Dr. Almy stated.

At present the 20,000,000-volt betatron is being used for research in the above fields.

Dr. Almy pointed out that increasing the energy to 250,000,000 volts opens wider the field of cosmic rays to new phenomena of the deepest significance.

It is believed that a 250,000,000-volt betatron will also provide a laboratory source of mesotrons, heavy electrons, particles of fundamental importance in studies of atomic nuclei and of, as yet, unknown practical usefulness.

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AGRICULTURE

Hillculture for Erosion

➤ COMMON WEEDS successful in checking erosion of productive cropland are regarded as more valuable than wheat or corn, it was announced by the Department of Agriculture.

At a time when obtaining a maximum yield per acre is vital to victory, the U. S. Soil Conservation Service is developing new and more effective ways to halt fissuring and cross-wash of top-soil, which have already ruined 50 million acres of American farmland.

On the Department of Agriculture's 1,700 acre experiment station at Beltsville, Md., northeast of Washington, an effort is being made to single out those strains of plants that make the best growth on poor, eroded soils, require a minimum of cultivation, and at the same time bring in the best income for the farmer. This phase of conservation is called hillculture because it is designed

SCIENCE NEWS LETTER

Vol. 45 JUNE 10, 1944 *No. 24*

The weekly Summary of Current Science, published every Saturday by SCIENCE SERVICE, Inc., 1719 N St., N. W., Washington 6, D. C. NOrth 2255. Edited by WATSON DAVIS.

Subscriptions—$5.00 a year; two years, $8.00; 15 cents a copy. Back numbers more than six months old, if still available, 25 cents. Monthly Overseas Edition: By first class mail to members of the U. S. armed forces overseas, $1.25 a year. To others outside continental U. S. and Canada by first class mail where letter postage is 3 cents, $1.25; where letter postage is 5 cents, $1.50; by airmail, $1.00 plus 12 times the half-ounce airmail rate from U. S. to destination.

Entered as second class matter at the postoffice at Washington, D. C., under the Act of March 3, 1879. Established in mimeographed form March 18, 1922. Title registered as trademark, U. S. and Canadian Patent Offices. Indexed in Readers' Guide to Periodical Literature, Abridged Guide, and in the Engineering Index.

The New York Museum of Science and Industry has elected SCIENCE NEWS LETTER as its official publication to be received by its members.

Member Audit Bureau of Circulation, Advertising Representatives: Howland and Howland, Inc., 393 7th Ave., N.Y.C., PEnnsylvania 6-5566; and 360 N. Michigan Ave., Chicago, STAte 4439.

to discover safe and profitable ways of farming steep lands.

Hillculture has under way such projects as production of sumac for use in tanning fine leathers, milkweed floss as a substitute for imported Java kapok, and Devil's shoestring roots for the manufacture of insecticides. Remarkable progress has been made in improving the raising of tobacco on sloping land.

One of the outstanding achievements of hillculture has been in developing the shipmast locust for use as posts, a great improvement over the abundant crooked-trunk black-locust stock.

A nursery is maintained at Beltsville. It is used to increase the growth of superior erosion-resistant plants. Many native and exotic species and varieties are under study and propagation.

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METEOROLOGY

To Measure Cloud Ceiling

Balloon methods replaced by air-cooled mercury vapor lamp and a photoelectric unit. Light projected vertically is reflected by clouds.

➤ THE U. S. Weather Bureau has begun installations of a new photoelectric instrument, called the ceilometer, for measuring the cloud ceiling at airports. The CAA has also announced its approval of the ceilometer after exhaustive tests at the National Airport in Washington, D. C.

Up to the present time, information concerning ceiling heights has been obtained by balloon methods, which were not satisfactory. The new ceilometer, developed by Laurence W. Foskett and B. L. Hansen of the instrument division of the U. S. Weather Bureau, provides a dependable means of obtaining cloud ceiling heights which are vital to the safe arrival and departure of aircraft at an airport.

The equipment consists of an air-cooled mercury vapor lamp of 30,000,000 to 40,000,000 candlepower, and a photoelectric unit, the ceilometer. The mercury vapor lamp projector directs vertically an intense beam of light which forms a spot on the base of a cloud. This spot of light is detected by the ceilometer, and the angular elevation of the spot, and thus of the cloud base, is noted. An automatic facsimile recorder connected to the ceilometer gives the airport meteorologist a constant check on the cloud ceiling height. This information is transmitted to pilots of incoming and outgoing planes.

"The ceilometer can be used in bright daylight or at night, and under all types of weather conditions," Mr. Foskett said.

The cost of a complete installation is about $3,500. It is expected that a nation-wide network of ceilometer installations will be in operation within a year or two.

Carrying on work begun by the CAA, another new instrument has been developed by the U. S. Weather Bureau in cooperation with the National Bureau of Standards and the Navy Department. This instrument, called the transmissometer, gives an automatic record of visibility by measuring the transmission of light through the atmosphere. Like the ceilometer it uses a powerful light projector and a photoelectric unit. The projector and photoelectric unit are set on the ground, about 2,700 feet apart, with the beam of light focused on the photo-cell. A recorder indicates the percentage of light transmitted which reaches the photo-cell, and by an automatic mathematical calculation the meteorologist is able to determine the visibility.

Both of these new devices are expected to be of valuable aid to post-war flying, enabling airports to have a minute-to-minute record of both cloud ceiling and visibility.

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ENGINEERING

Portable Fog Generators Can Blank Out Entire City

➤ NEWEST DEVICE for the protection of our troops as they storm the bastions of Fortress Europe, the midget M2 fog generator, was given its first public showing by the Chemical Warfare Service at an Army exhibition of weapons and equipment in Washington, D. C.

This fog generator is a compact, highly portable, trimmed-down but more efficient version of the M1 device that has done great service in North Africa, Sicily and Italy. Wholly automatic in operation, it uses the same materials and produces the same kind of concealing white cloud. Under proper atmospheric conditions, a CWS company equipped with 48 M2's could fog out a whole city.

Big advance in the M2 generator is in its compactness and portability. It is only one-twentieth as bulky as the M1. Its dimensions are hardly those of a small steamer trunk; it is light enough to be carried on the back of a jeep. Four husky men can pick it up and carry it over rough ground or up rocky slopes. It can be hidden behind a low bush or set down in a fox-hole.

This does not mean that the M1 fog generator is headed for the scrap-pile. This big machine, looking a good deal like an old-fashioned circus steam calliope, will still function around permanent large installations that need concealment from enemy planes, such as airfields, seaports and railroad yards. The M2 will take over in the fighting zone, where high mobility and inconspicuousness as a target are at a premium.

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CHECKS CEILING — Airplane pilots can have continuous information about the height of the clouds by means of this instrument, the ceilometer, shown here with Laurence W. Foskett, of the U. S. Weather Bureau, one of the inventors.