METEOROLOGY

Unmanned Weather Stations

Experimental ground-stations and balloons are being used to report weather automatically. Land-based units are able to operate some two months without attention.

By A. C. MONAHAN

See Front Cover

➤ AUTOMATIC weather reports will serve weather bureaus of the future with up-to-the-minute data for use in weather forecasting. They will come from thousands of isolated and widely separated stations from the Arctic to the Antarctic.

They will provide information from weather-breeding regions from which no reports are now received. They will need no attending crew. Reports will go on the air at regular intervals in radio code.

A few such stations are already in use experimentally, both in frigid and tropical climates. Their usefulness has been proven. Maintenance crews visit them every two months or so. Their reports are sent without further help from man, and they are given at the intervals for which the mechanism is set.

First Operating Model

The U. S. Weather Bureau, the National Bureau of Standards, the Army and the Navy have all had a part in their development. They are war-products, one might say, but work on them was started as early as 1935 by the National Bureau of Standards, under sponsorship of the Navy. The first operating model was completed in 1941 by the Bendix Aviation Corporation at Towson, Md., and several were placed in operation in the Pacific area the next year.

The United States is particularly interested in frequent reliable weather reports from stations along the Arctic Circle from the western Aleutian islands, across Alaska and northern Canada, Baffin island and Greenland. It is along this stretch that many storms breed that effect future weather in the north Pacific, continental United States, and air and surface shipping routes to Europe.

In developing these automatic reporting stations, lessons were taken from radiosonde. This method of obtaining weather data from high above the earth's surface, particularly for the benefit of aviators, is about a decade old. It, however, did not come into extensive use until during the war. It is now used regularly by the Weather Bureau, the Army and the Navy, the information obtained being interchanged.

In radiosonde, battery-operated electrical observation and radio-reporting instruments are carried high into the atmosphere by small balloons. Reports of temperature, humidity and pressure are sent almost constantly by radio code. The five-foot balloon ordinarily used expands in the decreasing atmospheric pressure as it rises, and is more than double that size at two miles or so up, when it bursts.

The instruments fall slowly to earth with the help of a parachute, and are frequently lost, but the observations are not lost because they were automatically recorded, as sent, on ground-based receivers.

Battery power is sufficient for the operation of the instruments in radiosonde equipment because the time in the air is relatively short. For the land-based stations, designed to operate some two months without attention, electric generators driven by gasoline engines are required. In addition to operating the various instruments and sending out powerful radio waves on the air to carry their reports, the engines are often needed for heating. The mechanisms used might fail to work in below-zero weather.

Special Housing

One essential in these land-based weather stations is their special housing. The eight-foot square building used must have a solid foundation to hold it in place in Arctic gales and tropical hurricanes, and also to provide an almost vibrationless setting for good instrument functioning. It must be well insulated against weather extremes, and automatically ventilated for instrument protection.

The generator set used gives both direct and alternating electric current. The first is used with the instruments, the second develops 115 volts and is primarily for the radio transmitter. An automatic clock is used to start the engine when needed. It starts the engine at the exact time when observations are to be taken and the instrument readings put on the air, much as the electric timer on a kitchen stove turns on the heat. The weight-driven clock is re-wound electrically when the generator set is in operation. A temperature control starts the engine when extreme cold makes it necessary.

A circuit selector set in the equipment ranks next to the generator in importance. It is composed of a number of synchronous motors so wired as to insert precision resistors into the keying relay of the radio transmitter. The resistors represent the actual recording shown by the meteorological instruments. These instruments are similar to those used in any weather observatory. They include a barometer, thermometer, humidity indicator, wind vane, wind velocity indicator and a rain gage.

Radio Antennae

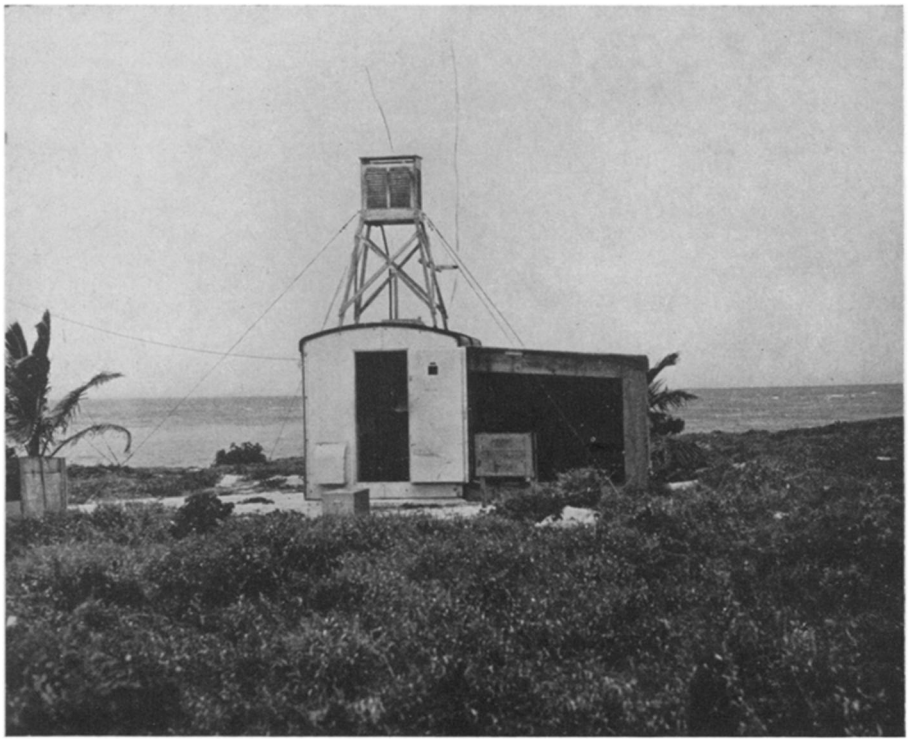
Two radio antennae stretch between two radio masts, 40 feet high and 75 feet apart. These masts must be strong to withstand all sorts of weather conditions, and positioned to provide projection in the particular direction desired. One difficult problem is securing good propagation from any particular locality in spite of terrain or other interference. Installations have to be "tailor-made" for the conditions existing at each station.

An assembly of instruments, including a vane, anemometer, and other wind equipment shown on the cover of this week's SCIENCE NEWS LETTER, are mounted on top of the radio mast.

The ideal set by scientists for weather reporting from the Arctic Circle is one station in every 300-mile stretch from the Aleutians to Greenland. Some would be manned, but many would be automatic. These latter will need servicing every two months and a supply of gasoline for fuel. Reaching them in some locations will be a dog-sled matter, at least until they can be reached by airplane or helicopter.

A typical station has an 80-gallon gasoline tank. Somewhat over half its content is used in a 60-day period under ordinary conditions. In cold weather, when heating is required, consumption is considerably greater. The amount consumed depends also upon the frequency of reports. For this reason, particularly hard-to-reach stations will report only at six-hour intervals.

How electrical readings are made with



AUTOMATIC WEATHER REPORTING—This shows a typical unmanned station used by the Department of the Navy. Electric generators driven by gasoline engines allow it to operate some two months without attention.

meteorological instruments is not a complicated matter. In the radiosonde, for instance, the electric hydrometer used contains a lithium chloride material that absorbs moisture. The higher the humidity, the greater the amount of electricity it transmits.

The temperature is measured by a ceramics resistor. As it gets colder, fewer electrons flow through the resistor. A diaphragm, which contracts and expands with the pressure of the surrounding air, measures atmospheric pressure. The diaphragm as it moves makes a changing electrical contact.

Weather forecasting for days ahead, as well as for 24-hour forecasting, needs constant information from many strategically-placed reporting stations. Some of these are great ocean regions where there is no land for land-based stations.

The weather over the Pacific far offshore from the continent affects the Pacific coast. Conditions over the Atlantic east of Florida must be known by pilots taking off for transoceanic flights. In these, and other areas, airborne weather-reporting stations are now in use.

Westward daily flights circling over the Pacific from California to Alaska by Department of the Air Force planes are reporting hourly the conditions encountered. Daily flights in the Bermuda-Florida and the West Indies region are reporting Atlantic conditions.

An adapted automatic station, similar to those used on land can be used on these planes. It would probably furnish a better system than the one used now by some planes on which readings are taken by crew members, and the data transmitted to shore bases by radio.

Weather reports are international in interest. Some day, through international cooperation, thousands of automatic and other stations will cover the world—for the benefit of all.

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GENERAL SCIENCE

Small Navy Force Returns To Map Antarctic Area

➤ A SMALL Navy expedition of two ships and approximately 450 men will leave this month for the Antarctic to continue some of the projects begun by last year's large task force into the southern polar continent.

Two icebreakers, the USS Edisto and the USS Burton Island, will make the long voyage south with a party of military and civilian scientists. The Edisto will leave an East Coast port, probably Norfolk, Va., early this month, while the other icebreaker will depart from San Pedro, Calif., about Nov. 20. The vessels will meet at Samoa early in December before proceeding to the Antarctic.

Chief job of the expedition will be to continue the mapping of the least-known continent. This will include further study of the Antarctic "oases", discovered early this year by the 1947 expedition.

The first postwar Navy venture into the Antarctic, which sailed less than a year ago, was the greatest in history. Four thousand men and a dozen ships comprised the task force which was commanded by Rear Adm. Richard H. Cruzen, now senior member of the Naval Review and Clemency Board.

Lt. (jg) R. G. Thompson of the Navy's Hydrographic Office will head a group of civilian and military scientists who will conduct mapping work on the expedition.

The ships will head into the Ross Sea and visit the famous base of retired Rear Adm. Richard E. Byrd, Little America. At Little America a check-up will be made on weather and time effects on equipment left there last year.

The expedition will be in the Antarctic for that continent's summer, our winter months.

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