RADIO

Forecasting for Radio

Warnings of approaching storms which will interfere with shortwave broadcasts can now be made in sufficient time to be used in routing important messages.

By MARTHA G. MORROW

➤ MEASURING radio echoes is one of the techniques perfected under war secrecy that allows science's most accurate radio forecasting, a new service to radio operators and the public. Radio experts can now warn of approaching storms in the ionosphere which will interfere with shortwave broadcasts from such overseas points as London, Stockholm and Moscow. What is also important is that these forecasts, like weather forecasts, are made in sufficient time to be used in routing important messages and broadcasts.

Several days ahead the forecasters venture a guess, based on careful observations and calculations, as to whether the radio reception on shortwave sets will be good or bad. Three months in advance they predict the best frequency for large radio companies and radio amateurs to use in getting messages through to listeners in such distant places as Athens, Tokyo and Lima.

Echoes from radio reflecting layers in the upper atmosphere, spots on the sun, absorption of radio waves and other such information is used in these latest of science's forecasts. Detailed records painstakingly made in the past and up-to-the-minute communications telephoned and telegraphed daily from research stations all over the world are used by radio experts at the National Bureau of Standards in making these predictions.

Interestingly enough, both radar, one of the great developments of the war, and this new radio forecasting can be traced back in their scientific beginnings to radio echo experiments conducted at least two decades ago.

The S O S of a ship in distress at sea, the beam that guides a plane to a safe landing in a cloudburst, the messages with which explorers keep in touch with those at home, and the globe-encircling signals of radio amateurs and professionals are all made possible by reflection from one of the ionized layers. These layers consist of atoms with all the electrons knocked out. Even the lowest of the layers is many, many miles above the earth, several times higher than a man has ever gone in either plane or stratosphere balloon.

When a sending station issues a series of radio signals, the energy travels in two ways. One wave travels along the ground, gradually becoming less powerful as it spreads out over a greater area and as energy is absorbed from it. The sky wave travels upward until it reaches the ionized layer of the atmosphere and then is reflected back in much the same manner that light is reflected from a mirror.

A receiving station located only a short distance from the transmitting station will pick up the signal from the ground wave first, then receive it as an echo from the sky wave. A station a hundred miles or so away will probably receive only the sky wave.

Depends upon Frequency

Whether radio waves will be reflected by the lower ionized layer about 40 or 50 miles above the earth's surface, or whether they will penetrate it and continue up to some greater height, to be reflected by one or another of the higher layers, sometimes extending 250 miles above the earth, depends upon the frequency or wavelength of the impulse.

The greater the frequency or the shorter the wavelength, the higher will the radio impulse penetrate into the ionosphere and the longer will be the time interval before the echo returns. The maximum frequency which will be reflected by each layer, called the critical frequency or maximum usable frequency for that layer, varies with the time of day, season of the year, longitude and latitude, and also with solar activity as shown in the sunspots.

In broadcasting overseas, it is best to use one of the highest permissible frequencies because. when too low a frequency is used, the radio waves tend to be absorbed by the ionosphere. The frequency that a powerful radio station or "radio ham" uses in broadcasting a message would lie within the band of possible frequencies, between the highest frequency that will bounce back from the upper reflecting layer and the lowest frequency that will get through to the reflecting layer without being absorbed.

By combing files kept by astronomers as well as by broadcasters and radio listeners, and by checking day-to-day reports, radio experts at the National Bureau of Standards have noticed a number of general trends useful in making predictions. A higher radio frequency can ordinarily be used in daytime in winter than in summer, whereas at nighttime a higher frequency generally can be used in summer than winter. When the path of the radio waves, following the great circle, lies near the equator, shorter waves can be used in broadcasting than when the path goes through the polar regions.

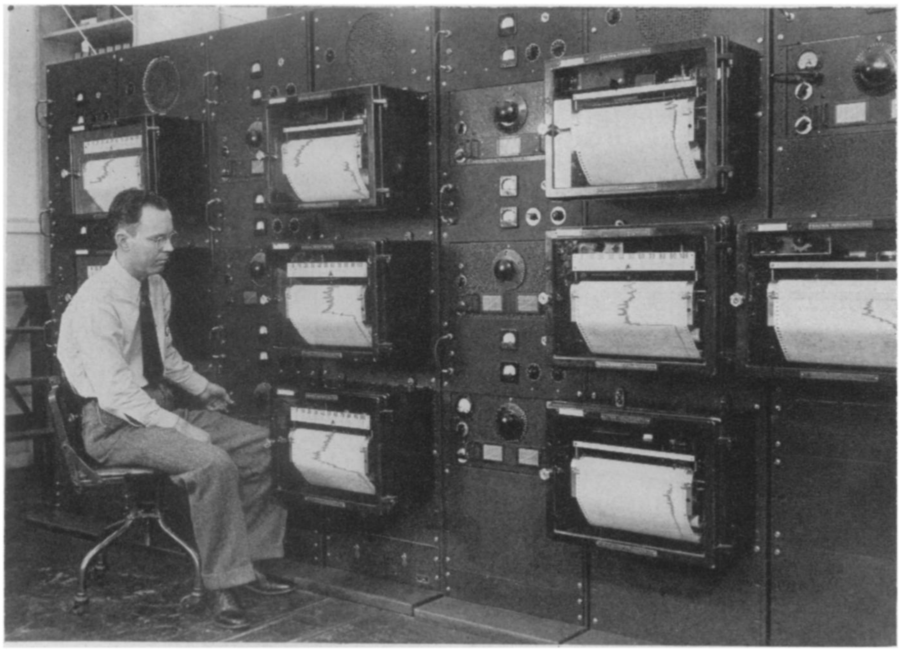
Shortwave broadcasts are more likely to get through when they pass through the equatorial regions than through the polar regions. Ionospheric storms start in the polar regions and from there spread out through the temperate zones. If the storm becomes violent, the reception of local broadcasts may become poor and telegraph messages fail to get through. Few violent storms, however, extend into the tropics, upsetting communications there.

When a broadcast is being sent by a station only 2500 miles or less away, conditions of the ionosphere midway between the stations are considered in deciding the frequency to use and in determining how loud or faint the reception will be. When the stations are quite far apart, however, the conditions of the ionized layer at two or more points must be taken into account. The lowest critical frequency of these points is the one which determines whether a message gets through or not.

Two Frequency Bands

When the stations are less than 2500 miles apart, two frequency bands are usually employed for communication or broadcasting. One is used during the day and the other at night. When the stations are quite distant, three or more frequencies have to be used. One is employed at night, one during the day, and a third, intermediate one, for hours around sunrise and sunset.

It is normally possible to use higher frequencies during the day than at night. The highest radio-reflecting layer, extending from around 100 to 250 miles above the earth, is always present, while the lower layers are present only during the day. It is the sun's ultraviolet rays that ionize the atmosphere. The upper



TEST STATION—Intensities of broadcasts picked up from ten test stations in such distant places as England, Honolulu, Africa and Chile are continually recorded at the Sterling, Va., Radio Receiving Station of the National Bureau of Standards. These records are used to study the amount radio waves are absorbed by the ionosphere.

regions, where the air particles are spaced so far apart, stay perpetually ionized. The lower ones, ionized during the day, return to normal at night.

Geomagnetic and ionospheric storms, experts at Interservice Radio Propagation Laboratory of the National Bureau of Standards found, tend to recur 27 days later, this being the time the sun takes to make a complete rotation so that the disturbed surface is again facing the earth. It is easier, they found, to foretell what radio reception will be several days ahead when sunspot activity is at a minimum than when the sun's face is quite pock-marked.

Prolonged, moderate disturbances are frequent during sunspot minimum. Briefer, more erratic storms tend to occur during sunspot maximum. But as data for a complete sunspot cycle, about 11 years, are not yet available, further study is needed to work out these general trends.

When an ionospheric storm is in progress, a lower and lower frequency must be used as higher ones escape through the ionized layer. On the other hand, more and more of the lower frequencies are absorbed and fail to reach the receiving station. When the frequency band is so reduced at both ends that nothing gets through, radio broadcasts are completely blacked out.

A warning of approaching trouble in the ionosphere which will make the announcer's voice sound mushy or weak, or cut him off the air entirely, is now being broadcast for paths across the North Atlantic. If broadcasts from London, Berlin and Paris are likely not to get through, "W's" (dot, dash, dash in Morse code) follow the time announcement over WWV at 15 and 45 minutes past the hour. Sent out from Washington D. C., the warning may be received at 2.5, 5, 10 and 15 megacycles, audible at almost any place in the world. If conditions are quiet, "N's" (dash, dot in code) follow the time announcement over the shortwave broadcast.

Radio experts, developing new techniques as they perfect this new type of forecasting, have a pretty good batting average. Checking the warnings with actual radio reception, it is found that they have warned of seven out of ten storms.

These forecasts are being developed to the point that those listening to a world-wide hook-up will no longer be bothered by having a broadcast from London ruined by sputters or having Moscow fade out entirely. Instead of those tantalizing pauses after the announcer says "Come in Berlin," it will be known in advance whether broadcasts from such far-off places can get through.

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AERONAUTICS

Maximum Speed for P-80 To Be Determined

➤ A SERIES of power dive tests by a remote-controlled Lockheed P-80 to be conducted in May or June will show Army Air Forces experts just how fast the plane can fly and give them information to be used in designing high-speed aircraft of the future.

Maj. Gen. B. W. Chidlaw, deputy commanding general, engineering, Air Materiel Command, said that a "mother" plane will guide the test craft on its dangerous mission.

He reported that the planes for the test are now being fitted out at Bell Aircraft Corp., Niagara Falls, N. Y., and they are expected to be ready within two months.

A television camera in the test plane will give a constant picture of the control panel, while a ground control unit will direct landings and take-offs and inform the "mother" ship of the technical operation of the robot craft.

Tests are scheduled to begin with dives at an oblique angle and build up to a perpendicular dive from a high altitude.

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