the deviation of a sample from its control. The data of this investigation were therefore studied in terms of the more directly measurable quantity, velocity. Now, the defining equation,

$$E=\frac{\text{stress}}{\text{strain}}=\frac{\text{load}}{\text{elongation}},$$

makes clear the direct relation holding between E and the resistance to elongation. In the light of this relation, eq (1) may be interpreted as saying that the speed of sound through a medium such as leather is greatest in the direction that offers the greatest resistance to elongation—that is, along the individual fibers.

In experiments with leather from cattlehide, the speed of propagation of sound varied with the lateral dimension of the specimen, increasing with width up to a certain maximum dependent on the wavelength of the sound. In cattlehide the fibers are oriented at random; consequently, there is no sound path directly along the specimen. That the speed of sound through a material like leather is related to fiber orientation was shown with vegetable-tanned sharkskin. In sharkskin, the fibers occur naturally in a highly oriented basket-weave pattern, the two fiber axes being mutually perpendicular in the plane of the hide. Specimens were cut so that sound could be transmitted either in the direction of a fiber axis or at a 45° angle with the axes. The specimens cut at an angle of 45° with the fiber axes should have sound paths roughly comparable with those existing in cattlehide, and a similar velocity-width relation would be expected. On the other hand, specimens with one set of fibers oriented in the direction of sound propagation should show no velocity decrease when width is decreased, since there is a sound path that goes directly through the specimen. For both types of specimen, experiment conformed to expectation. The 45° cuts showed the same sort of velocity-width relation as did leather, and in parallel cuts the velocity was independent of the width within experimental error. The velocity of parallel propagation was also observed to be greater than the maximum velocity in the oblique direction.

Additional evidence that sound propagation follows fiber orientation was obtained from experiments with kangaroo tail tendons. These tendons are composed of collagen fibers highly oriented along a single direction. The speed of propagation through the tendons was approximately 2,000 meters per second, or about three times greater than the speed in cattlehide.

Another study showed that the speed of sound through leather increases with period of aging at 100° C until it reaches a maximum. Therefore, an indication of the quality of a sample of leather may be obtained by comparing the speed of sound through the sample with the maximum speed in a control specimen that has been subjected to aging.

It is thus possible to detect changes in fiber orientation without harming the specimen by comparing sound-velocity measurements caused by strain, aging, and filling. Moreover, there is good correlation between sonic measurements and the results of tensile and breaking elongation tests. The effects of tannage, grease, and moisture can also be demonstrated. Finally, for an inhomogeneous material such as leather, the sonic technique has the distinct advantage of providing a means of following the effects of aging, chemical treatments, and the like on a single specimen.

[1] *For further technical details see* Studies on leather by means of a sonic technique, *by J. R. Kanagy and M. Robinson, J. Am. Leather Chemists' Assoc.* (in press).

Improvements in Standard Frequencies Broadcast by Radio Stations WWV and WWVH

IMPROVEMENTS have been made in the technical radio broadcast services provided by stations WWV, near Washington, D. C., and WWVH in Hawaii. Users may now make a better assessment of high-precision oscillators and clocks without waiting for correction data.

Broadcasts have been increased in accuracy from 1 part in 50 million to 1 part in 100 million. Also, broadcast frequencies at WWV are now normally held within plus or minus 1 part in a billion of the Bureau's primary standard of frequency. This is done if necessary by making daily adjustments at 1900 UT. The primary standard, which is constant to 1 part in a billion, is derived immediately from standard quartz crystal clocks which are evaluated over long intervals with reference to Standard Time from the U. S. Naval Observatory.

Time signals from WWV are maintained in close agreement with a new uniform time, called UT 2, determined by the U. S. Naval Observatory. This is done by occasional step adjustments in time of precisely plus or minus 20 milliseconds. Adjustments may be necessary several times a year. When required they are made on Wednesdays at 1900 UT simultaneously at WWV and WWVH.

The broadcast frequency from WWVH is now normally held within five parts in a billion of the primary standard. Adjustments are made, if necessary, at the station each day during the interval 1900 to 1935 UT.

During this same interval, the time signals from WWVH are adjusted, if necessary, so as to commence simultaneously with those from WWV, within plus or minus 500 microseconds.

Final corrections to the broadcast frequencies are available as before on a quarterly basis from the NBS Boulder Laboratories, Boulder, Colorado. Final corrections to the time signals as broadcast are determined and published on a weekly basis by the U. S. Naval Observatory, Washington 25, D. C.

The same six technical radio services are given continuously by the stations; they are: Standard radio frequencies, standard audiofrequencies, standard time intervals, standard musical pitch, time signals, and radio propagation forecasts. The radio carrier frequencies (2.5, 5, 10, 15, 20, and 25 Mc) are unchanged.

Recent additional modifications in the broadcast program are as follows:

(1) At WWV and WWVH, the time interval for the tones 440 or 600 cps is shortened from 4 min to 3 min. This gives longer intervals, free from modulation, which are useful in the assessment of high-precision frequency standards.

(2) At WWV, the tones 440 or 600 cps are interrupted precisely 40 milliseconds each second except at the beginning and end of each 3-min tone interval. The time pulse commences precisely 10 milliseconds after commencement of the 40-millisecond interruption. An additional pulse, 0.1 sec later, is transmitted to identify the beginning of each minute. As before, no pulse is transmitted at the beginning of the last second of each minute.

(3) WWV is off the air for approximately 4 min each hour. The silent period commences at 45 min, plus or minus 15 sec, after each hour.

(4) At WWV the tone frequency 440 or 600 cps, except on 25 Mc, is experimentally operated as a single upper sideband with full carrier. Power output from the sideband transmitter is about one-third the carrier power. Single sideband tone on 25 Mc may be added at a later date. Other signals (announcements and seconds pulses) remain at 100 percent amplitude modulation, double sideband.

(5) At WWVH the wave form of the seconds pulse now consists of 6 cycles at 1,200 cps tone.

(6) At WWVH the radio propagation forecasts at 9 and 39 min past each hour are for the North Pacific area. Those from WWV at 19½ and 49½ min past each hour are unchanged; they are for the North Atlantic area.

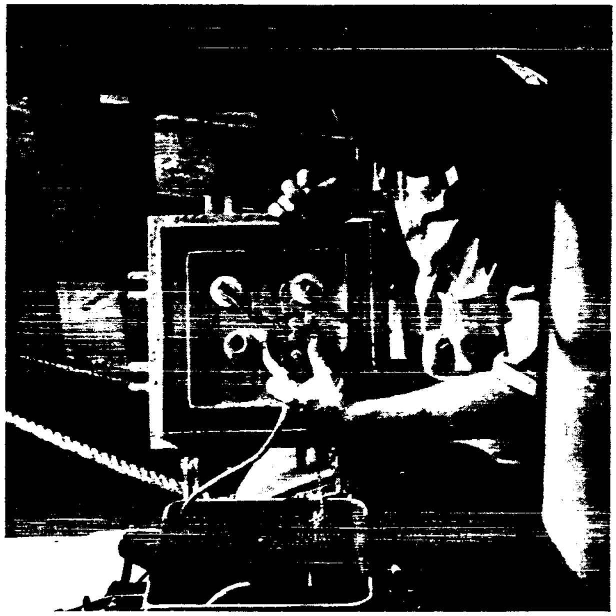
All inquiries concerning the technical radio broadcast services should be addressed to National Bureau of Standards, Boulder Laboratories, Boulder, Colorado.

An Ocean-Based Automatic Weather Station

THE BUREAU has developed a prototype marine weather station that automatically reports local weather data by radio. Incorporated in a buoy, the unit can be anchored in remote locations and left unattended for periods up to six months. At regular intervals throughout the day, the station broadcasts in code the air temperature, water temperature, barometric pressure, and wind speed and direction. Preliminary tests in Chesapeake Bay show that the station has a radio range in excess of 800 miles. The equipment was developed by P. D. Lowell, W. Hakkarinen, and L. M. Allison of the Bureau's electronic instrumentation laboratory for the Navy Bureau of Aeronautics.

At the present time the gathering of comprehensive weather data from many ocean areas outside of regular shipping lanes is haphazard and limited. Both military and civilian authorities would be better able to predict weather conditions if they received continuous weather reports from a much wider area. If a series of stations similar to the Bureau's prototype station were placed over wide areas of the Pacific Ocean, for example, they could give operations officers and meteorologists frequent reports making possible a complete weather picture for the entire ocean. If moored in certain areas of the Caribbean, these stations might also give warning of hurricanes as they begin to form.

The automatic station translates information from each of five weather-sensing elements into three-letter groups in continental code and transmits the coded signals on a pulse-modulated 6-megacycles per second carrier frequency. These signals can be received on standard communications receivers and compared with a decoding table which gives numerical values for each of the meteorological variables measured. A single transmission takes 3 minutes. During this interval six items of information are broadcast. The first transmission is a three-letter signal identifying the station. Coded transmissions follow containing information on (1) air temperature between −25° and +110° F, (2) water temperature between 15° and 90° F, (3) barometric pressure between 950 and 1,050



Part of the control equipment for the marine weather station. At regular intervals throughout the day the station broadcasts in code the air temperature, water temperature, barometric pressure, and wind speed and direction.