How did your Receiver Measure Up?

Frequency Test from 2YA

J. M. BINGHAM, A.M.I.R.E.,

Chief Engineer of the R.B.C., who conducted the frequency test from 2YA last week.

—S. P. Andrew, photo.

LISTENERS were given a chance to test the efficiency of their receivers by the frequency test put over the air by Mr. J. M. Bingham, Chief Engineer of the Broadcasting Company, last Saturday. This was the outcome of a request from the Hawke's Bay Radio Society. Nor was it the first of its kind for almost two years ago a similar test was carried out, and a great amount of interest was taken in it. No doubt it resulted in improvements to the designs of very many sets. Since then a great many new listeners have taken out licenses, and the tests were worth repeating. Prior to the tests Mr. Bingham explained the meaning and purpose of frequency tests.

All sounds which you hear, said Mr. Bingham, are composed of vibrations of the air. Some of the vibrations are very slow and some are very fast, and it is the combination of air vibrations of various speeds which give characteristic sounds. The lowest single speed or frequency of vibration which it is possible to hear is somewhere in the vicinity of 16 vibrations per second. This value may vary somewhat with different people, but, anything of a lower frequency than this is usually made manifest by the sense of feeling rather than by hearing.

The upper limit of audibility on the other hand is not so clearly defined. It may vary from 7000 vibrations per second to even 20,000 per second, depending on the person's physical makeup. Generally 12,000 vibrations per second can be taken as a good average for the highest sound frequency it is possible to hear. The range of sound frequencies therefore from 16 per second at one end of the scale to 15,000 per second at the other end is called the range of audibility.

IF we hear a musical note played on an instrument there are three characteristics which distinguish it from any other note. These are the pitch, the loudness, and the quality. The pitch is governed entirely by the number of air vibrations per second which give rise to that particular note. If a certain note is played on an organ and then another note an octave higher is played, the second note will have exactly twice as many vibrations as the first note. Loudness is self-explanatory, it really corresponds to the amount of energy put into the playing of a note. Quality, however, is a little more difficult to understand. It is that characteristic which enables us to distinguish between a note played on say a violin and the same note played on a cornet for example. The actual note may be the same in both cases.

It will have the same fundamental number of vibrations in both cases, yet, there is something about the two notes which enables our ears unconsciously to distinguish definitely that the first was played on a violin and the second on a cornet.

This characteristic is the quality of the note and is governed largely by the number of overtones present.

There are very few musical instruments which give absolutely pure tones. By this it is meant that they cause vibrations of one definite frequency only.

They emit the fundamental tone or note played on them, but in addition have other vibrations of higher frequencies superimposed. Most overtones are really harmonics of the fundamental frequency. The second harmonic has twice, the third three times, and so on, the number of vibrations that are present in the fundamental tone. Although these harmonics and overtones are frequently very weak, it is their presence, or absence, and relative intensities which enable us to distinguish between various musical instruments.

Wind instruments, for example, are designed with a view to securing overtones that are true harmonics of the fundamental frequency, but other instruments, such as bells and some organ pipes, do not possess any true harmonics although they are rich in overtones.

A flute possesses 1st, 2nd, 3rd and 4th harmonics, a clarinet has only 3rd, 5th and 7th. The mere omission of these even harmonics distinguishes between the tone of the two instruments.

Here Mr. Bingham demonstrated by a recording the difference between a flute and a clarinet.

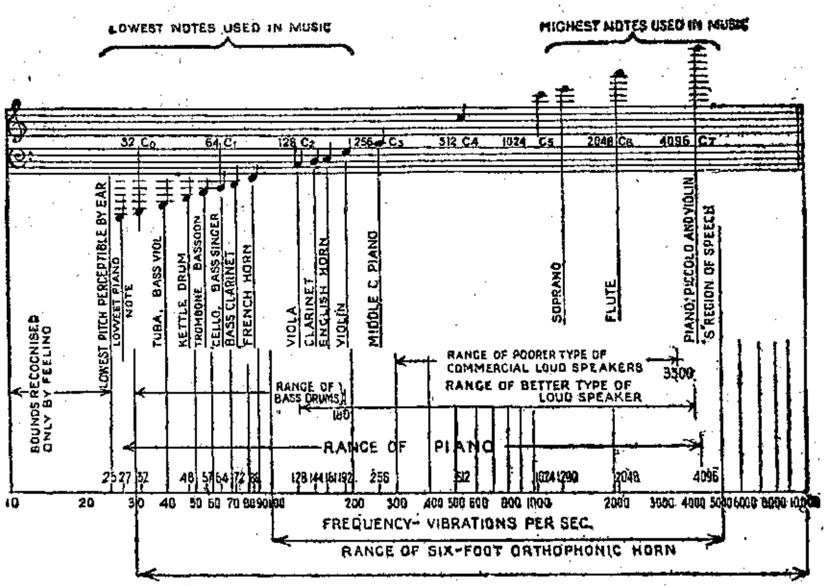
IF we wish to get the truest reproduction from our radio sets it is evident that our sets will have to be capable of faithfully reproducing not only fundamental tones of the musical scale, but all overtones and harmonics as well.

When we consider that the top note of the piano has 4096 vibrations per second, it is evident that to get even the second harmonic of this note, our sets will have to be able to reproduce a frequency of 8182 vibrations per second.

The top note on the piano is very rarely used and notes as high as this do not often occur in musical compositions. Acoustic engineers usually take C above middle C as an average value for the general musical range. This note has a frequency of 512 cycles per second, in Scientific or Physical Pitch. The third harmonics of this has 1536 vibrations which is quite high and necessary for reasonable reproduction of the characteristics of most instruments.

Unfortunately, so far as radio reproduction is concerned, there are several factors which make it difficult to obtain satisfactory reproduction of anything much over 7000 per second.

If musical frequencies up to this value can be satisfactorily received, there should be no reason why the full brilliance of all music reproduction should not be obtained.



A diagram to show the frequency ranges referred to by Mr. Bingham. The lowest arrows indicate the response of an ideal reproducer. The one above that of a good average instrument.

Lately there has been a lot of talk about "listening to the bass." This is all very well so far as it goes, but in the majority of cases the reproduction of the bass is at the expense of the higher frequencies, and the higher frequencies are really more important from the point of view of character and brilliance than the bass end of the scale. The bass end gives roundness. The high end gives brilliance.

Both are important, but one should not be obtained at the expense of the other, as unfortunately seems to be frequently the case nowadays. All frequencies from 60 per second to, say, 7000 cycles a second, should be able to be faithfully reproduced if the best is to be obtained from a radio receiver.

LET me now give a word of caution. Too much significance should not be placed on the following tests, for the simple reason that it is practically impossible for a person to judge relative intensities merely by ear. Neither should you worry if frequencies above 5000 per second commence to get weaker than the lower frequencies. All frequencies will leave 2YA's aerial at equal intensities, but the wavelength used and the selectivity of your receiver will have a marked influence on its response to the higher notes. All tones should, however, be audible to some degree.

The first tone which we transmitted was that of 50 vibrations per second. Some who had dynamic speakers in the receivers probably received this tone very well, as this is very close to the natural period of many dynamics.

For the purpose of comparison a note 3200 cycles per second or a note five octaves higher was sent out. A perfect receiver should have given these two notes with equal intensity, but their relative intensities could not be judged merely by ear.

Many receivers of the horn or small cone type probably gave weak reproduction of the lower note. Some dynamics should reproduce the lower tone quite well, but be weak on the high tone.

The next note was 100 cycles. This should have been well within the range of most receivers and is one octave higher than the 50 cycle tone.

Mr. Bingham then proceeded through a range of frequencies, calling the various tones as they were transmitted 200, 400, 800, 1600, 3200, 4500, 6400, 7500, 10,000 cycles. The notes between 200 and 3,200 cycles should have been evenly received by everyone. A large falling off in most receivers was anticipated above 6400 cycles.

AS an addition to the test a record entitled "Instruments of the Orchestra" was presented. It was observed that every instrument has its own characteristic tone. These tones are taken from a special gramophone record, and while a record possesses

(Concluded on page 31.)