BEKESY AUDIOMETRY

James Jerger

The Bekesy audiometer is a relatively new arrival on the audiological scene. During the short time that it has been widely available however many audiologists have come to have high regard for its diagnostic value. Some have even abandoned traditional, manually operated audiometers altogether and use the Bekesy audiometer exclusively. It is quite likely that this trend will continue. Within the foreseeable future the familiar manual audiometer may become obsolete as a diagnostic instrument in audiology.

The basic idea behind the Bekesy audiometer is that the patient records his own threshold automatically on an audiogram blank. When the audiometer is turned on, a pure tone of very low frequency comes into the earphone, and a motor causes the frequency to move slowly upward. At the same time another motor causes the tone to become gradually louder. As soon as the patient hears the tone he pushes a button. This reverses the loudness motor and the tone becomes gradually fainter. As soon as the patient doesn't hear the tone any more he releases the button. This reverses the loudness motor again and the tone gets gradually louder. The patient keeps doing this over and over; pushing the button when he hears the tone, and releasing the button when he doesn't hear it. All this time the frequency is moving slowly upward. In order to make a permanent record of these threshold crossings over the entire frequency range, a recorder pen is attached to the loudness motor drive. It writes out the threshold crossings on a audiogram form moving slowly under it. The audiogram form moves along at the same rate as the frequency of the pure tone to which the patient is listening. When the test is over, the patient has traced out his threshold from low to high frequency in the form of a zig-zag line on the audiogram form. Figure 1 shows examples of such threshold tracings. The midpoint between low and high points of the zig-zag line is ordinarily considered to be the threshold at any single frequency.

In order to use the Bekesy audiometer diagnostically we make two such tracings on each ear. The first tracing is made with a pure tone that is turned on and off rapidly. This is called an "interrupted" tone. The second tracing is made on the same audiogram form with a different color ink. During the second tracing the pure tone is left on all the time. This is called a "continuous" tone. The diagnostic value of Bekesy audiometry is based on the relationship between these two tracings, the "interrupted" tracing and the "continuous" tracing. There are four possible outcomes; Type I, Type II, Type III, and Type IV Bekesy audiograms. Figure 1 shows an example of each type.

In the Type I audiogram the continuous or "C" tracing overlaps the interrupted or "I" tracing. Both are about 10 db wide. The Type I audiogram occurs in normal ears and in disorders of the middle ear.

In the Type II audiogram the "C" tracing overlaps the "I" tracing at low frequencies. Somewhere between 500 and 1000 cps, however, it drops 10 to 15 db below the "I" tracing and runs below it but parallel to it all the way out to the high frequency end. In some Type II audiograms the width of the "C"tracing becomes quite narrow (3-5 db) in this high frequency region, but not always. Type II audiograms occur when the disorder is in the cochlea, but not all cochlear disorders show Type II audiograms. Some show Type I audiograms.

In the Type III audiogram the "C" tracing drops dramatically below the "I" tracing, sometimes as much as 40-50 db. The outstanding characteristic

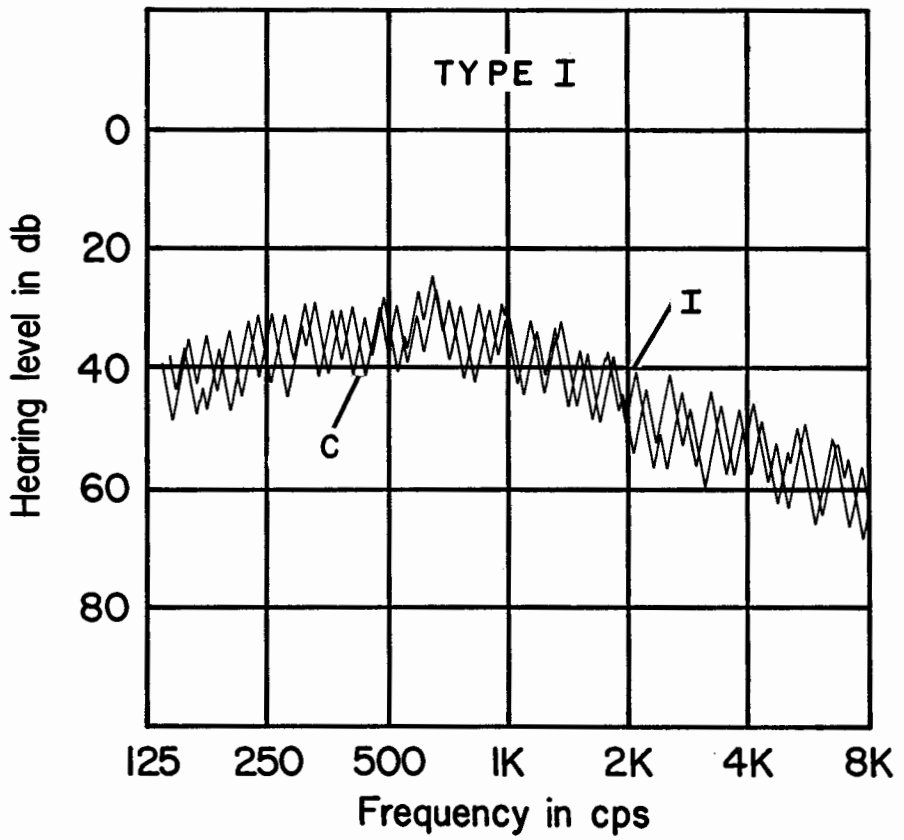

Figure 1a

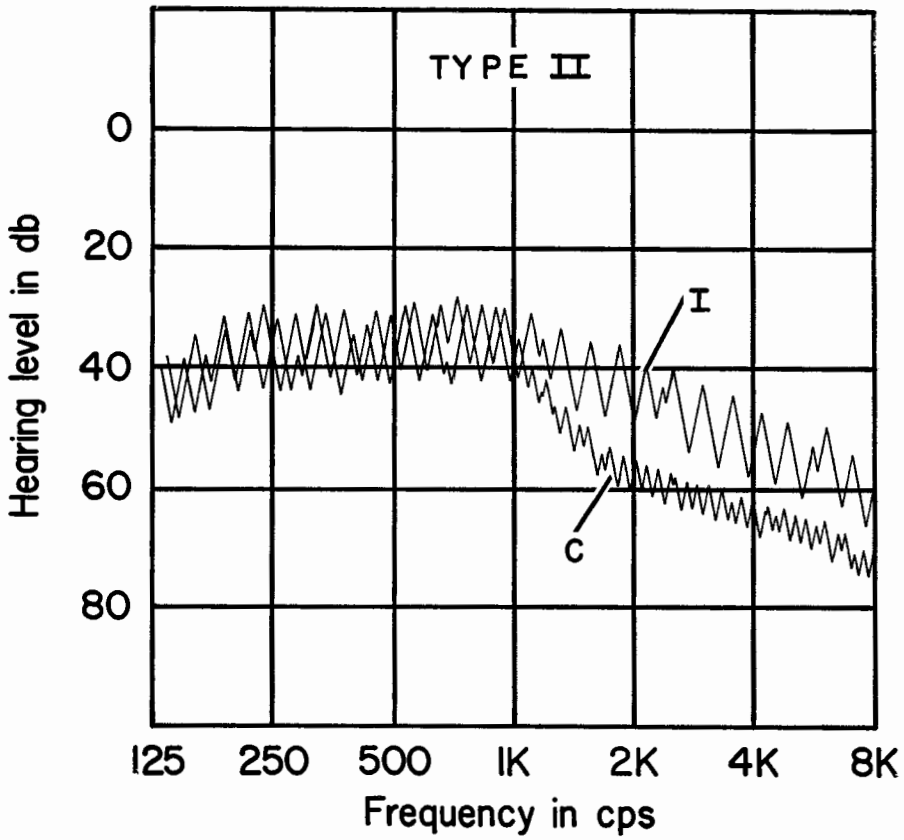

Figure 1b

of the Type III audiogram is that, once the "C" tracing starts to drop below the "I" tracing, it ordinarily continues down to the intensity limit of the equipment. The break may occur at almost any point in the frequency range. Type III audiograms occur in eighth nerve disorders but not all eighth nerve disorders show Type III audiograms.

In the Type IV audiogram the "C" tracing runs well below the "I" tracing at all frequencies but seldom shows the precipitous drop of the Type III. The Type IV audiogram differs from the Type II in that there is not the overlap at low frequencies characteristic of the Type II. Also, the difference between "C" and "I" is much greater in the IV than in the II. Type IV audiograms occur in eighth nerve disorders but not all eighth nerve disorders show Type IV audiograms. Some show Type III audiograms.

In summary, middle ear disorders show Type I Bekesy audiograms. Cochlear disorders show Type I or Type II. Eighth nerve disorders show Type III or Type IV.

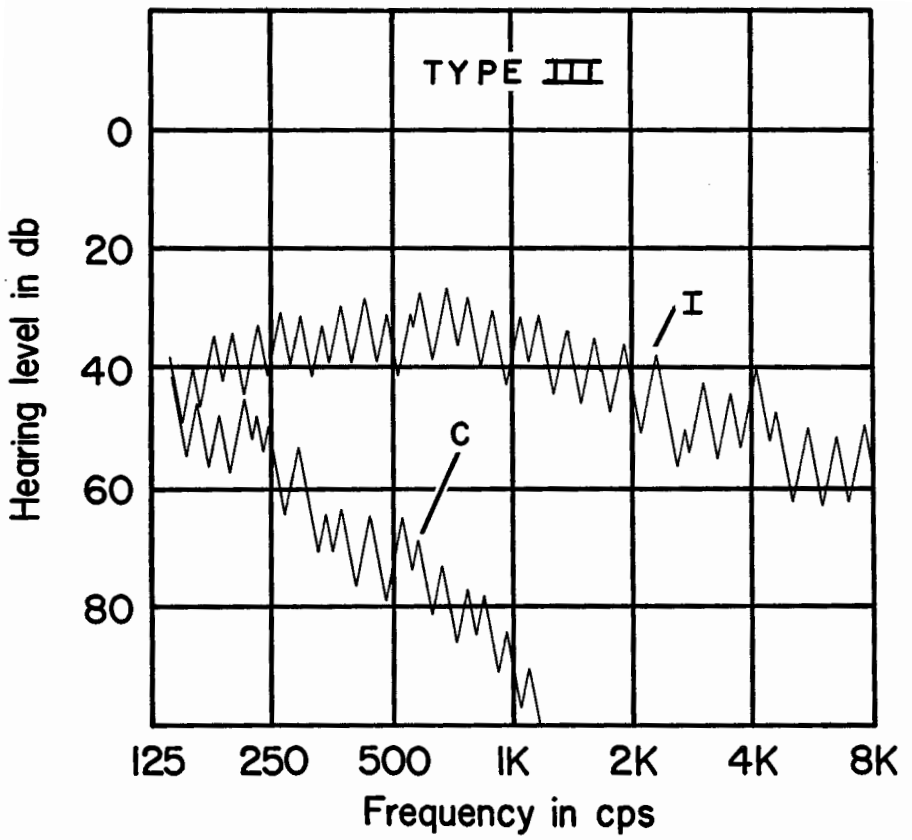

Figure 1c

You will recall that, in connection with the Type II audiogram, we said that the width of the "C" tracing sometimes becomes quite narrow in the high frequency region. In the past, many people have assumed that this narrowness was an indirect test of loudness recruitment. This is an erroneous assumption. It is unfortunate that it has caused so much confusion in the field. Like the SISI test, the width of the Bekesy "C" tracing is not an indirect test of anything. It is simply a phenomenon that may or may not happen when the disorder is in the cochlea. The fact that it may coexist with loudness recruitment in some ears does not mean that the two effects are necessarily causally related.

Many people ask whether Bekesy audiometry is not too complicated a procedure for patients to understand and execute successfully. This has not been our experience. I can recall only two or three patients in well over 700 in which Bekesy audiometry could not be done. In each of these patients conventional manual audiometry could not be done either. Certainly, however, patience and adequate instruction are important to this procedure.

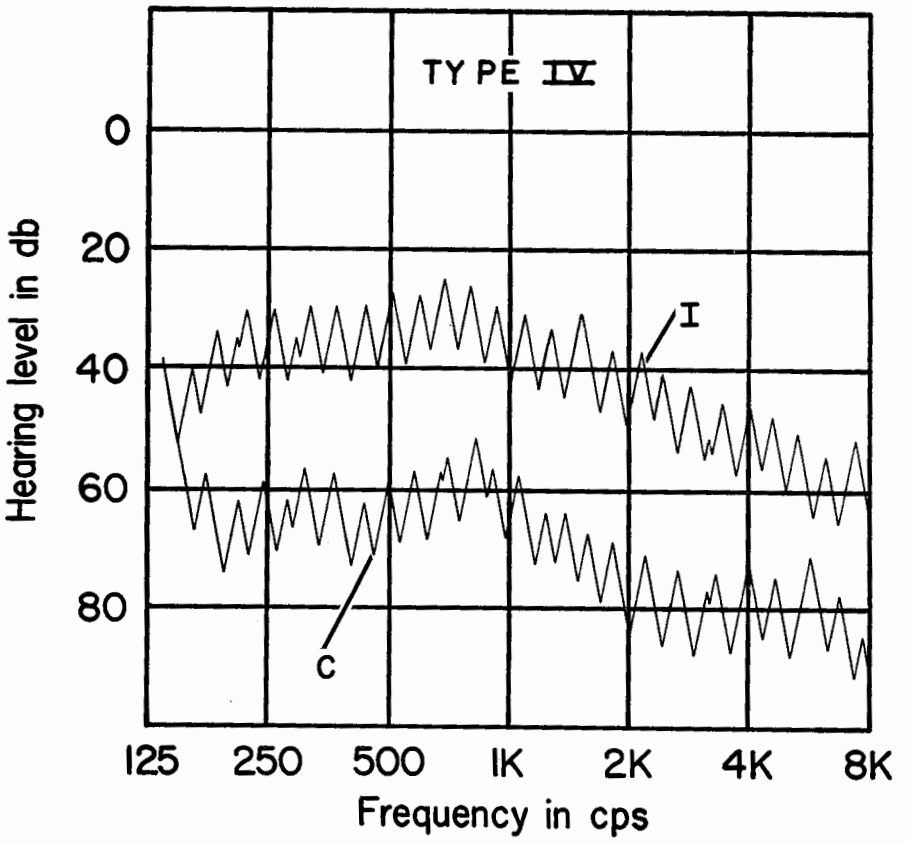

Figure 1d

AUDIOMETRIE DE VON BEKESY

La valeur diagnostique d'audiométrie de Békésy est basée sur la parenté entre les tracements commençants pour les tons continus et interrompus. Ils sont distingués quatre modèles distincts. Les moyens désordres d'oreilles montrent le type I déparenté. Les désordres de limaçons montrent le type I ou II de modèles. Les lésions de huitième nerf montrent le type III ou le type IV.

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