Thus, the method for measurement of the sound pressure, the kind of response that the listener is requested to give and, of course, the nature and manner of presentation of the sound are all factors that can influence the threshold of hearing. Therefore, one must use standard audiometric techniques and make direct comparisons of thresholds only under like circumstances.

D. NORMAL HEARING

Normal hearing is the threshold of hearing found in young people with no evidence or history of infection or other diseases of the ears. As with height or weight, their thresholds of hearing are not all the same, but are distributed over a range of sound pressure levels of about 25 db. This is the "range of normal hearing."[13] The thresholds of these young people are distributed throughout this range in a nonuniform manner, as are their heights and weights. Many are near the center of the range and only a few are at the extremes.

For convenience in comparing thresholds of hearing sensitivity, a decibel scale is used. The reference level for most hearing scales is set arbitrarily at the *commonest* (modal) threshold sound pressure level (not the *lowest* sound pressure level) for a group of listeners with normal hearing. The difference between this arbitrary reference level and the sound pressure level at the listener's threshold is called his "hearing loss." The use of the word "loss" here may be somewhat misleading because the smaller "hearing losses" lie within the "range of normal hearing."

Another common cause of confusion is the existence of "negative hearing losses." Since the reference level is the *commonest* threshold for normal listeners, there will be many whose threshold sound pressure level is less than the reference level. Thus listeners with "negative hearing losses" should be expected when any group of normal listeners are tested, under appropriate conditions.

Because "hearing loss" is a term reserved for a particular use, it should not be applied to the amount of hearing lost by an individual between two audiometric examinations. Such changes in an individual's hearing are called "threshold shifts." For example, a man has a 30 db "hearing loss" as the result of a "threshold shift" of 20 db. His original 10 db "hearing loss" may have been quite normal for *him* contrary to the misleading implication of the words "hearing loss."

E. PURE-TONE AUDIOMETRY

The instrument of choice in hearing-conservation programs is the air-conduction, pure-tone audiometer. This device presents a tone like that from a tuning fork to the ear of the listener. The hearing loss for pure tones is usually determined at a number of frequencies, and a graph of hearing loss vs. frequency is called an audiogram (Figure 24). Note that reductions in hearing sensitivity

[13] For a clear statement of the concept "range of normal hearing," see Council on Physical Medicine and Rehabilitation, Principles for evaluating hearing loss, *J. Am. Med. Assoc.* 157, 1408 (1955).

hearing losses, are plotted downward. Negative hearing losses are plotted upward, above the reference level indicated by the double line.

The dial of the audiometer that controls the intensity of the tone presented to the listener's ear is called the hearing-loss dial. The 0 db setting of this dial corresponds to a reference level for the threshold for pure tones that was derived from

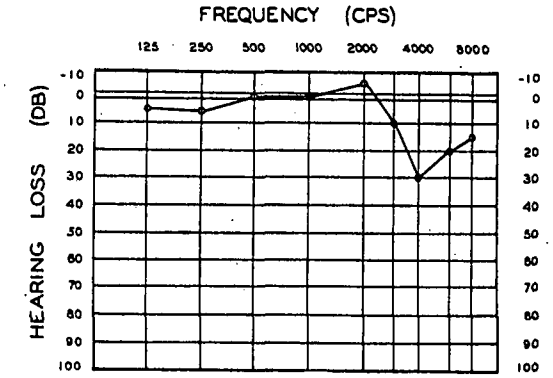

Figure 24. The audiogram, a method for recording audiometric data.

the commonest value of the thresholds of a large number of listeners with presumably normal ears measured in a survey carried out by the United States Public Health Service in 1935.[14] It should be emphasized that the reference level does not represent the best human hearing, nor the boundary between normal and abnormal hearing. The reference level does represent a threshold that is a few decibels more sensitive than a threshold in the middle of the "range of normal hearing."

On most audiometers, the markings on the hearing-loss dial extend from −10 db (an extremely faint tone) to 100 db (a very intense tone). The "range of normal" extends from −10 db to about +15 db, but the limits are not clearly defined. It is important to note that these values of hearing loss do not correspond to either sound pressure levels or intensity levels even though the units are decibels. This is because the reference for the hearing-loss scale is different from that for either of the two level scales and, in fact, varies from frequency to frequency as shown in Table 5.

A second major control on the audiometer is the frequency dial, which allows the operator to switch to any one of a group of test tones. Those required on

[14] National Health Survey: 1935–1936, Normal hearing by air and bone conduction, *National Health Survey, Prelim. Rept. Hearing Study Series, Bull.* 5, 1 (1938).