authored by the founder generation of the AOS including those of Roosa (5), Blake (6), Buck (7), and Burnett (8) as well as publications by others describing hearing test methods in the late 19th and early 20th century America.

The Voice Test

In 1887, An AOS Committee on ''The examination of the power of hearing'' chaired by H. Knapp concluded that: ''The human voice is generally acknowledged to be the most important test of hearing (9).'' This statement is consistent with the idea that perhaps the most common measurement of hearing used in the first 25 years of the AOS was the ''voice test'' or the ''whisper test,'' in which the human voice is used to infer the hearing status of the patient. Variants of this test are used in current audiologic practice with measurement of the speech reception threshold, which is widely used to cross-check pure-tone thresholds. Remarkably, the implementation of ''the voice test'' changed little during the early years of the AOS. In 1869, Anton von Troltsch recommended, ''. . .you must make a closer examination, by testing the power of hearing the voice and conversation. While one ear is being examined to this, the other should be closed by the finger of the patient, and you should speak slowly and distinctly, at first in a whisper. . . You must guard against deception, by seeing that the patient does not practice the habit of watching the mouth of the speaker... thus you will often be informed by a patient. . . that he hears much worse by twilight and at night in bed, than when it is light around him (10).'' In 1882, Winslow recommended, ''It is best to stand a few feet away from the patient upon the side of the ear to be tested, so that he cannot see the lips move, then ask him questions in a low voice. If he cannot hear, address him in a medium tone, and if he is still unable to hear what is said, raise the voice to even a shout if necessary. There are varying degrees of hearing for each tone, but low, medium, and high will be sufficiently exact for all practical purposes (11).'' Thirty years later, Barr provided a similar set of instructions, ''The patient and physician stand at opposite ends of the room, the ear to be examined turned towards the physician. The opposite ear is closed firmly by a finger to the meatus. Standing thus sideways to the physician, the patient cannot see his lips, and the element of lip-reading is eliminated. The physician now repeats the words or numbers which he chooses to employ, the patient having been instructed to repeat after him. If the patient cannot hear, or hesitates, or calls the word out incorrectly, the physician at once moves nearer and repeats the experiment, but using different words, but those having as nearly as possible the same sound values. The distance between patient and physician is thus reduced until one is reached at which the words are repeated promptly and correctly (12).'' The same author noted that differences in pitch, timbre, volume, etc., of different voices make it impossible to determine an exact level of hearing, but reported consensus that conversational speech can be heard at 60 to 70 feet.

Also noteworthy during this time was the awareness that some speech sounds may be audible, while others are inaudible. This point was illustrated in 1877 by Burnett, who articulated, ''The distance at which separate vowels can be heard has not yet been established, but they are endowed with the greatest strength of tone, being heard and understood at a distance at which all the consonants are inaudible (4).'' In his manual, Burnett subsequently provided distances at which various consonants could be heard, noting that ''H is the weakest of all consonants when not followed by a vowel. It is lost at a distance of a few paces. . .. Next in strength is B, Ba being heard further than Ha (4),'' and so on. Such comments are similar in spirit to the early studies of acoustic phonetics, which began in earnest during a similar time frame as to the beginning of the AOS, and were later reiterated by Politzer (13).

Because it was widely understood that the voice can vary tremendously between different individuals, some physicians attempted to standardize presentation of speech of these early attempts, the phonograph was perhaps the most widely used. In 1904, Bentley proposed, ''Instead of employing directly the voice of the investigator, and instead of relying upon acoustic and organic conditions which vary from experimenter to experimenter and from place to place, it proposes to use permanent phonographic records, which can be copied an indefinite number of times and can be reproduced independently of local conditions (14).'' Similarly, in 1890 Fiske noted, ''to sum up briefly we need a method of testing the hearing which shall 1, make use of human speech; 2, which shall be accurate and independent of the examiner; 3, which shall make a record capable of interpretation and use by other aurists (15).'' Fiske proposed using the ''phonometer'' developed by Lucae which would enable a recording of the assessment; this would allow for a record of each appointment, which could then be shared with other physicians as needed. Ultimately, however, the cost of the device, and difficulties with reliability meant that widespread use of the phonometer never occurred. The principles of standardized speech materials, presentation levels, and recording of the responses, however, reverberate through audiologic practice even today.

The Watch Test

In addition to the voice test, one of the most widely used measures of hearing assessment during the early years of the AOS was the ''watch test'' (Fig. 1 (16)). Indeed, it was often stated that, ''Thus far, the ticking of the watch has been found to afford the

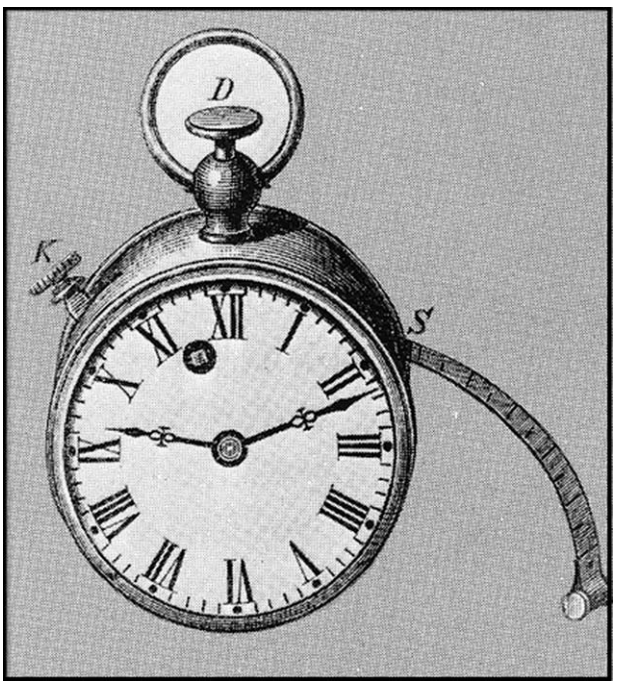

FIG. 1. A specialized watch for use in hearing testing from Bing 1890 (16). Hearing ability was recorded as the distance at which the watch tick could be heard. Note the attached tape measure used for this purpose.

Table showing the Disproportion between the Power of Hearing the Tick of a Watch and the Human Voice.[1]

No.	Sex and age.	Hearing distance for the watch.	Hearing distance for conversation, the patient being with the back to the speaker.
1	Female, 17.	R. laid/40, L. 0/40.	Words spoken loudly at 10 feet with difficulty.
		R. 4/40, L. 0/40.	Loud conversation at 20 feet.
2	Male, 45.	R. 0/40, L. 8/40.	Voice at 30 feet; cannot tell the direction from which sound comes.
3	Female, 28.	R. 7/40, L. 4/40.	Conversation at 20 feet.
4	Male, 56.	R. laid, L. laid.	Conversation at 20 feet.
5	Male, 62.	R. pressed, L. pressed.	Loud conversation at 20 feet.
6	Female, 23.	R. 5/40, L. 3/40.	Loud conversation at 6 feet.
7	Male, 9½.	R. 1/40, L. 3/40.	Loud conversation at 30 feet.
8	Male, 16.	R. laid/40, L. laid/40.	Conversation at 20 feet.
9	Male, 18.	R. 40/40, L. 30/40.	Conversation at 12 feet.
		R. 40/40, L. 40/40.	Conversation at 30 feet.
10	Female, 15.	R. 4/40, L. 8/40.	Conversation at 20 feet.
11	Male, 19.	R. 5/40, L. 10/40.	Conversation at 20 feet.
12	Female, 29.	R. laid/40, L. laid/40.	Conversation at 20 feet.
13	Male, 40.	H. D. R. ½/40, L. laid/40.	Ordinary conversation with great ease at 30 feet.
14	Female, 25.	R. 12/40, L. 6/40.	Ordinary conversation with difficulty at 20 feet.
15	Male, 32.	R. 0/40, L. 1½/40.	Conversation at 16 feet.
16	Male, 15.	R. 6/40, L. mastoid.	Conversation at 20 feet.
17	Male, 41.	R. 8/40, L. 0/40.	Conversation with ease at 40 feet.

FIG. 2. Table of hearing ability from Roosa 1885 (18) for watch tick compared with spoken voice both expressed in terms of distance from the sound source. The fraction 4/40 refers to perception of the watch tick in inches from the ear (4) over the distance with which a tick was heard for a normal ear (40).

best practical means of testing the capacity of the ear for distinguishing delicate sounds (7).'' The basic premise of this approach was to determine whether a patient could detect the ticking of a watch, and if so, then to determine the distance at which the patient could no longer hear the watch. A detailed and widely cited utilization of this approach was described in 1872 by Prout (17) (Fig. 2 (18)). In his report, he recommended the use of distance to estimate hearing acuity in much the same manner as the Snellen chart is used in the visual system. In his system, hearing acuity was recorded as a fraction. ''The numerator of which is the distance at which the particular sound is heard, the denominator the distance at which it should be heard by an ear of good average hearing power. This denominator must vary according to the sonofactor used, and should generally be expressed in inches (17).'' Thus, 12/36 would indicate that the ticking of a watch was heard at 12 inches, when it should have been heard at 36 inches. According to Prout, one advantage of using fractional distances was its potential applicability to any signal, whether a watch or a whispered voice. In retrospect, it is interesting to consider the use of distance to assess hearing acuity given that the American Otological Society initially began as an offshoot of the American Ophthalmological Society (see Jackler et al., elsewhere in this issue), and visual acuity as a function of distance is a key aspect of the testing of vision.

During the early years of the AOS, several recommendations were given to physicians to increase the accuracy of their measures or the diagnostic power of the watch test. For example, it was generally accepted that ''the distance at which the watch used is heard by the normal ear should be known by the examiner (11).'' Internal consistency in the testing approach was also reported to be a key step, as ''it makes considerable difference whether one hangs the watch by the finger, or holds it in the palm of the hand with the whole hand as a resonator (11).'' The watch was also used to assess hearing via bone conduction, ''The watch may be placed on the vertex or the forehead to determine roughly the condition of the middle ear and auditory nerve. . . If the watch is not heard when applied thus, it is pretty sure evidence that there is disease of the labyrinth or nerve (11).'' Finally, use of a stopwatch was widely recommended as well; the rationale behind this recommendation was that with a stopwatch, the ticking can be stopped or started, and in this way false positives (e.g., reporting hearing the watch when no ticking is present). In other words, use of the stop watch was a ''means of finding out whether the patient really hears the sound of the watch, or whether he thinks he does because he knows a watch is being held before his ear.'' This approach was reported to be particularly useful with children who ''as a rule, give erroneous statements as to their ability to hear a watch (11).''