

The Virtual Laboratory

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Seashore, C. E. 1899. New Psychological Apparatus, II: An audiometer. Studies in Psychology from the University of Iowa 2: 158-163

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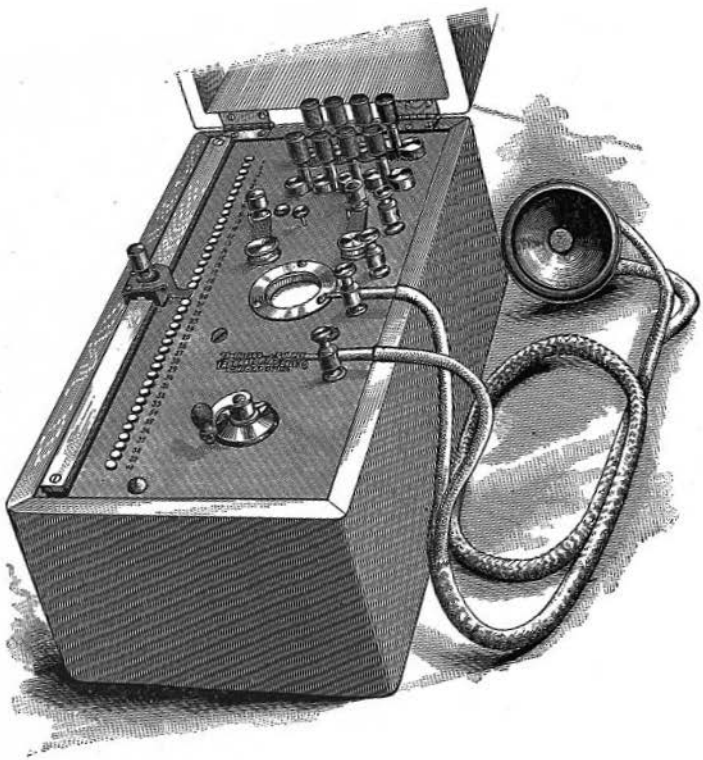
constructed a new tachistoscope which is adapted for use with the chronoscope. A face board contains an aperture 2 cm. high and 4 cm. long. Back of this is a double electric shutter which opens to expose the word or object to be seen. When the circuit in the electromagnets which keep the shutter closed is broken, one leaf of the shutter is drawn up and the other down by the action of two pairs of springs. In the opening, straight springs co-operate with coil springs making a quick exposure, but after the leaves have passed the aperture the former counteract the latter and thus minimize the vibration and sound of the shutter. The shutter exposes one section of a chance-wheel in which a series of cards may be inserted. The time for the exposure of any particular area can be readily measured with the chronoscope. This apparatus is also adapted for use in the usual tachistoscopic experiments in time exposure. It may be connected electrically with a pendulum which breaks and makes the circuit at measured intervals. This tachistoscope, like the chronoscope, has been made by the Chicago Laboratory Supply and Scale Company.

The following may be mentioned as special merits of this chronoscope: accuracy, adaptation for a variety of connections, soundless action, direct reading, ease and permanence of adjustment, and quickness and convenience of manipulation.

II. An Audiometer.

There exists a great demand for an instrument by which to produce and measure relative variations in the intensity of sound. Many instruments and methods have been devised for this purpose, but aurists and psychologists to-day measure the sound stimulus in terms of "my watch" or "my voice." The audiometer shown in the accompanying cut has been constructed primarily for use in the measurement of keenness



of hearing.[1] It is adapted to the needs of the psychological laboratory, the school room, and the aurist's office.

The essential and unique feature of this apparatus consists in the method of varying and measuring the relative intensity of the sound. This is accomplished by applying the principle that, for certain given relations between the primary and the secondary coils of an induction coil, the induced current varies directly with the number of turns of wire in the secondary coil. The complete apparatus consists of an induction coil, a battery, a galvanometer, a resistance coil, switches and a telephone receiver, all except the receiver being built into one compact and portable piece.

A dry battery is so connected that it may be thrown into the primary circuit of the induction coil by turning the left-hand switch. The galvanometer, seen through the crystal in the center, may be thrown into circuit by turning the right-hand switch. The fall of potential over the primary coil is reduced to the standard, e. m. f., by varying the resistance by means of the plugs at the farther end of the chest and gauging it by the galvanometer. The resistance permits of as small variations as can be detected by the galvanometer; and the galvanometer detects smaller variations in the current than can be detected by the ear at the receiver. The lever at the near end of the chest is a key which is used for the rapid closing and opening of the primary circuit in producing the stimulus. No current is drawn except for the moment that the circuit is closed by this key. The primary coil is longer than the secondary. The latter is wound in forty sections, arranged in a series according to the number of turns of wire that each contains, as may be seen in the accompanying table. Each of these sections is so connected with the surface terminals along the scale that the spring contact on the sliding carriage throws into circuit the number of sections indicated by the numbers on the scale. Therefore, to vary the energy communicated to the receiver in this circuit, it is necessary

[1] I am indebted to Mr. Charles Bowman, instructor in physics in this University, for much valuable aid in developing this audiometer.

only to move the carriage along the scale to the proper terminal. As it is most convenient to vary the stimulus in a geometric ratio according to the psycho-physic law, this principle has been taken as a guide in determining the scale of intensities of the sound. The numbers on the audiometer scale are given in the first column in the accompanying table; these indicate the corresponding number of sections involved in the secondary circuit. The second column gives the corresponding number of physical units in terms of the total number of turns of wire in circuit. The ratio of the increments in the sound is such that the forty steps in the series are, as nearly as can be determined, psychologically equal. The serial numbers on the scale are used in all readings. These measurements all refer to the strength of the current which energizes the receiver. The functional relation between the strength of current and the amplitude of vibration in the receiver is somewhat complex, but for the present purpose it may be regarded as fairly constant.

Table of Values for the Audiometer Scale.

I	*II*	*I*	*II*	*I*	*II*	*I*	*II*
1	1	11	13	21	58	31	270
2	2	12	15	22	68	32	315
3	3	13	17	23	79	33	368
4	4	14	20	24	92	34	429
5	5	15	23	25	107	35	500
6	6	16	27	26	125	36	583
7	7	17	32	27	146	37	680
8	8	18	37	28	170	38	793
9	9	19	43	29	198	39	925
10	11	20	50	30	231	40	1079

I, scale on the audiometer.
II, corresponding values.

The range of the intensity of the sound is such that it is not probable that any person can hear the weakest sound and all who can hear ordinary conversation at all can hear the strongest sound. The average threshold for normal ears lies near the middle of the scale. No delicate parts of the appara-

tus are exposed, and the battery, which is practically the only part that deteriorates, can be replaced without disturbing the adjustments. So long as the apparatus remains intact, the given relative measurements are constant for the same audiometer. Furthermore, the Chicago Laboratory Supply and Scale Company, which has taken great pains to perfect the mechanism of this apparatus, has one standard piece by which all audiometers made by them are standardized. Thus all who use this audiometer have a common standard and unit of measurement.

The relative scale of the intensities of the sound, the means of retaining the standard, the compact form, and simplicity and convenience of manipulation, are some of the merits in this apparatus.

For certain tests by aurists and experiments in the psychological laboratory, it is desirable to have a tone instead of a click for stimulus. Provision has been made for the production of tones in the audiometer. The inside connections are so arranged that by attaching a double contact electric tuning fork to the binding posts seen to the right, the fork may be made to interrupt the primary circuit of the audiometer and thus produce the tone of the fork in the receiver. This tone may be varied and measured in the same way as the regular stimulus.