SIMPLE CIRCUIT FOR MEASURING VARIATIONS IN ELECTRICAL RESISTANCE OF A HUMAN BEING UNDER EMOTIONAL STRESS

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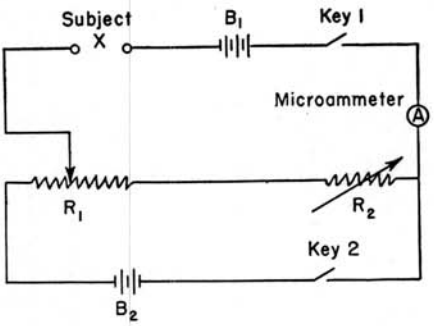
Variations in electrical resistance offered by the body of a human being under different circumstances of physical and mental stress have been known for some time. Darrow[1] in 1934 described a "reflexohmeter" which was improved upon and modified by Lauer and Anderson[2] in 1937. Many years previous to this, the studies of Leonarde Keeler brought forth the instrument known as the "electrocardiograph."

The Lauer instrument was used for several years in measuring the excitability of persons as one of several factors which were thought to be pertinent characteristics of a good automobile driver. The National Reseach Council, as it was organized at that time, together with the American Automobile Association and the National Safety Council used this device for several years. As an index of the intensity of its use, the author applied the Lauer "Responsohmeter" to some 2,300 persons during one summer. In each case, the instrument was balanced to give a null reading with the individual in the circuit. As the individual's tension increased, the electrical resistance was found to decrease, thus upsetting the balance of the circuit. It might be worth noting here that using palm contacts consisting of cups filled with salt water which were inverted, palm-of-the-hand, up, yield resistances which vary among individuals from about 4,000 ohms to nearly 30,000 ohms, when the cup diameter is approximately 4 centimeters. Under such minor excitations as the noise produced by slapping a desk top sharply with a ruler (behind the testee's back), resistance variations of the order of 2 percent may be expected. If the subject is "nervous," or if the particular stimulus carries great significance in the subject's pattern of evaluations, variations as high as 16 percent of the resistance may be found. Thus, a stenographer who is afraid of her dictatorial boss will show more response to the sound of a buzzer than she will show to a much louder automobile horn.

The principle of the device is that of the simple potentiometer. Two cells of comparable e.m.f. or voltage are connected in opposition to each other, each through variable resistances. The person tested is one of these resistances. Variations in his resistance occur as his perspiration varies. A time lag of from 2 to 7 seconds is observed between the stimulus and the maximum ammeter reading. A new setting or resistance level is used after each stimulus. These new settings are found after the resistance seems to stabilize which is usually a matter of a minute or two after the stimulus is given.



Sometimes a subject professes to be afraid of electrical wires. Of course, the total amount of "electricity" passed through the subject is less than that which redistributes itself in the process of combing the hair. A colleague suggests that "potentials" instead of resistances are responsible for the readings. Failures to date to find any polarity effects make the concepts of "potentials" difficult to accept.

To make the device readily portable, a simple microammeter was substituted for the galvanometer of the convential potentiometer circuit. A microammeter whose range is 0-30 mu when used with 4½ volts and 20,000 ohm resistances has proved to be usable.

Assembled into a portable unit, this becomes an instrument which is useful in motivating students who have occasion to study the potentiometer. It is useful as a means of measuring excitability of persons in unexpected situations—such as the study of characteristics of automobile drivers by Lauer and others. The statement has been made that no satisfactory way of measuring pain has been devised. Perhaps this device may be a step in that direction—at least it can measure the response to pain. It provides a simple means of studying some of the electro-chemical phenomena of human reactions without requiring a puncture or abrasion of the skin for contacts.

Since some interesting perturbations of the ammeter needle have been observed during the early stages of reponse to a stimulus, two proposals have been made for further study. One involves connection with an oscilloscope to study possible oscillotory character of the variations in resistance—or of potentials, if so they be. The other proposal is to incorporate a push-pull amplifier or similar device into the circuit to give greater sensitivity.

A popular usage of this device should not be totally neglected. While reference was made to Keeler at the beginning, it is not the intention to indicate that such a potentiometer circuit alone would be a suitable lie detector. However, the concern which the ordinary individual bears toward the winning of any game will cause enough increase in his perspiration at the palms to readily detect the little "white lie" when he denies his correct age, or similar incident. The usual procedure at social and service clubs is to instruct a subject to choose one number between one and ten. Then he is instructed to deny all suggested numbers. Try to beat it!

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[1] C. W. Darrow, The reflexohmeter (pocket type), *J. Gen. Psychol.*, 10, 1934, 238-239.

[2] Alvah R. Lauer and Donald E. Anderson, *Am. Jour. of Psychol.* 51:1, Jan. 1938, 156-159.