SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR ESTIMATING THE DEGREE OF MINERALIZATION OF BONES FROM TRACINGS OF ROENTGENOGRAMS[1]

FOR an adequate study of skeletal status as a part of a program of research in the field of human nutrition, it is desirable to have a technique for measuring the comparative degrees of mineralization of the bones of living subjects. For this purpose, Sanders,[2] in 1935, began to use a photometric apparatus in which a ray of light was directed through a certain area of a roentgenogram onto a photronic cell in circuit with a voltmeter; the deflection of the voltmeter was compared with that obtained when the light was passed through each of a series of steps of a density ladder on the same roentgenogram. Stein[3] reported use of a photronic apparatus in 1937 and suggested employing density ladders made of ivory for comparative purposes.

The use of a beam of light through a stationary film presents the difficulty of locating comparable bone areas in the roentgenograms of different subjects. To obviate this difficulty, the authors have rebuilt a Type B Moll recording micro-photometer, designed originally for making tracings of spectra, so that it can be used for obtaining tracings from one fixed landmark to another on a roentgenogram. The apparatus as it is now in operation is shown in Fig. 1. The modification of the original apparatus has consisted in substituting a photronic cell for the thermopile originally in the instrument, to obtain greater sensitivity and quicker response; in introducing a means of regulating the current through the light source; in providing for the continuous recharging of a storage battery in the circuit of the light source; and in introducing resistance into the galvanometer circuit sufficient to give critical damping.

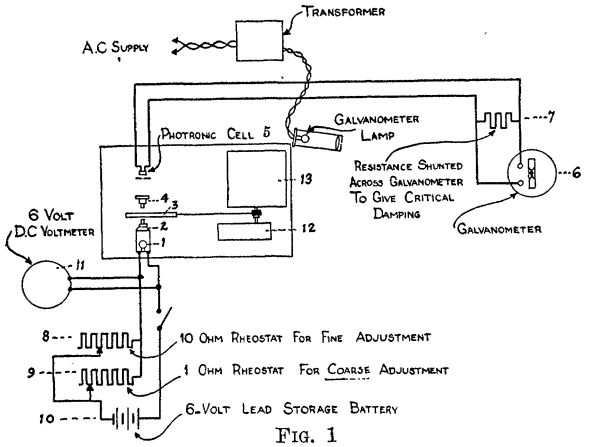

FIG. 1

In the rebuilt instrument, the light source (1) sends a beam of light through an objective (2) upon the film, which is fixed to the plate-holder (3). The light transmitted passes through a second objective (4) upon a Weston photronic cell (5). The photronic cell is connected with a galvanometer (6) (No. 1136 accompanying microphotometer No. 303, made by Kipp and Zonen, Delft, Holland) in a circuit in which resistance is shunted across the galvanometer to give critical damping (7).

The light source is maintained at constant voltage with a 10-ohm (8) and a 1-ohm (9) resistance in parallel with a 6-volt storage battery (10) in the light circuits, the former resistance for fine and the latter for coarse adjustment. A 6-volt D.C. voltmeter (11) in this circuit permits the voltage to be read. The storage battery is continuously recharged by means of a Retox type trickle charger with a capacity of about one ohm.

In making a tracing, the plate-holder is moved through the stationary beam of light by a spring motor (12), the speed of which is regulated by a magnetic damper. A cylindrical housing (13) encases a drum on which 12×40 cm. bromide photographic paper is mounted. A slot in the housing permits a beam of light from the mirror of the galvanometer in the photronic cell circuit to shine upon the photographic paper. The cylinder of the drum around which the photographic paper is secured is rotated by the same spring motor as that which moves the plate-holder; both the plate-holder and the circumference of the drum travel at the same rate.

The instrument as described is being used to make tracings of roentgenograms of both bones and teeth. By measuring with a planimeter the area between a tracing and a base or zero line, and recording the area per unit length of base line in comparison with the area between the tracing of a density ladder and the same length of base line, densities of similar sections of certain bones or teeth of two or more individuals may be compared, comparative densities of different sections of the same bone or of the same tooth may be found, and density values of bones or of teeth in terms of units of a density ladder of known mineral composition may be calculated.

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[2] A. Pauline Sanders, Ph.D. Dissertation, the Pennsylvania State College, 1937.

[3] I. Stein, *Am. Jour. Roentgenology and Radium Therapy*, 37: 678–682, 1937.