13505

A Photoelectrical Recorder for Biological Purposes.

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The conventional method of manometric recording of blood pressure in animal experiments with a mercury manometer and a float, which carries a writing point, has been essentially the same since Ludwig described it in the last century. A vertical kymograph and specially treated paper (lamp black, etc.) are necessary, as any substantial friction between the paper surface and the writing point causes the float to submerge. This happens occasionally in spite of all precautions. A comparatively wide manometer tube has to be used in order to support the float, which has to carry the writing point and to overcome the friction on the paper; a wide tube draws several cc of blood from the vessels of the animal, when a rise in blood pressure occurs, and therefore a manometer cannot be used in small animals.

To eliminate these shortcomings of manometric recording an apparatus was designed where the float is substituted by a light beam (Fig. 1).

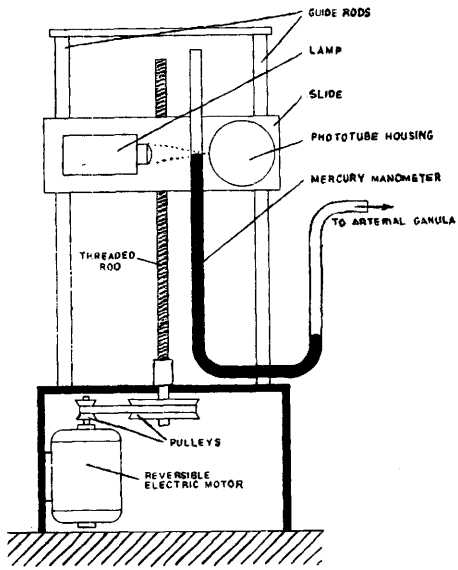

FIG. 1.
Schematic diagram of the recorder.

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A slide carries a lamp and a phototube. It has a female thread, which engages a threaded brass rod. This rod is rotated by a reversible electric motor. When the motor runs clockwise, the slide—and with it the lamp and the phototube—are raised, at a speed of 2 cm per second, and it is lowered at the same speed when the motor runs counterclockwise. After amplification† the phototube current operates a relay. The relay contacts are connected with the motor in such a way that the motor runs clockwise when the relay is open, and counterclockwise when it is closed.

When the light beam from the lamp strikes the phototube (the phototube housing has a hole 2 mm in diameter), the relay closes, the motor runs counterclockwise and the slide goes down, until the light beam is cut off by the mercury in the manometer tube. Then the relay opens, the motor is reversed and the slide goes up, until the light strikes the phototube again, and the cycle is repeated. This results in an oscillation of the slide at the level of the mercury meniscus; the stroke is 1 to 2 mm, the period ½ second. When the mercury level changes, the light beam, *i. e.*, the slide—phototube—lamp assembly, follows these changes. The maximal speed is 20 mm per second.

Fig. 2 illustrates a record of blood pressure, as obtained with this apparatus, with an ink-writer attached directly to the slide.

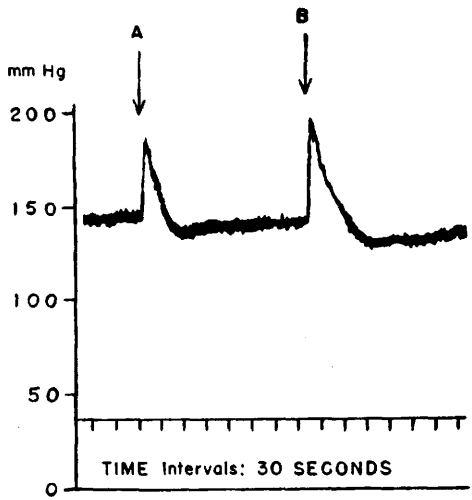

FIG. 2.

Record of arterial blood pressure with the photoelectrical recorder. Cat, 2.5 kg. At the arrows intravenous injection of adrenalin, at A—30 γ, at B—50 γ.

† A conventional phototube amplifier is used. Blueprints of the electrical circuit will be sent by author upon request.

The limitations of the apparatus are determined by its mechanical characteristics. They come near to those of the mercury manometer itself. For a close analysis of the pulsewave, however, an inertia-free manometer and photographic recording are still necessary. The advantages of the photoelectrical recorder are as follows: 1. Any kind of recording can be used, as the power is supplied by the motor. An ink writer on a horizontal kymograph using a paper roll can be connected to the slide. 2. A very thin mercury column can be used; thus the amount of blood entering the manometer system upon a rise of blood pressure is substantially reduced. 3. The deflection of the manometer can be amplified by mechanical means (in the mechanical connection of the slide with the writer) and by inclining the manometer tube; the amplification factor is $1/\cos \alpha$, where α is the angle between the tube and the vertical. 4. Colored water can be substituted for mercury, *e. g.,* for recording venous pressure, intestinal pressure, etc.

The use of this apparatus is not limited to manometric recordings. Any lever with a broad pointer can be substitued for the manometer, and the light beam will then oscillate at the level of the upper margin of the pointer. All difficulties due to the contact of the pointer with the recording paper are thus eliminated. By removing the lamp from the slide and setting the apparatus in a horizontal position, it can be used for recording deflections of a reflecting galvanometer, eliminating the inconvenient photographic methods.

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Demonstration of Rh Antibody in Breast Milk.

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Landsteiner and Wiener[1, 2, 3] recently described a new blood factor referred to by them as the Rh factor. Rabbits and guinea pigs when treated with rhesus monkey blood, produced antibodies that

[1] Landsteiner, K., and Wiener, A. S., PROC. SOC. EXP. BIOL. AND MED., 1940, **43**, 223.

[2] Landsteiner, K., and Wiener, A. S., *J. Exp. Med.*, 1941, **74**, 309.

[3] Wiener, A. S., and Peters, H. R., *Ann. Int. Med.*, 1940, **13**, 2306.