In the Laboratory

A Modification of the Ergograph

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The ergograph is used in physiological and psychological laboratories where it is desired that muscle work be measured and recorded. These instruments are costly and are usually designed to record upon a single type of kymograph or at one height. The ergograph to be described is relatively simple to construct, is durable, and can be adjusted readily to record at any height upon various types of kymographs.

An essential feature of the instrument (Fig. 1) is a metal base on one end of which is a wrist support, consisting of a curved wooden block with adjustable metal plates to contact the wrist, and a hand grip. On the other end of the base is a rigid vertical rod. The rod is arranged with a pulley proximal to the hand, another at the top, and two on the distal side. The ring into which the finger is fitted is connected to one end of a stainless steel, flexible, twisted cable

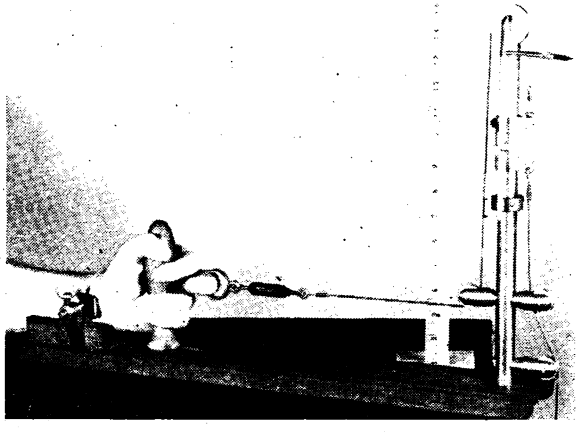

FIG. 1

by means of a turnbuckle. The cable then extends beneath the proximal and over the uppermost pulleys to end in a loop which is slipped onto a hook on the upper part of the sliding sleeve. This sleeve is constructed with a key or pin which slides in a groove in the rod, permitting free movement up and down but preventing rotation. The sleeve carries on its surface a post with a knurled setscrew which tightens against the stylus to permit vertical and lateral adjustments. The end of the stylus is slotted and has a piece of flexible X-ray film fastened in place by means of a sliding collar. The looped end of a second stainless steel cable extends from the lower hook on the sliding sleeve and across two pulleys, ending in a hook on which the desired weight is hung. A collar is fixed at the desired height on the vertical rod by a setscrew and serves to arrest the sliding sleeve.

Operation: The wrist is laid in the support and the hand support gripped. The hand grip is then fixed at a comfortable position, the wrist support adjusted, and one finger placed in the ring. The desired weight is suspended from the hook on the end of the second cable. The stylus is adjusted vertically or laterally until its X-ray film tip touches the flat surface of the kymograph. Exercise is then performed at the rate which is desired, and a kymographic record is obtained of a definite weight being lifted through a measured distance.

Use of Wetting Agents in Histological Fixatives

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The quality of a tissue fixative is thought to be enhanced not only by a careful balance of its component ingredients but also by its speed of penetration (*2*). In the past, rapid penetration has been achieved by the addition of such substances as urea, acetic acid, and certain wetting agents (*1*).

To test the validity of the hypothesis that speed of penetration improves the quality of a fixative, a series of carefully prepared, well-known fixing solutions were employed, and to these, three wetting agents were added.

METHODS

Nine widely used fixatives were selected as follows: Zenker's, Carnoy's, Helly's, Bouin's, Allen's, Gilson's, Orth's, and Vandegrift's fluids (*3*), and 10 per cent formalin. All of the above solutions were modified in three ways by the addition of the following aliphatic substances: Tergitol-7; Tergitol-4; and Tergitol-08 (*4*) in the ratio of 3 drops to 100 cc. of fixative. Because of the known characteristics of these three agents in decreasing surface tension, it was hoped that the speed of penetration would be increased.

Because of their histological differences, homogeneous nature, large size, and ready availability, the tissues selected were sheep cerebrums and human liver. Pieces of tissue one inch square were cut and placed

in 250 cc. of the aforementioned fixatives for a period of 24 hours. They were then sectioned, and the average depth of penetration of each fixative was measured grossly. Those fixatives containing picric acid and potassium dichromate could be measured by color changes. Methylene blue was added to the colorless fixatives to obtain the same result. Pieces of the fixed areas were then dehydrated, infiltrated with paraffin, sectioned, and stained with Harris' hematoxylin and eosin by standard methods. Those preparations were studied carefully to evaluate the quality of fixation in regard to staining reaction and cellular preservation.

Results

Allen's fluid. The addition of the aliphatics did not appear to affect the speed of penetration of the fixatives, although the addition of Tergitol-4 gave the best fixation and staining qualities in brain tissue.

Helly's fluid. The addition of aliphatics resulted in a decrease in penetration and relatively marked changes in staining reactions. Although the addition of Tergitol-4 improved the staining qualities in liver, it was not as marked in brain. The quality of fixation was not noticeably changed in brain and varied slightly in liver. Tergitol-08 was comparable to Tergitol-4 in most respects, although the nuclear staining was poor.

Carnoy's fluid. There was only slight variation in penetration with the addition of the Tergitols. The fixation qualities were generally decreased, although Tergitol-08 with brain and Tergitol-4 with liver seemed to improve fixation.

Vandegrift's fluid. There was some variation in penetration with the Tergitols added. Thus, Tergitol-4 resulted in less penetration but improved fixation in brain, whereas Tergitol-7 gave equal penetration with improved fixation and less shrinkage. In liver, Tergitol-08 apparently gave maximum penetration; however, Tergitol-4 with decreased penetration showed better fixation.

Gilson's fluid. Penetration was generally improved in brain tissue with the addition of aliphatics. However, fixation was poorer because of the markedly increased shrinkage.

Zenker's fluid. In brain tissue, the addition of Tergitols -4 and -08 decreased penetration but improved fixation. In liver, Tergitols -7 and -08 decreased penetration of the fixatives but slightly improved the fixation and staining qualities of the tissue.

Formalin (10 per cent). The addition of the aliphatics, on the whole, resulted in little improvement. However, Tergitol-4 added to the fixative improved fixation in both liver and brain.

Orth's fluid. The addition of the aliphatics increased the penetration of the fixative, but usually resulted in poorer fixation and greater shrinkage. In liver, the addition of Tergitol-4 improved fixation and staining.

Bouin's fluid. The penetration of the fixative was not affected by the addition of the aliphatics. There was little variation in fixation and only slight changes in the staining reactions of liver and brain.

There was no correlation between the various fixatives, their pH, component ingredients, or supplemental Tergitol, and the degree of penetration or the quality of fixation, staining, and shrinkage. However, we found that Tergitol-4, when added to Allen's, Orth's, Vandegrift's, and Zenker's fluids and 10 per cent formalin, improved fixation and staining (Table 1). Also, Tergitol-08, when added to Zenker's fluid, improved fixation and staining (Table 2). All other combinations of fixatives and detergents showed either no improvement or a decrease in the quality of fixation and staining.

TABLE 1

Results With Tergitol-4 Added to the Fixatives

Fixative	Tissue	Penetration	Fixation	Staining
Allen's	Liver	0	0	0
	Brain	0	+	+
Orth's	Liver	+	+	+
	Brain	+	0	0
Vandegrift's	Liver	−	+	+
	Brain	−	+	0
Zenker's	Liver	+	0	+
	Brain	−	+	+
10 per cent formalin	Liver	0	+	+
	Brain	0	+	0

TABLE 2

Results With Tergitol-08 Added to Zenker's

Tissue	Penetration	Fixation	Staining
Liver	−	+	+
Brain	−	+	+

(−) = decreased penetration; (0) = equal penetration, fixation, and staining; (+) = increased penetration, improved fixation and staining.

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