not from sodium chloride disturbance. The results appear to refute the theory that sodium chloride metabolism is specially regulated by the adrenal cortex. They furnish further strong evidence, however, in favor of our first-proposed carbohydrate theory of cortico-adrenal function.

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THE PERIPHERAL ACTION OF BARBITURATES[1]

LIEB and Mulinos[2] and other authors[3,4] described the action of amytal in impairing vagus cardiac inhibitory effects. According to Swanson and Shonle,[5] this action was regarded as characteristic for amytal, since a closely related barbiturate, iso-amytal (1-methyl-butyl ethyl barbituric acid or pentobarbital), failed to produce a similar peripheral depression of the cardiac vagus in doses of 5 to 20 mgm per kgm.

In a large series of experiments, using dogs and rabbits, we confirmed the original observation of Lieb and Mulinos with amytal. We found that amytal in doses ranging from 50 to 60 mgm per kgm abolished the typical cardiac vagus effect, *viz.*, the cardiac inhibition which resulted from stimulation of the peripheral vagus. Experiments of a similar nature revealed the fact that this peripheral action of amytal is also exhibited after very large doses of pentobarbital-sodium and other barbiturates. The animals used in these experiments were kept alive with picrotoxin. Doses of pentobarbital-sodium varying from 40 to 100 mgm and barbital-sodium in doses of 500 to 1,100 mgm per kgm completely abolished the typical vagus response to faradic stimulation. Phenobarbital-sodium in doses of 100 to 350 mgm per kgm impaired but did not abolish the cardiac vagus effect. In all these instances where the peripheral vagus effect had been abolished by barbiturates, the central vagus effects, *e.g.*, the respiratory inhibition following the faradic stimulation of the central end, remained unimpaired.

The mechanism of the depression of the cardiac vagus function by barbiturates was disclosed by another series of experiments. The following facts relative to this problem have been ascertained:

(a) Pilocarpine (1 mgm per kgm) slowed the heart of barbiturate-treated animals which did not respond to peripheral vagus stimulation.

(b) Large doses of acetyl choline (0.1 mgm per kgm) produce vasodilation and cardiac inhibition in the animals which had received barbiturates.

(c) Doses of physostigmine (0.2 to 0.35 mgm per kgm) which were insufficient to produce slowing of the heart rendered the cardiac vagus sensitive to faradic stimulation. Also large doses of acetyl choline had the same effect after the blood pressure and heart rate returned to the original level.

These experiments suggest that the cardiac vagus impairing action of barbiturates is not an atropine-like action but probably a nicotine-like effect on the vagus ganglia.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE TYPE OF ERGOMETER

IN order that the greatest value may be obtained from many laboratory experiments in human physiology it is desirable that students, particularly those in the preclinical years of medicine, understand the relationship between basal manifestations and known amounts of activity. Ergometers, when constructed to give a reasonably accurate measure of the work performed, are usually so costly that one piece of apparatus is to be found in a laboratory. Hence experiments must be either done by very large groups or the experiment conducted as a demonstration.

It has been the policy in the author's laboratory to correlate to a maximal degree the effect of known amounts of activity with the various physiological systems. In order to do this a simple yet efficient type of ergometer has been devised of such a nature that each table of a special laboratory devoted to human physiology is equipped with this device. The arrangement has proven of great convenience, since students have an opportunity to evaluate the effect of graded activity upon such physiological manifestations as blood pressure, pulse rate, metabolism and respiration. A further definite advantage of the apparatus rests in the fact that preliminary measurements can be taken under nearly basal conditions, which is not true of many common forms of ergometer.

The ergometer is constructed at one end of a table, 72×30 inches, with legs of sufficient height that the usual type of clinical metabolism apparatus may be

[1] From the Department of Pharmacology and Materia Medica, Georgetown University, School of Medicine, Washington, D. C.

[2] Lieb and Mulinos, *Proc. Soc. Exper. Biol. and Med.*, 26: 709, 1929.

[3] Shafer, Underwood and Gaynor, *Am. Jour. Physiol.*, 91: 461, 1930.

[4] Garry, *Jour. Pharmacol. Exper. Therap.*, 39: 129, 1930.

[5] Swanson and Shonle, *Jour. Lab. and Clin. Med.*, 16: 1056, 1931.

rolled into place and adjusted to the subject without changes in the connections. It has been found that this area of table top is sufficient to permit a student to lie relaxed and yet allow space for a kymograph and the necessary stativs to carry the recording apparatus. The construction of the ergometer is very simple. This may be seen in Fig. 1. An upright

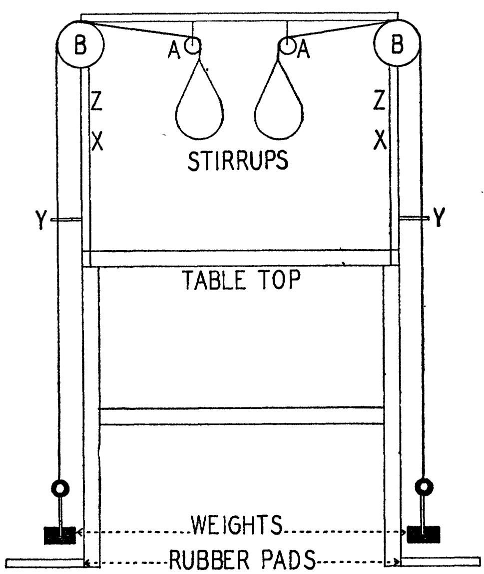

FIG. 1.

frame of 1-inch angle iron, 30 inches high by 30 inches broad, is bolted firmly to the table top by means of lag screws and braced by 1-inch × $\frac{1}{8}$-inch steel strips fastened at points X and to the table at a point 30 inches from the base of the ergometer frame. These steel braces serve a second purpose, since they may form a grip for the subject during the course of vigorous exercise. Work is performed by extension and flexion of the legs raising known weights. The subject lies in a supine position with each foot in a stirrup formed by a loop of cord. These cords each pass over two pulleys. One (A) is suspended from a swivel about ten inches from the angle of the frame. The second (B) is bolted to the frame in such a manner that the edge of the pulley gives adequate clearance, thus avoiding friction due to the rubbing of the cord against other parts of the structure. It has been found necessary to insert an eye bolt (Y) near the bottom of the ergometer frame to prevent oscillations and bumping. This further serves as a marker in measuring the distance the subject extends his leg. The cord terminates in an 8-inch eye bolt which is screwed into a 2.5 kilogram weight. The arrangement using a 2.5 kilo weight has been found to be about the most efficient minimum load we can use. Each pulley and cord is supplied with three additional weights so that a maximum load of ten kilos on each leg may be attained. The weights are made of cast iron in the form of a cylinder 4 inches in diameter and $1\frac{5}{8}$ inches high. A casting of gray iron of this size slightly exceeds 2.5 kilos when drilled with a $\frac{5}{8}$-inch hole, through which the eye bolt passes. It is a simple matter to drill away the remaining excess iron in order to attain correct weight. It has been the writer's experience that the most efficient cord or rope one may use is a $\frac{1}{4}$-inch steel tiller cable, which combines flexibility together with great strength. It has also been found desirable to put a soft rubber pad beneath each weight to prevent damage to the floor, although the apparatus should be so adjusted that in the zero position the weight just clears the surface of the cushion.

The operation of the ergometer is as simple as its construction. With the subject in the supine position with his feet in the stirrups and with weights added commensurate with the amount of work to be done, the basal readings are taken. At the same time the member of the group responsible for the ergometer marks with chalk the position Y on the steel cable and a second position Z on the frame. The point Z is determined by the distance the subject can extend his legs without danger of the weights hitting the table. It is not at all difficult during a preliminary test to adjust even a long-legged individual to such a position that the movement of the weights from Y to Z will represent a maximal extension without mechanical interference. During the period of work the subject alternately extends his legs in a predetermined rhythm, during which time a record of the number of kicks per minute is recorded. Knowing the height to which the weights are raised by each leg and the number of kicks per minute it is a simple matter to compute the amount of work done. We have found that flashing lights controlled by an electric sign flasher are very valuable in signalling the interval for extension and relaxation. Exercise of this type and in this position has a distinct advantage where apparatus must be carefully adjusted to the subject. We have found little difficulty in recording carotid pulse waves during quite heavy exercise without disturbance of the receiving tambour. On the other hand, the amount of work done using the ten-kilo load on each leg at a maximal rate is sufficient to build up a considerable oxygen debt in a short bout of exercise.

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A METHOD FOR MEASURING SWEAT OUTPUT FROM SKIN SURFACES

MEASUREMENT of the "perspiratio insensibilis" has interested investigators since Sanctorius in 1614 began his observations on the weight loss of the body by means of a large balance of his own construction. Numerous methods and devices have since been devel-