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

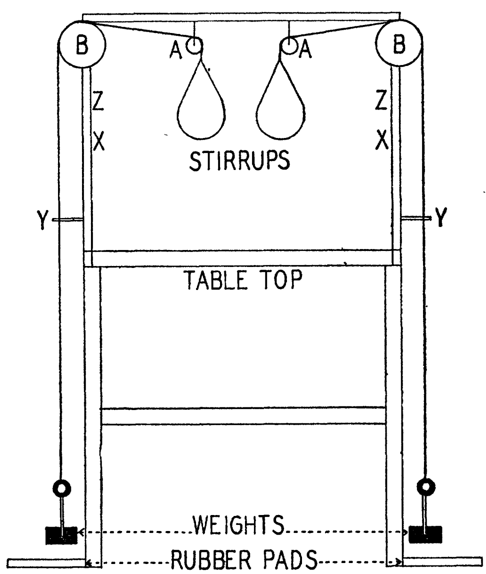

FIG. 1.

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 $1\frac{7}{8}$ 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 developed for determining the amount of the sensible and insensible perspiration and great degrees of accuracy have been attained; but all these are too cumbersome for routine clinical use.

With the idea of simplicity in method and equipment in mind, we have devised the following technique for the estimation of sweat output in terms of time with sufficient accuracy for use by the clinician. It must of course be considered an empirical method because the chemistry of the various hydrates of cobaltous chloride is extremely complex and still under study. The determinations by this method can not thus be considered precisely quantitative, but they do give a fairly accurate index of the amount of secretion.

PRINCIPLE

Cobaltous chloride is a salt of blue color in its anhydrous state, but which turns distinctly pink after taking up six molecules of water of crystallization. There are intermediate hydrates formed, containing less than six molecules of water, but none of these are of a pure pink color. The hydrates of cobaltous chloride readily give up all their water on heating to 140° C., forming the blue anhydrous salt. The color change may be graphically expressed by the following equation:

$$\underset{\text{(blue)}}{CoCl_2 + 6\,H_2O} \rightleftarrows \underset{\text{(pink)}}{CoCl_2 . 6\,H_2O}$$

METHOD

A special bibulous sheet is treated by immersion in a standard 10 per cent. solution of cobaltous chloride, allowed to dry and then cut into strips of suitable size for use. Any good grade of fine-grained perfectly white filter paper may be substituted. Just before use, the strips of this treated paper are thoroughly dried in an oven at 140° C. and then placed upon the area of skin to be studied and immediately pressed to the surface by an ordinary glass diascope. The time required for a complete change in color from blue to a pure pink is observed and recorded. Since the paper contains a standard concentration of anhydrous $CoCl_2$ when blue, and since it requires a definite amount of water to completely change this into the pink hydrate $CoCl_2.6\,H_2O$, the time observed for the color change corresponds to the time required by the sweat glands of the area under study to secrete this amount of water.

APPLICATION

Up to the present we have employed this method to determine relative changes in, rather than absolute amounts of, sweat secretion. Several patients under treatment with x-ray for a dermatosis associated with excessively sweaty palms were followed by this test to determine its practicability in measuring the progressive decrease of sweat secretion under roentgen irradiation. In Table 1 is a typical set of readings obtained at weekly intervals.

TABLE 1

	Initial reading	Irradiation	Second reading	Irradiation	Third reading
Right hypothenar eminence ..	1 min.		2 min. 30 sec.		4 min. 30 sec.
		125r		125r	
Left hypothenar eminence ..	1 min.		2 min. 45 sec.		4 min.

On several subjects with normal skins the test was used to measure the increase in sweating of the palms produced by the nervous effort of mental arithmetic. Determinations were first made with the subject at rest and immediately afterward repeated while the subject was given multiplication problems to solve mentally. The readings showed clearly the expected very definite increase in sweat output, by the diminution of the time required for the color change from blue to pink. Some actual figures obtained are given in Table 2.

TABLE 2

Subject	At rest	Doing mental arithemetic
A	9½ min.	4½ min.
B	10 min.	3 min.
C	10 min.	6½ min.

This method of measurement is in process of calibration, so to speak, by making simultaneous quantitative determinations by means of one of the older methods. But even without determining the absolute value of the sweat output the test has a definite practical clinical value in observing and recording the relative changes in local sweat output under treatment; or the increase or decrease of sweat due to nerve injuries; or the study of the influence of temperature, muscular exercise, emotions, mental effort, etc., on the sweat output of various portions of the skin surface.

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