We have used a Vreeland oscillator, giving a current of pure sine wave form with no direct current component, the frequency of which can be changed by small gradations between 7000 and 300 cycles per second. Since the time of stimulation is one-half of a cycle, the minimum time of stimulation may be determined, our results on the stimulation of gastrocnemius muscle of the frog in Ringer's fluid being 0.000079 seconds. With curarized muscle it was found that the minimum time for stimulation was increased to 0.00009 seconds. The tongue muscle required 0.00013 seconds. The minimal time for stimulation of smooth muscle could not be determined by means of the oscillator because a low enough frequency could not be obtained, but this presents no difficulty since Englemann was able to determine it in 1870.

This is a preliminary report.

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An Indirect Calorimeter for the Determination of O_2 and CO_2.

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The essential parts of the calorimeter are: (a) a tank containing about 300 litres of water; (b) 2 cylindrical spirometer domes in the tank, the capacity of each being 100 litres and height 1 meter; (c) a tank containing 5 kilos of 4 mesh soda lime connected with each spirometer with a 3-way valve; (d) a glass tube of 2.5 cm. bore shaped like the Greek letter π, one end of the horizontal portion being the mouth piece, the other closed by a rubber stopper at the moment the experiment is to begin, and the 2 vertical portions fitted with 4 cm. lengths of Visking sausage casings (to act as valves) and connected by rubber tubing to the 3-way valves. Each spirometer dome is counterbalanced by a weight fastened to a bicycle chain passing over a large bicycle sprocket wheel. The thickness of the wall of the dome is such that the weight of water displaced equals the weight of the chain. A meter stick is used as a scale and each mm. corresponds to 100 cc. A thermometer is inserted in each spirometer dome. The tube leading from the 3-way valve up through the water into the spirometer has a large enough surface to bring the air passing through it to the temperature of the water and this tube in spirometer No. 1 contains a wick to saturate the air with moisture.

In operation, spirometer No. 1 is filled with outdoor air (the CO_2 of which is considered negligible), the temperature recorded and spirometer No. 2 left empty, the mouthpiece adjusted to the patient and the breathing watched. At the end of an expiration the rubber stopper is inserted and stop watch started. Air now passes from spirometer No. 1 into the lungs and out into spirometer No. 2. At the end of about 10 minutes or until spirometer No. 1 is nearly empty, but at the end of an expiration, the rubber stopper is removed and stop watch stopped. The reduction in spirometer No. 1 and volume and temperature in spirometer No. 2 are recorded, spirometer No. 1 is emptied to the outside and the 3-way valves turned to connect 1 and 2. By placing a 300 gm. weight on 2, the air slowly passes through soda lime into 1, where its volume and temperature are recorded.

The CO_2 is the difference in volume of the air after and before it passed through the soda lime. The O_2 absorbed by the patient is the difference between the volume of the air after passing through the soda lime and that passing from spirometer No. 1 into the lungs of the patient. In order to verify the complete absorption of CO_2 it is merely necessary to pass the air through the soda lime into 1, then back into 2 and see that the volume is constant.

In the practical working of the apparatus it is not only necessary to read the temperature in each spirometer but also to see that the temperature of the air in one spirometer is the same as that in the other and does not change appreciably in 10 minutes. The water is of sufficient volume to absorb the heat from the lungs and soda lime without appreciable rise in temperature, but when the dome of a spirometer is filled with air, heat exchange through the thin wall of the spirometer must be minimized. The wall must be thin as its displacement equals the weight of the chain, but is better to be of heat insulating material. Oil on the water outside the dome is desirable. Having the dome in a space at the same temperature as the water and saturated with moisture would be desirable.

This is a preliminary paper.