detail. The nine forms found in the fiber pattern of β-keratin and heated ovalbumin[1] have been found also in chemically treated ovalbumin. The chemicals used were by no means equally effective in converting the globular protein to the fibrous form. However, the degree of crystallinity and orientation produced by treatment with aqueous formamide, urethane or aliphatic alcohols was at least equal to that obtained after heat treatment. Judging from the sharpness and length of the diffraction arcs, the best of the converted protein preparations were equal to the natural fiber, raw silk, in both crystallinity and orientation.

Filaments of the more soluble proteins were prepared by mixing the powdered material with approximately half its weight of water and extruding the mixture through a die in an arbor press. One per cent. of sodium chloride was added to the mixture of pumpkin seed globulin and water to make it readily extrudable. Casein filaments were extruded from a briefly heated casein-water mixture. This heating produced no detectable change in the x-ray diffraction pattern.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CLOSED CIRCUIT APPARATUS FOR THE MEASUREMENT OF RESPIRATORY METABOLISM

Several devices for calorimetry of small animals have been described.[1, 2, 3, 4] Metabolic studies frequently require the determination of the exchange of respiratory gases for large numbers of animals. Because of certain disadvantages in some of these methods we have devised an apparatus shown in Figs. 1 and 2.

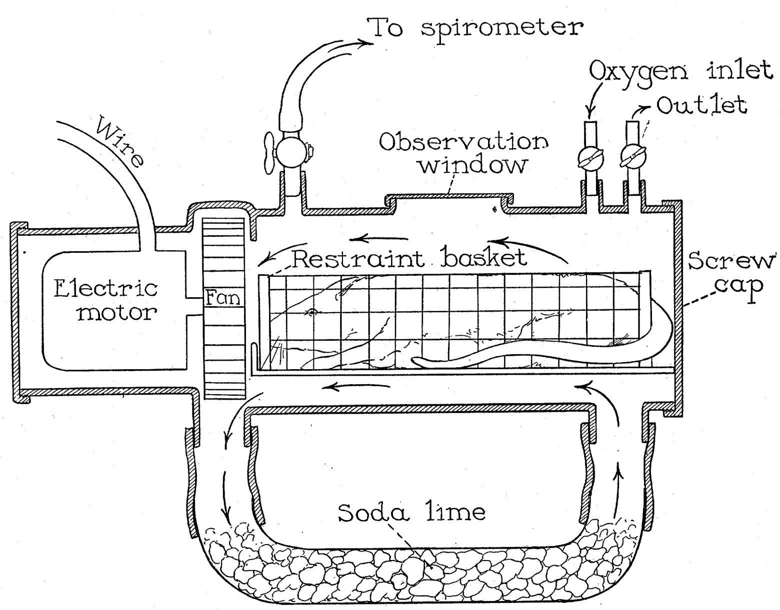

Fig. 1. Cross section of metabolic chamber showing rat in place in restraint basket.

The chamber is constructed of heavy brass tubing, 4 inches (10 cm) in diameter and 9 inches (23 cm) in length. A screw cap is fitted to one end and a smaller brass tube 3 inches (7.6 cm) long and 3¼ inches (8.3 cm) in diameter is riveted to the other end and closed by a screw cap. The smaller tube contains a 6-volt electric motor and fan assembly from an automotive windshield defrosting unit. This centrifugal fan circulates the gases through a 1-inch (2.5 cm) glass tube which is filled with soda lime and attached by rubber connections to the bottom of the main chamber.

Three outlets equipped with stopcocks lead from the upper part of the chamber; one is for the inflow of oxygen, one is a simple outlet or vent and the third one connects the respiratory chamber with a small, brass, Krogh spirometer measuring 5½ by 3 by 2¼

[1] F. G. Benedict and Grace MacLeod, *Jour. Nutrition*, 1: 343–366, 1929.
[2] M. L. Tainter and D. A. Rytand, *Proc. Soc. Exper. Biol. and Med.*, 32: 361–363, 1934.
[3] E. L. Schwabe and F. R. Griffith, Jr., *Jour. Nutrition*, 15: 187–198, 1938.
[4] W. H. Newton, *Jour. Physiol.*, 89: 421–428, 1937.

[7] One of four Regional Research Laboratories operated by the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

inches (14 by 7.6 by 5.7 cm). Kerosene was found to be a satisfactory fluid for use in the spirometer. A concave mirror is attached to the axis of the spirometer float, so that any change of volume within the respiratory chamber causes a rotation of the mirror. The image from a single filament bulb is focused by the concave mirror on an arc equipped with a centimeter scale, the radius of which is such that an excursion of the light beam of 1 cm on the scale equals a change of volume of 1 cc within the respiratory chamber.

Half an hour before the first metabolic determination is made the unit is submerged, with the motor running, in a constant temperature bath thermostatically regulated to ± 0.10° C. In rat calorimetry the temperature was maintained at 28° C, as suggested by Benedict and MacLeod. Small restraint baskets of wire mesh were designed to limit the activity of the animal before and during a calorimetric determination.

After the rat (enclosed in a basket) has been placed in the chamber and submerged, oxygen is passed slowly into the system for five to seven minutes. One starts the experiment by closing the oxygen supply and the outlet stopcock and opening the stopcock to the spirometer. The deviation of the beam of light during five minutes indicates the volume of oxygen consumed in that period. Three to five consecutive readings are obtained. Water vapor pressure is maintained constant by the presence of a moist sponge in the chamber.

The performance of this apparatus is entirely satisfactory in our hands. Any limitations of the method are in the experimental animal and not in the apparatus. The unit is inexpensive to build and could be made easily in the average machine shop.

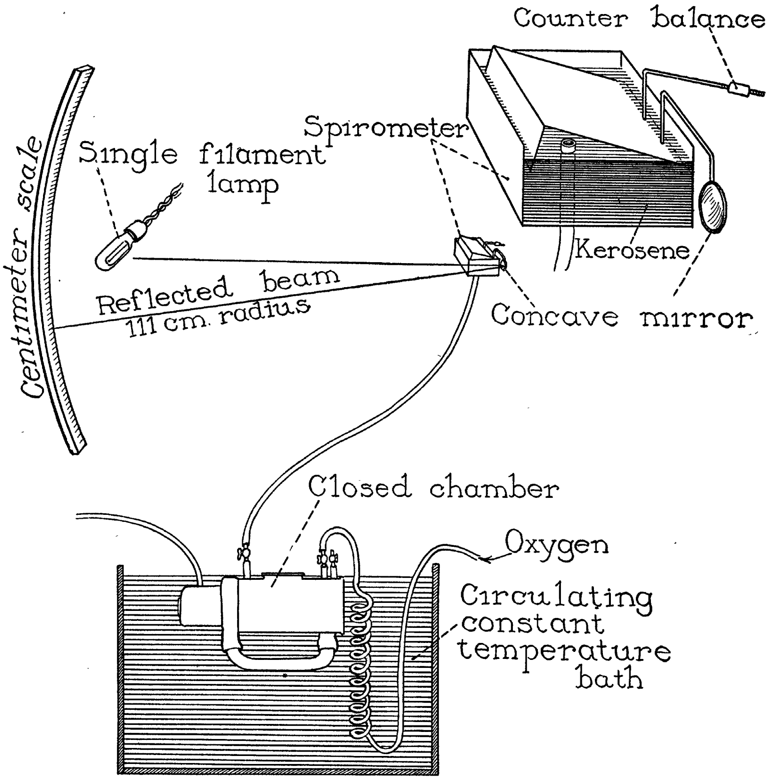

FIG. 2. Arrangement of metabolic chamber, spirometer and scale. Note that oxygen intake passes through a coil submerged in the constant temperature bath.

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