

A MICRO-RESPIROMETER FOR SINGLE PREPUPAE OF *DROSOPHILA MELANOGASTER* MEIGEN

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(With Two Text-figures)

INTRODUCTION

Many workers have measured the rate of oxygen consumption of puparia of *Drosophila* (see Ellenby, 1945); all have worked with groups of animals. As the rate of oxygen consumption is proportional to the surface area and not to the first power of the body weight (Ellenby, 1945), the mean weight of a group of animals is an incorrect basis for the comparison of oxygen consumption. Nor is the mean weight raised to some power strictly correct, for the size composition of groups of animals will vary, and the mean weight to some power will not be equal to the mean of the individual weights to the same power. It therefore seemed desirable to investigate the oxygen

the movement of a drop of manometric fluid in the capillary is measured with a microscope. The apparatus is of the differential type, the two vessels being the capillary tube and the jacket-tube; but the volume of the latter is very large in comparison with that of the former; in these circumstances the pressure change in the jacket-tube during an experiment is negligible, and the movement of the manometric fluid indicates the change of volume. The apparatus is therefore simple to use, and calibration merely involves the determination of the volume per cm. of the capillary tube; already it has been shown that it can be readily adapted to different purposes (Waddington, Needham & Brachet, 1936; Brachet & Shapiro, 1937). Figs. 1 and 2 show the present

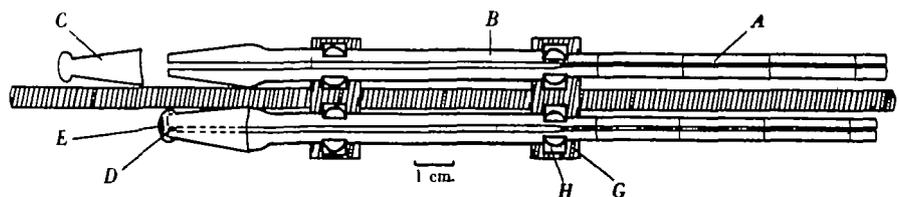


Fig. 1.

consumption of individual animals. Moreover, for a number of reasons, information was required on the oxygen consumption of triploid prepupae; such animals can only be distinguished in the imaginal stage, so that it is necessary to use individuals and to establish their constitution subsequently. An apparatus suitable for such work is here described; it was found very convenient in use and it was thought it might be of interest to workers in related fields.

APPARATUS

Essentially, the apparatus consists of a battery of micro-respirometers of the type used by Gerard & Hartline (1934) for the measurement of the oxygen consumption of nerve. In the original design, a capillary tube, which contains the nerve and a strip of filter paper soaked in KOH, is sealed at one end with vaseline, and contained in a large jacket-tube;

design. Each respirometer consists of a capillary tube (A), about 0.5 mm. internal diameter and 9 cm. long, joined to another capillary of about the same length but wider bore (B), the end of which is ground to take a small cup (C). The prepupa (D) is placed just inside the wide capillary, and filter paper (E), cut with a paper punch and moistened with KOH, is carried at the bottom of the cup. A drop of oil is introduced at the open end and its position measured from the most convenient of a number of marks etched on the fine capillary. The prepupa is removed from the apparatus with a hooked platinum wire, the animal being pulled on to a small piece of folded card from which it is easily transferred to the pan of a torsion balance.

The large capillary projects into the potash cup. This brings the prepupa close to the CO₂ absorbing surface and also reduces the effective volume of the cup; and the vaseline on the ground glass of the

capillary provides an effective barrier to the creeping of potash to the experimental animal.

Two such capillary assemblies are contained in a single jacket-tube. The capillaries are mounted on ebonite blocks (*G*) by means of metal clips (*H*), the two blocks connected by an ebonite rod (*J*), and the whole is so constructed that it fits firmly into the jacket-tube. All metal parts are coated with vaseline. In use the capillaries are seldom removed from their mountings, even for cleaning.

of a low-power microscope mounted on a traversing screw; the oxygen consumption of twelve separate prepupae can thus be determined simultaneously.

As designed, the apparatus is not among the more sensitive of micro-respirometers; but it suits the range for which it was designed very well. The volume of the fine-bore capillary is about 15 cu.mm., and larger prepupae almost consume this volume of oxygen in the 5 hr. during which they were studied. The average excursion was about 1 cm. an hour, so

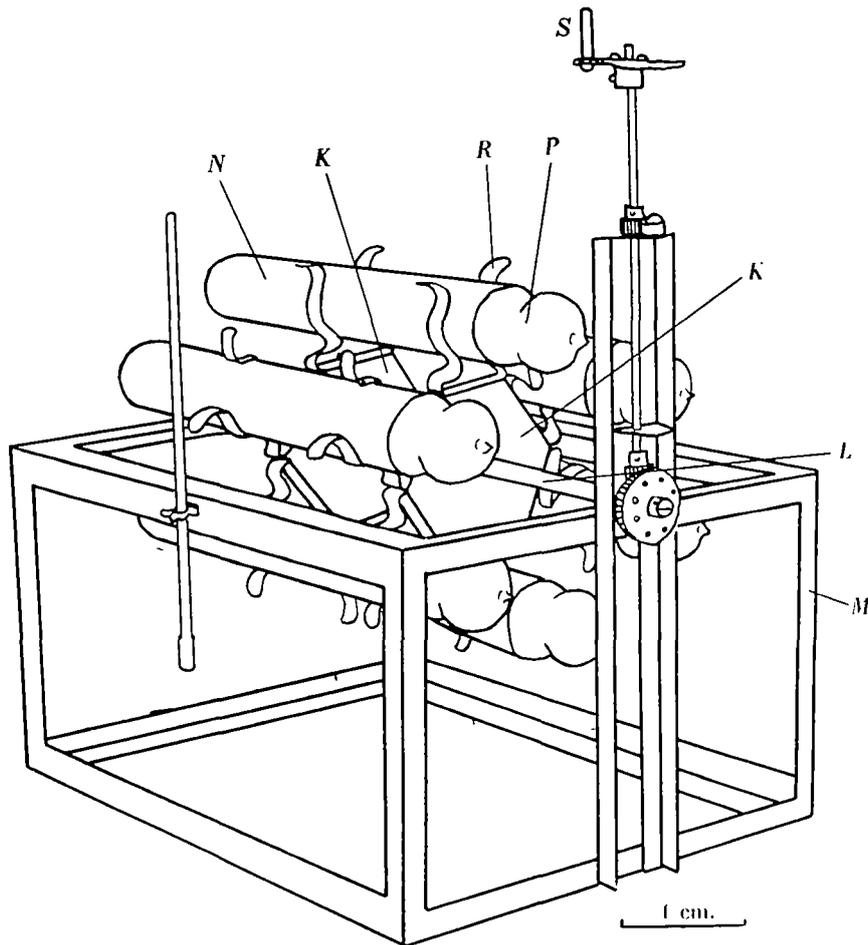


Fig. 2.

The complete apparatus is shown in Fig. 2. Two hexagonal ebonite blocks (*K*) are mounted on a horizontal spindle (*L*), carried by a framework (*M*) and connecting by a cogwheel with a vertical shaft. Six jacket-tubes (*N*), with hollow ground-glass stoppers (*P*), each containing two capillary assemblies, are carried on the hexagons by metal clips (*R*). The whole is immersed in a water-bath. Turning the handle (*S*) rotates the horizontal spindle and thus brings each of the capillaries, in turn, under the field

that if a scale were mounted with the capillaries, accurate readings could be taken directly with a microscope, and the traversing screw dispensed with. While the fine capillary increases the sensitivity, the wider capillary and potash cup increase the total volume of air to about 0.5 c.c. and thus ensure that the oxygen consumption does not fall to any significant extent during an experiment. Excluding the air displaced by the contained apparatus, the volume of the jacket-tube is about 250 c.c.; the volume ratio

of short- and capillary tubes, while not as high as in the original apparatus, is therefore still sufficiently high for the pressure changes in the former to be ignored.

Oxygen consumption falls very rapidly during the first few hours of the prepupal period (Ellenby, 1938), and it is therefore very desirable to reduce the equilibration period to a minimum. In the present case, the apparatus was used in a constant temperature, room and the equilibration period thus eliminated; but for other work, in which the rate of oxygen consumption is not changing so rapidly with time, simple modification would permit the apparatus to be used under more ordinary circumstances.

SUMMARY

An apparatus is described, of the Gerard-Hartline type, suitable for the measurement of the oxygen consumption of single pupae of *Drosophila*. The design is such that the oxygen consumption of twelve separate animals can be conveniently measured simultaneously.

The apparatus was constructed in 1938 in the Department of Zoology, University College, London. I am very grateful for the encouragement I received from Prof. D. M. S. Watson, F.R.S., and for the co-operation of Mr J. R. Redpath, the departmental mechanic.

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