A respiration recorder / by W.D.M. Paton.

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A respiration recorder.

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The apparatus provides a compact instrument for use with cats; it records on the smoked drum, the height of the record above the base-line being directly proportional to the respiratory minute volume; it does not need repeated calibration; and it offers little resistance to respiration. The principle involved is simply explained by an electrical analogy. If charge flows continuously into a capacity, from which it can leak away through a resistance, the potential in the capacity rises exponentially to a limiting value which is a measure of the rate of flow of charge. If the flow of charge is intermittent, the system acts as a smoothing device. Here the flow of 'charge' is the expiratory minute volume

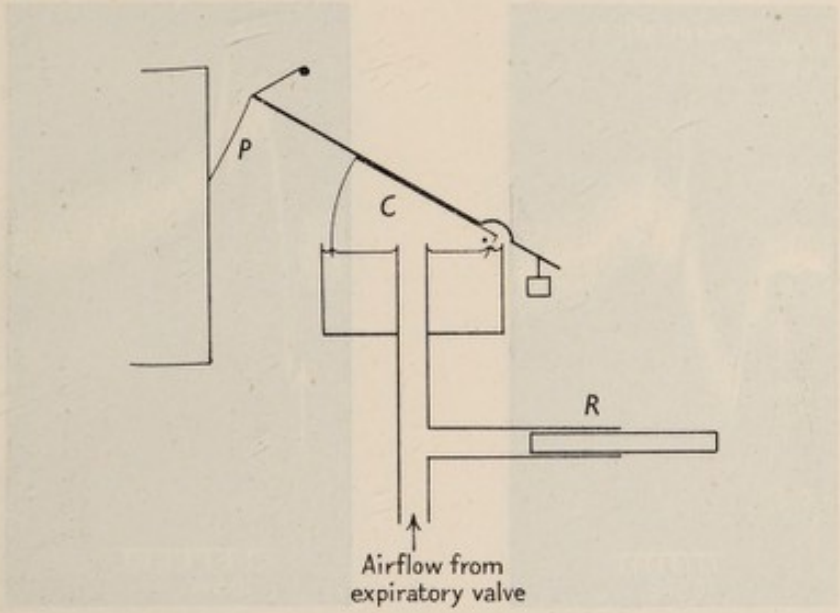


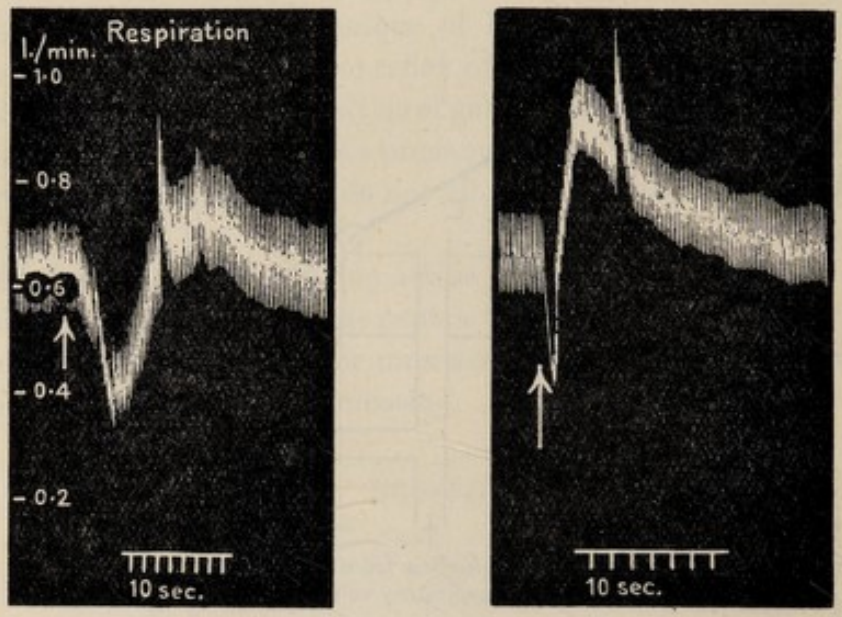
Fig. 1. Diagram of recorder.

of the animal (V l./min.). The 'capacity' is a float recorder (C) (Fig. 1); this also records directly the 'potential' or pressure within it by the rigidly attached frontal writing lever, since the pressure is proportional to the height (P cm.) of the tracing. The 'resistance' (R) is a variable leak consisting of a brass rod sliding within a glass tube. Certain constructional details require mention:

(1) the *float recorder* is made of Perspex 2 mm. thick, cross-section 6·8 × 5·8 cm. and 7 cm. deep at its widest end. This end is covered with a layer of paraffin wax 15 mm. thick to give it additional weight. It is counter-weighted so that with no air flow the recorder is near the bottom of its excursion. The aluminium writing lever terminates 18·5 cm. from the pivot in a writing point 63 mm. long. (The dimensions given are not critical.)

(2) The *variable leak* consists of a brass rod 6·34 mm. diameter in a glass tube of inside diameter 6·88 mm. There is appreciable play of the rod in the tube, and a centring device is necessary; a thin brass triangle making three-point contact on the inside of the tube is screwed to the end of the rod in the tube, and a bearing attached to the tube carries the other end. If the rod or the tube is not quite uniform in diameter, they may be marked so that the alinement at the time of calibration is maintained.

Calibration. The deflexion of the float-recorder varied linearly both with the pressure inside it and with the volume of air entering it (1·49 mm. water and 25·8 c.c./cm. deflexion respectively). The resistance also proved to be satisfactorily laminar for air flows up to 1 l./min., and it was directly proportional to the length of overlap (d cm.) of the rod and the tube. The final calibration of airflow against deflexion on the drum was also linear with an error less than 5%. From these figures the apparatus can be characterized by the equation for the steady state, $V = \frac{0{\cdot}371P}{d+0{\cdot}5}$, and by the half-time of the system (which depends on the capacity and resistance) which equals $2{\cdot}93d$ sec. The constants do not change with time, and the calibration remains constant indefinitely. The distortion of the time scale of respiratory events by the damping action is rarely significant.



(*a*) (*b*)

Fig. 2. Cat, 2·8 kg., chloralose. Effect of intravenous injections of (*a*) 200 μg. adrenaline; (*b*) 0·5 mg. lobeline hydrochloride.

Use. It is essential that valves used should be leak-free and junctions air-tight; moistened rubber valves of low resistance in a Perspex holder are suitable. A length of tubing at least 0·5 m. long between valves and apparatus prevents condensation in the resistance.

Since respiration is intermittent, the tracing has an appreciable width. This is, in fact, an approximate measure of the tidal air, which may be determined more accurately from the minute volume and the respiratory frequency. For most purposes it is sufficiently accurate, when ascertaining the minute volume, to measure the height from the base-line to the middle of the tracing, since the rise and fall of the recorder are nearly linear. The resistance is made variable so that a convenient deflexion can be obtained for a given minute volume. The resistance offered to the cat's respiration is usually $\frac{1}{2}$–$\frac{3}{4}$ cm. water and need never exceed 1 cm. water.

Fig. 2*a* and *b* illustrates the use of the recorder, showing apnoea and compensatory hyperpnoea due to adrenaline, and respiratory stimulation by lobeline.

I am greatly indebted to Mr R. C. Blakemore and Mr G. Pierson for the construction of the recorder and the valve-holder.