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A Mercury Valve for Obtaining Alveolar Air Samples.

ROLLAND J. MAIN.

From the Department of Physiology, Medical College of Virginia, Richmond.

In obtaining alveolar air by the Lindhard method of securing the last portion of each expiration,¹ most investigators have collected the sample over aqueous solutions. In order to obtain the advantages of collecting it over mercury, the following valve was designed, employing a tuberculin syringe with a slot filed through the barrel, and enclosed in a glass shell, with an electromagnet to activate the plunger (Fig. 1). A nasal catheter (No. 8 Fr.) is passed through a nostril to the base of the uvula, and connected to the Haldane gas tube with Rehfuss tubing.

The gas tube is filled with mercury from the reservoir, and the clamp below is closed. A 10 cc syringe with a short piece of rubber tubing is connected to the short arm of the top cock of the Haldane gas tube, with the cock turned to open to the tubing. At the end of each of several expirations, a few cubic centimeters of air is rapidly drawn into the syringe. This flushes the dead space of the tubing and catheter, which approximates 1 cc. The cock is then turned to connect the mercury filled gas tube to the tubing.

At the end of each expiration (as can be noted by pasting a wisp of cotton to the nostril or with a chest pneumograph) the key is pressed down for 1 or 2 seconds. The mercury level in the gas tube promptly drops, drawing in several cubic centimeters of air. A minimum of rubber tubing should be used on the valve, to prevent lag and rebound, and the tubing used should be thick walled. If desirable electrical contacts on a pneumograph to activate the valve in place of the key could be used.

Results with this method during normal respiration, however, showed distinctly lower percentages of CO₂ than did the Haldane-Priestley method (at the end of expiration). This may be due to the following factors: (1) that a normal expiration may not completely wash out the dead space of the respiratory tract, (2) that the expiratory sample of the Haldane-Priestley technic is obtained slightly later in the respiratory cycle, than is the Lindhard sample, and (3) that the Lindhard sample shows the average CO₂ over a period of time, during which it may vary, whereas the Haldane-Priestley

¹Lindhard, J., *J. Physiol.*, 1911, **42**, 337.

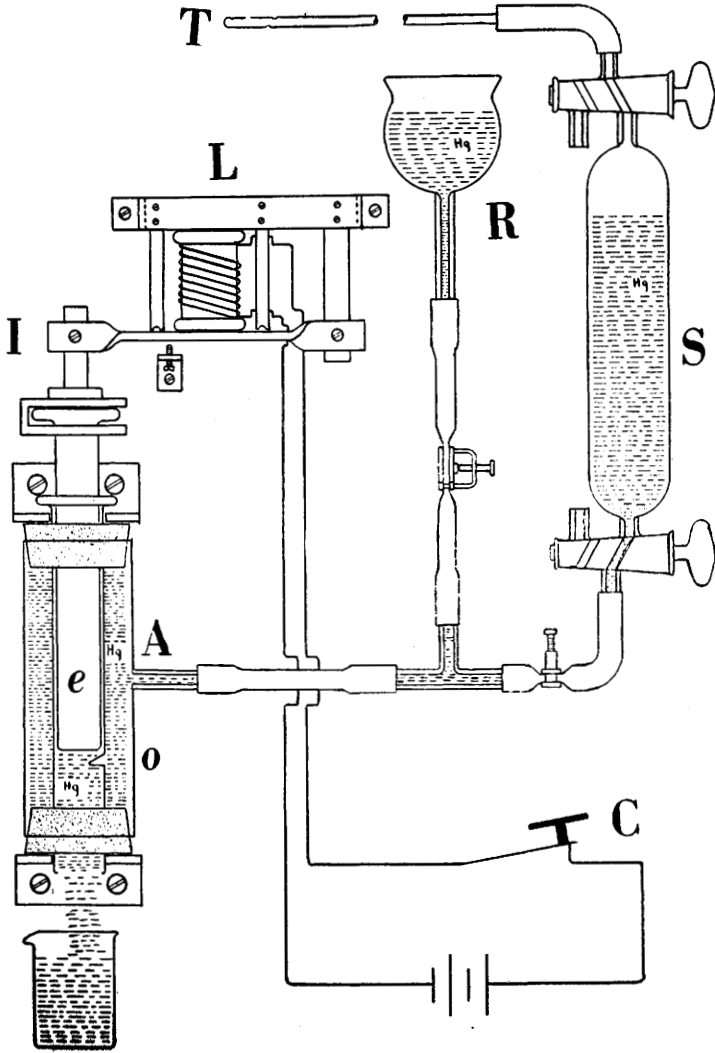


FIG. 1.

An electrically activated mercury valve for obtaining gas samples over mercury. Switch C is closed and the current of 2 dry cells activates the tripole electromagnet L, iron bar I is drawn upwards, pulling up plunger e of the tuberculin syringe. This syringe is inside the glass shell A with a side arm. Movement of plunger e upwards opens slot o filed through the barrel of the syringe, allowing the mercury to come in the side arm A, down the shell, through the slot into the barrel of the syringe, and down and out into the beaker below. This will lower the mercury level in gas tube S, thus sucking in air from nasal catheter T. Reservoir R is merely to refill gas tube S. When taking a sample, clamp under R is closed and clamp below S tube is open. Clamp below S tube is closed only when removing gas tube. The buret of the gas analysis apparatus could replace the tube S.

sample is an immediate index. In an attempt to obviate these first two objections, the subjects were made to breathe in the tempo set

TABLE I.

| Subject | Lindhard % CO ₂ | Haldane-Priestley % CO ₂ |
|---------|-------------------------------|--|
| A | 5.08 | 5.4 |
| B | 4.62 | 4.93 |
| C | 5.2 | 5.3 |
| D | 5.22 | 5.22 |

by a revolving electrically driven marker, so that they would breathe deeply at a rate of 6 times per minute. Haldane² has proved that voluntarily altering the rate of respiration does not affect the alveolar CO₂ percentage. However, the Lindhard samples were usually still slightly lower than the Haldane-Priestley samples as shown by Table I.

To obtain comparable results to the Haldane-Priestley method, it would probably be necessary to place the catheter further down the respiratory tract, as can be done with an anesthetized patient.

Summary. A mercury valve is described for obtaining samples of alveolar air over mercury at the end of expiration by a nasal catheter. The CO₂ values are lower than the Haldane-Priestley values, even when respiration is voluntarily slowed.

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Susceptibility of Spadefoot Toad and Tree Frog to Ouabain, Cymarin, and Coumingine Hydrochloride.

ALBERT P. BLAIR, CHESTER C. HARGREAVES AND K. K. CHEN.

From the Department of Zoology, Indiana University, Bloomington, and the Lilly Research Laboratories, Indianapolis.

Almost 85 years ago Vulpian¹ pointed out that the toad had a natural tolerance to digitalis. Subsequent investigators in confirmation with Vulpian's work reported that the toad was resistant to other cardiac drugs such as antiarin and strophanthin,^{2, 3, 4} ouabain, cymarin, and coumingine hydrochloride.^{5, 6} The African clawed

² Haldane, J. S., *Am. J. Physiol.*, 1915, **38**, 20.

¹ Vulpian, E. F. A., *Compt. rend. Soc. biol.*, 1856, **3**, 125.

² Fornara, D., *J. de thérap.*, 1877, **4**, 882.

³ Heuser, O., *Arch. internat. de pharmacodyn. et de thérap.*, 1902, **10**, 483.

⁴ Epstein, D., *J. Pharm. and Exp. Therap.*, 1931, **43**, 697.

⁵ Chen, K. K., and Chen, A. L., *J. Pharm. and Exp. Therap.*, 1933, **47**, 295.

⁶ Chen, K. K., Hargreaves, C. C., and Winchester, W. T., *J. Am. Pharm. A.*, 1938, **27**, 307.