

(0.5 cm.). These valves were connected to a flask which in turn was connected to a large capacity pump. The solenoid valves were activated by electrical contacts (A' , B' , ...) on an insulating disk over which turned a contact arm driven by a constant speed motor. This was arranged to turn at 4, 8 or 12 seconds per revolution. The contacts used were such that while the subject inspired at an average rate of 18 l./min. and for three eighths of a cycle from one arm of the Y tube, the control sampler was operating from the other arm of the Y tube (18 l./min.). For one eighth of a cycle (T_1 , fig. 1) no sampler was in operation, so that during this time the subject slipped his mouth from the Y tube, closing the lips, then with a slight rotation of the head moved his lips in position to close his lips about the tube (O_2) for collecting the lung sample. The expiration began automatically when the contact arm reached the first contact (A'), which activated sampler 1. After one fourth of the expiration cycle the first solenoid valve (A) closed while a second solenoid valve opened, thus stopping the sampling by number one but starting number two. Each sampler operated at 18 l./min. After the fourth sample had been taken, no valve was opened (T_2 , fig. 1), so that the subject moved back to the Y tube (O_1) to repeat the cycle. Simultaneously with the beginning of the cycle a buzzer was sounded. It was also sounded at the time the control sampler ceased sampling, shortly before the first lung sampler was started and just after the last fraction had been taken.

Chemical Analysis.—Triphenyl phosphate was hydrolyzed with sodium hydroxide and the resultant analyzed for free phenol by the color reaction with a commercial phenol reagent.¹⁰

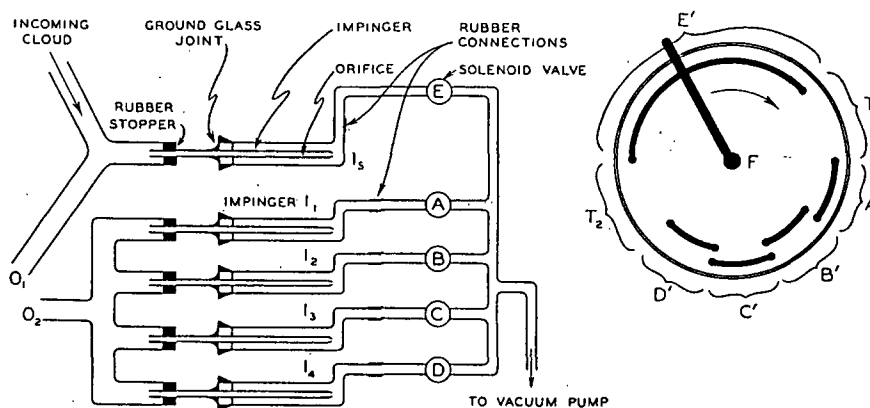


Fig.1.—Diagram of apparatus. The subject inspires air from opening O_1 at the same time that the control sampler (I_s) operates. The sampler is a critical pressure orifice impinger with two fine mesh screens (200 mesh, .002 in.) below the orifice. The screens are not needed if a negligible amount of material is composed of particles smaller than about $1\ \mu$. The inspired air is expired through opening O_2 , its pathway being determined by the timer shown on the right half of the figure. This timer consists of a circular insulating block with short arcs of copper wire attached as shown. Arcs A' , B' , C' and D' subtend equal angles from F and their total angle equals the angle subtended by arc E' , this being three eighths of the whole circle. The arm (copper) shown is attached to a pivot F , which is driven (clockwise) by a constant speed motor in such a way that it contacts the arcs of wire successively during its excursion. The timer is connected to the solenoid valves A , B , C , D and E in such a way that whenever the arm of the timer is in contact with a given arc, the corresponding solenoid valve is open, the remaining valves being closed. Only one valve is open at any one time.

About 5 ml. of 95 per cent alcohol was used to transfer the triphenyl phosphate from the impingers¹¹ into test tubes. To each test tube 1 ml. of alcoholic sodium hydroxide solution (9.4 Gm. sodium hydroxide, 125 ml. ethanol diluted to 250 ml. with water) was added.

The test tubes (1.8 cm. $\times$ 15 cm., of fairly uniform thickness) were placed in a boiling water bath to evaporate the alcohol. The water temperature was brought back to 100 C. after

10. The phenol reagent (Folin O., and Ciocalteu: On Tyrosine and Tryptophane Determinations in Protein, J. Biol. Chem. **73**:627, 1927) may be obtained from Sargent & Company, Detroit, Chicago, Dallas.

11. The droplets of triphenyl phosphate were generally crystallized by the time the analysis was carried out.