thus be a great convenience to the historian of the biological sciences and also to specialists in a number of fields, especially since American titles have often been so incompletely represented in European bibliographies of the last century.

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LABORATORY APPARATUS AND METHODS

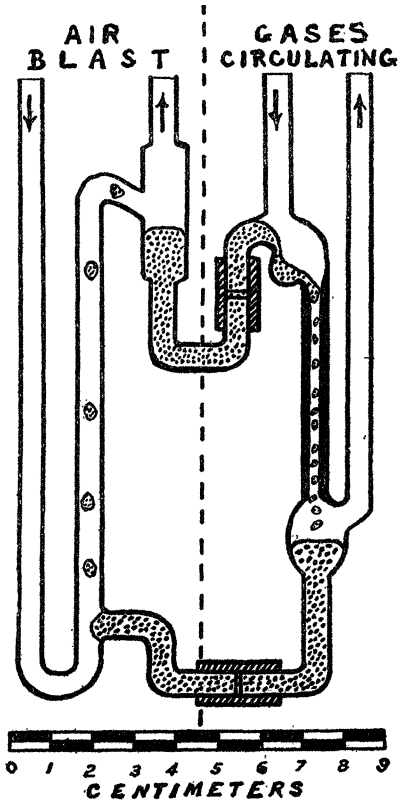
A SIMPLE CIRCULATION PUMP FOR GASES

THE physicist, the chemist and the biologist all may have occasion to pass continuously the same sample of gas at ordinary pressure over an object under investigation. This is commonly done by some form of circulation pump involving valves, which gives stepwise circulation and requires an individual motor. In meeting this problem, we have secured practically uniform and continuous flow by utilizing a very simple form of gas circulation, which uses for power the customary air-blast to be found in most laboratories. We believe a brief description of our apparatus will prove of interest to other workers.

The principle on which our apparatus functions may perhaps be made clear by an analogy. If one wished to circulate water round an annular trough, one might employ a paddle wheel operating at a constricted part of the annulus. In our gas-circulator, we paddle the gas round the closed system by means of a constant stream of droplets of mercury falling by gravity down a narrow tube which forms part of the circuit. This constant falling of mercury is reminiscent of the operation of a Sprengel pump, in which, however, the mercury droplets, by filling the bore of the fall-tube, act rather as pistons than as paddles. The portion of the figure to the right of the vertical dotted line shows the construction that serves the fall-tube.

The portion of the apparatus to the left of the dotted line is devoted solely to the purpose of raising the fallen mercury back to the level of the top of the fall-tube. Its action is precisely the converse of that of the right-hand portion, for here an air-blast from outside is employed to blow the mercury in droplets, which do not fill the bore of the rise-tube, from the low to the high level.

The entire apparatus as sketched is smaller than a man's open hand, and is constructed of glass tubing of 4 to 5 mm bore, except for the fall-tube, whose bore is about 2.5 mm. The two rubber connections shown in the figure make for ease in construction; and, in any case, the gases to be circulated come in contact only with glass and mercury. About 7 cc of mercury are sufficient. As in Bunsen and other pumps which incline to temperamentality, slight differences of construction sometimes lead to large changes in efficiency. A satisfactory model is furnished by the Eastern Instrument Company, 109 Oliver St., Newark, N. J.



A single such apparatus will circulate gases against back pressures in the circuit corresponding to a head of over 30 cm of water at a speed of two liters per hour; while, if the back pressure or resistance is negligible, the speed of circulation may exceed eight liters per hour. The consumption of air-blast air, at the customary six pounds pressure, is about one eighth of a cubic foot per minute, which is but half what a blast lamp uses. If greater volume of air circulation is desired, several such circulators may be used in parallel.

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SPECIAL ARTICLES

PROPAGATION OF ELECTROMAGNETIC WAVES OVER THE EARTH

AMONG the facts to be explained in a satisfactory theory of the propagation of radio waves over the