

A Rapid Variable-Temperature Micro- or Macro-Dialyser

RAPIDITY and completeness of dialysis are favoured by a high concentration gradient at the membrane, which, in turn, depends on rapid transport of dialysable material to and from the membrane. At the same time, it is desirable in certain studies to obtain the permeate in the smallest possible volume, to simplify manipulation and to minimize the relative magnitude of analytical blank values. The apparatus is based on these considerations; it is particularly suited for dialysis of suspended materials and can be used at temperatures between 0 and 100° C. We have employed it in the study of the soluble components of bacteria (in connexion with work conducted under a research contract (NONR-244(00)) with the Office of Naval Research), the amount of dialysable material varying between 0.1 and 40 mgm. of total nitrogen per experiment.

The essential components are a U-tube, a polyethylene-covered magnetic stirring bar, and a horse-shoe magnet which is rotated by a small motor. The assembly is shown diagrammatically in Fig. 1. Interaction between the rotating outside magnet (arranged by trial) and the inside magnet moving up-and-down causes rhythmic movements of the casing and agitation of its contents. For larger assemblies the stroke of the inside magnet may be lengthened by putting two magnets end to end (UU) into the clamp. Continuous renewal of the outside fluid is provided by running water slowly through the U-tube. Temperature control is maintained by placing the assembly in a suitable bath. For temperature equilibration the water enters at the bead-filled leg of the tube. The permeate may be sampled or collected in aliquots at the other end. Connexions are made with polyethylene tubing which can be used up to 105°. 'Tygon' tubing releases ultra-violet-absorbing substances.

In order to avoid contaminations when dealing with low levels of nitrogen, rubber gloves should be

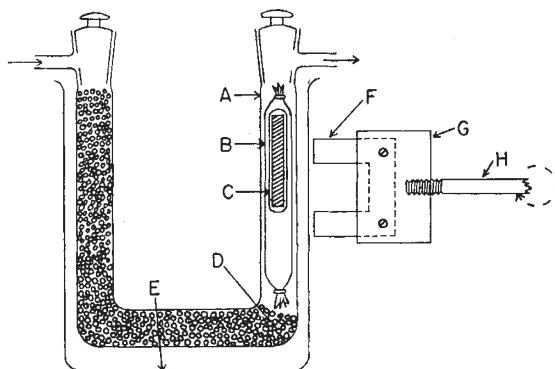


Fig. 1. Dialyser. *A*, U-tube, the bottom of which can be constricted to prevent beads from shifting into the right arm (absorption tubes, Schwartz, Z 12/30 to 24/40 (the legs may be lengthened), No. J-310, Scientific Glass, Bloomfield, N.J.). *B*, dialysis casing knotted on both ends. *C*, stirring bar consisting of 2-6 cm. pieces of rod magnet slipped into polyethylene tubing, the ends being sealed by gentle heat (rod magnets, $\frac{1}{8}$ - $\frac{1}{4}$ in., Alnico grade 2 or 3, magnetized lengthwise, Permag Corp., Brooklyn 5, N.Y., covered with 'Intramedic' polyethylene tubing, wall thickness between 0.3 and 0.6 mm., No. PE 350 to PE 440, Clay-Adams, New York 10, N.Y.). *D*, $\frac{1}{4}$ mm. glass beads. *E*, beaker. *F*, horseshoe magnet (rectangular U-magnet, outside length $1\frac{1}{2}$ in., inside length $\frac{1}{2}$ in., No. 71 D 778 P 4, Permag Corp.) held by aluminum clamp (*G*) and (*H*) the motor shaft (24 rev. per min. electric motor, No. 4 K 237, W. W. Grainger Co., Philadelphia, Pa.). The shaft should turn at about 10 rev. per min. The external water space of the U-tube ranged from 15 ml. for a 3-ml. dialysis casing ('Nojax' casing, 3/32 or 1/8/32 in. diameter, Visking Corp., Chicago 38, Ill.) to 100 ml. for a 50-ml. casing

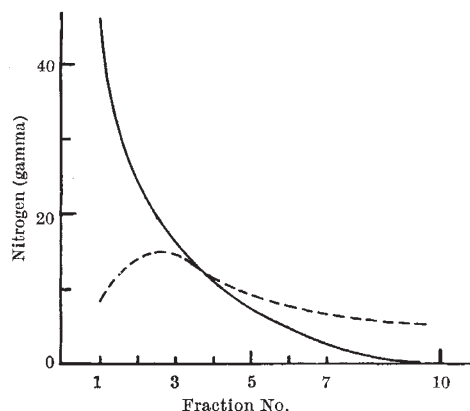


Fig. 2. Effect of agitation. Equal suspensions (43 mgm. dry) of washed lyophilized bacteria were dialysed (3 ml. inside volume) against water (1 ml. per min.) without (dash line) and with (full line) magnetic agitation at room temperature. The nitrogen content of successive 25-ml. fractions of the permeate is shown

used for knotting the cellulose casing, and water purified with 'Amberlite IR-120' for dialysis. 'Nojax' casings show no evidence of mechanical weakening after several hours in boiling water.

Acceleration of dialysis by agitation has been demonstrated¹. Fig. 2 shows the effect of inside agitation under our experimental conditions. At the time dialysis is complete with inside agitation, the yield is 50 per cent without agitation. Another example may illustrate the practical efficiency of the proposed method: 400 mgm. of dry bacterial substance suspended in 5 ml. water yielded, in 100 min. of dialysis, during the first 40 min. of which the bath was kept at 100°, a permeate of 100 ml. which contained 2.24 mgm. ninhydrin-nitrogen. Further exhaustive dialysis (250 ml.) yielded an additional 0.07 mgm.

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¹ Kunitz, M., and Simms, H. S., *J. Gen. Physiol.*, 11, 641 (1928).

Quotation of Titles of Papers in Review Articles

I wish to support Dr. Charity Waymouth's plea for the inclusion of titles of papers in the bibliography of a review article.

The editors of "Advances in Virus Research" asked me for a review. I looked at volume 1, the only one then published, and found a very pleasing chaos in the manner of citing references and some authors gave titles in full. I had half written my review when I realized that dull conformity had descended on the journal and that, worse still, it took the form of eliminating titles. To withdraw the article would have meant wasting the time already spent on it so I simply protested, and I welcome the opportunity of protesting again.

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