(IV) In one of the papers cited (*1*) a loss of 2.7% in 6 days is reported for a sample stored in a covered Petri dish. A fourth set of experiments has been performed to shed more light on this long-term exchange loss. Pairs of heat-dried barium carbonate plates of different thicknesses were stored over a period of 9 weeks in different controlled and uncontrollable atmospheres. At intervals of 10 to 14 days the plates were collected and their radioactive strengths determined; at the end of the test all samples were reweighed, but no significant weight changes were observed. The sensitivity of the counter was checked with standards of uranium glass and of shellac-bound barium carbonate. The data obtained are collected in Table 2.

It is apparent from these data that some barium carbonate samples, at least those which are heat dried, can be stored for long periods without serious loss of activity. Exchange may not be a trivial matter with samples prepared by other methods, because of particle size distribution, particle surface condition, etc.; each circumstance at least requires observation of active samples for long periods.

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IN THE LABORATORY

A Piston Recorder for Small Volume Changes

Foster N. Martin, Jr.

Department of Pharmacology, Tulane University of Louisiana School of Medicine

The apparatus here described was designed for use in recording small volume changes, associated with pressure changes, such as occur in the eye of a cat following administration of vasoconstrictor drugs.

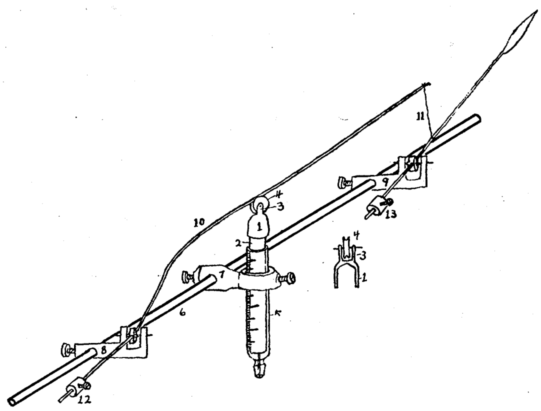

Fig. 1

The basic part of the apparatus (Fig. 1) is a piston made from a portion of a tuberculin syringe. A brass cap (1) was drilled to fit the cut-off plunger (2) of the syringe and then turned on the lathe until very thin. A stem about one-third the diameter of the cap and 5 mm long was left projecting at the top. The projecting stem was sawed and filed into a U-shaped fork (3) and fitted with a small, grooved pulley (4) which was held in place by a small pin of stainless steel wire. This cap was placed on the plunger (2), which was then inserted in the syringe barrel (5). The latter was cut shorter than the plunger to prevent the cap from striking it. This piston assembly was fixed to a small brass rod (6) by means of a clamp (7) made of brass and drilled vertically to fit the syringe barrel and horizontally to fit the rod.

Lever supports (8, 9) were made to fit the same rod, supplied with levers of aluminum wire, and fixed one on each side of the piston clamp. One aluminum wire lever (10) was bent to fit and placed in the groove of the pulley (4) on the piston cap. A thread (11) was used to attach the first lever to the second to magnify the movements.

Adjustment of the magnification of the movement could then be made by altering the distance between the first lever clamp (8) and the piston clamp (7) and also by varying the position of the thread (11) connecting the two levers. The weight of the levers may be nullified by using small cylindrical brass counterweights (12, 13) fastened by set screws on the short ends of the levers.

An hydraulic system is necessary for smooth operation of the piston assembly. Water is not satisfactory, since the small amount lost by evaporation from the piston will show as a gradual fall in the base line of the record. Mineral oil is perhaps best for filling the piston. As used for recording intraocular pressure changes, a small mercury manometer made of fine-bore glass tubing was interposed between the piston and the eye, oil being used on the piston side of the manometer and aqueous solutions on the other.

With a piston made of about one-third of a tuberculin syringe volume, changes up to about 0.2 cc may be recorded, giving an excursion on the record of 10–20 cm or less, according to the adjustment of the levers. By using other sizes of syringes in a similar way other orders of volume changes may be recorded.

Radiation From a Flask Containing Various Amounts of Radioactive Phosphorus[1]

Russell F. Cowing and Egilda DeAmicis[2]
New England Deaconess Hospital, Boston

The handling of radioactive phosphorus becomes a radiation hazard if not properly executed.

One must consider beta particles from radioactive phosphorus as a potential hazard. These beta particles produce ionization directly and thus directly injure tissues. The most energetic of these particles penetrate tissue to a depth of 8 mm (*2, 5*), and during this passage each expends 2.7×10^{-6} ergs of energy (*3*). If one were to receive as whole-body radiation the permissible daily dose of 0.1 r for an 8-hr day (*1, 4*), the dosage rate per hour would be 12.5 mr (0.0125 r/hr). The dose of radiation for multiple exposures that can be tolerated by the fingers has not definitely been determined; therefore, it is being assumed that a dosage rate of 12.5 mr/hr is a permissible amount. Under these conditions, if one were to receive this permissible dose on his hands, each square centimeter of area will have been struck by 4×10^5 beta particles. This fact must be taken into consideration when handling an ordinary Erlenmeyer flask containing a solution of radioactive phosphorus.

To substantiate the existence of this radiation hazard, measurements were taken of the radiation emitted from a 125-cc Erlenmeyer flask containing 100 cc of distilled water to which various amounts of P^{32} were added.

Readings were taken in mr/hr by means of a glass beta-gamma counter tube having a wall of 30 mg/cm² approximately 0.12 mm thick. The counter was placed at an angle of 45° with the liquid level and at a distance of 15.0 cm from the angle formed by the meniscus and the side of the flask.

It was found during this investigation that the wall thickness of several flasks was not the same and that variations in the amount of emerging radiation were as great as 30%. Also, as any one flask was rotated, the amount of emergent radiation varied, indicating uneven thickness of the glass in various areas.

Table 1 shows the amounts of P^{32} in millicuries that were added to the 100 cc of distilled water and the average mr/hr as measured at a distance of 15 cm. The values listed in the column headed "1.5 cm" were calculated by the inverse square law. Those given in the column headed "On flask" were obtained by extrapolation from a graph of mr/hr vs. distance.

[1] The radioactive phosphorus used in this investigation was supplied by Clinton Laboratory and obtained on allocation from the U. S. Atomic Energy Commission.

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[2] The authors gratefully acknowledge the assistance of Kathryn H. Haley and Charles K. Spalding.

From Table 1 it is readily seen that a solution containing 1 mc (1,000 μc) of P^{32} is emitting 56 times the permissible amount per hour through the flask at zero distance. The allowable handling time for a flask under these conditions would be 8.5 min, since in this length of time one's hands would have received a daily dose.

TABLE 1

Relation Between Various Concentrations of P^{32} and the Average mr/hr at Several Distances

P^{32} (mc)	Average mr/hr at		
	15 cm	1.5 cm	On flask
0.5	2.2	284	450
1.0	3.6	475	700
1.5	5.3	703	1,100
2.0	7.0	925	1,500
2.5	9.2	1,210	1,900
3.0	11.0	1,450	2,300
3.5	12.8	1,690	2,700
4.0	14.3	1,880	2,920

Fig. 1 has been drawn from the data shown in Table 1 and may be used as a guide for determining the length of time a flask of this type can be safely handled when it contains various concentrations of radioactive phosphorus.

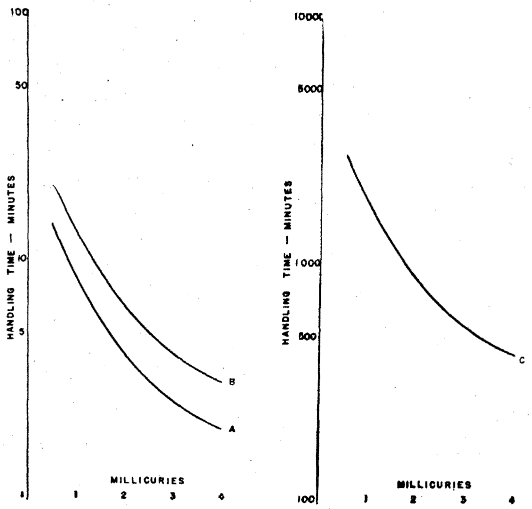

Fig. 1. Handling time for various concentrations of radioactive phosphorus. Curve A indicates the handling time when one grasps the flask barehanded. Curve B is to be used when the distance from hand to flask is only 1.5 cm. Curve C shows the handling time at a distance of 15 cm from hand to flask.

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