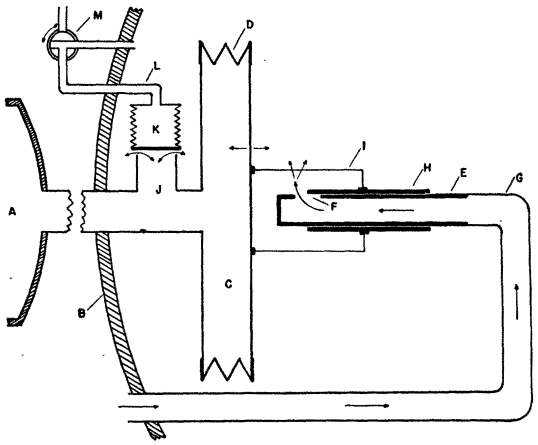

FIG. 1. Schematic drawing of barostat.

machines). In the relaxed position the metal disks are approximately 1½ in. apart. The pipe from the tank is sealed rigidly in a hole in the center of one disk of the bellows; the opposite disk is then free to move back and forth within the limitations of the rubber convolutions. Directly in the front and center of the movable disk of the bellows and at right angles to it is mounted a hard rubber or plastic tube (*E*) of approximately ¾ in. OD and ½ in. ID, with the end adjacent to the bellows occluded. A ½-in. hole (*F*) is drilled through the side of the plastic tube approximately 3/8 in. from the occluded end. The opposite end of the tube is sealed into a ½-in. pipe (*G*) which leads through the chamber wall to the outside. The OD of the plastic tube is machined so that it just turns or slides freely in the barrel of a 20-ml glass syringe. Both ends of the syringe barrel are cut off to produce a cylinder (*H*) approximately 3 in. long. This cylinder slides over the plastic tube and by means of a wire yoke (*I*) is flexibly linked to the movable disk of the bellows. The wires of the yoke are fastened to the glass cylinder by means of a plastic ring cemented to the cylinder. The wires are made of such a length as to have the glass cylinder cover half the side opening in the plastic tube when the bellows is in the relaxed position. A "T" (*J*) is placed in the 1-in. pipe between the bellows and the chamber wall and a small metal sylphon bellows (*K*) (approx 2″ diam × 1½″ length) is rigidly mounted directly over the open end of the "T." The closed, movable end of the sylphon bellows when it is in its relaxed position should be about ¼ in. from the open end of the "T." This end of the bellows is fitted with a rubber gasket which, when the bellows is expanded, forms a complete seal over the end of the "T." The stationary end of the sylphon bellows is connected by means of ¼-in. tubing (*L*) through the chamber wall to one leg of a three-way cock valve (*M*), or air switch, the second leg of which is connected back through the chamber wall and the third leg to the outside air.

Operation of the barostat is as follows. During the evacuation of the chamber the three-way valve is set, as indicated in Fig. 1, so that the pressure within the small bellows equalizes with that of the chamber and the bellows remains in the relaxed position. This allows equalization of the pressure in the chamber with that of the tank and the large bellows through the opening in the "T." The large bellows, remaining relaxed, maintains a static position of the glass cylinder over one half of the opening in the plastic tube, which allows a continuous flow of air into the chamber through this opening via the ½-in. line from the outside. When the desired altitude is reached and the chamber is "leveled off" as accurately as possible with the regular controls, the three-way valve is rotated clockwise a quarter turn so as to bring the small bellows into equilibrium with the outside or ground level pressure, which causes the bellows to expand and seal off the "T." The desired pressure in the tank and large bellows is thereby sealed off. A decrease in pressure within the chamber results in an expansion of the large bellows, which acts on the glass cylinder and causes it to move away, increasing the effective size of the tube opening. The resulting increase in air flow raises the pressure in the chamber. The reverse is true when for any reason the pressure in the chamber is increased. In this case a contraction of the bellows causes a closure of the tube opening, less air flow, and a consequent decrease in the chamber pressure. Before the pressure of the chamber is manually changed for any reason, the three-way valve must be in the position shown in Fig. 1. This is to prevent overexpansion or contraction of the bellows, since the opening in the plastic tube of the barostat can handle only a limited flow of air. This also places a limitation on the magnitude of the pressure changes it can correct. In our experience the ½-in. opening has been entirely satisfactory.

The dimensions given in this paper are for approximate guidance only, since they apply to the control of a specific apparatus. In general, the larger the opening at (*F*), the less sensitive will be the adjustment, and the larger the reservoir (*A*), the more sensitive will be the adjustment.

Determination of Radioactivity by Solution in a Liquid Scintillator

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The fact that certain solutions emit light when exposed to an externally placed radioactive source (*1, 2*) suggested that a simple and geometrically ideal counting system might be obtained by dissolving the material to be counted directly in such a liquid. This method would facilitate particularly the counting of soluble compounds labeled with a weak β-emitter, such as C^{14}. The homogeneous distribution of the radioactivity and the virtually complete absorption of the

TABLE 1

COINCIDENCE COUNTING OF C^{14}-LABELED CAPROIC ACID DISSOLVED IN A LIQUID SCINTILLATOR

Sample	C^{14} (μc)	Counts/min		
		Uncorrected	Corrected for background	Noise background as % of signal
I Tube voltages 700 and 900				
(1) C^{14}-caproic acid in 0.5% terphenyl in xylene	.031	10,816	10,560	0.3
(2) As (1) + .45 mg cholesterol	.031	9,280	9,024	0.4
(3) As (1) + .45 mg dehydroisoandrosterone	.031	8,960	8,704	0.4
(4) 0.5% Terphenyl in xylene (background)	—	256	—	
(5) Emptied cell (noise background)	—	32	—	
II Tube voltages 750 and 940				
(1) Same as in I	.031	27,264	25,664	3.2
(2) " " " "	.031	24,128	22,528	3.7
(4) " " " "	—	1,600	—	
(5) " " " "	—	832	—	

emitted energy by the scintillator would solve the problems of geometry and self-absorption that make the usual counting methods technically difficult.

A narrow cell was improvised from flattened glass tubing and placed between the windows of two photomultiplier tubes (RCA 5819). A good optical contact between the cell and the windows was established with Canada balsam. The cell was 4 mm wide internally and 11 mm × 18 mm on its face sides, with 1-mm walls. A light-tight shield was put around the two photomultipliers and the cell. Fluid could be injected or removed through a small opening covered by black tape. The output pulses of the two photomultipliers were fed into linear amplifiers and discriminator circuits of conventional design. These were followed by a coincidence circuit with a resolving time of about 0.4 μsec, and the coincident pulses were counted by a 64-scaler, followed by a mechanical register.

Approximately ½ mg of C^{14}-labeled sodium caproate (7.28 μc/mg) in 0.5 ml of water was extracted with 2 ml of xylene after the addition of 2 drops of concentrated HCl. An aliquot of the radioactive solution was diluted 1:20 with a liquid scintillator, 0.5% terphenyl in xylene, and 0.45 ml of the diluted solution, containing 0.031 μc C^{14}, was injected into the cell to be counted.[1] Similar samples were counted that contained, in addition, nonradioactive steroids in a concentration of 1.0 mg/ml. The background was measured with the liquid scintillator in the cell, and the noise background with the cell emptied.

The results (Table 1) indicate that at the lower voltage 15% of the C^{14} disintegrations were counted with a noise background of 0.3% of the count. When the gain of the photomultipliers was raised by increasing the voltages by about 50 v, 37% of the disintegrations were recorded, but the noise background was increased to 3.2% of the count.

The addition of cholesterol to one sample and dehydroisoandrosterone to another caused only a small decrease in the count, suggesting that C^{14}-labeled steroids can be determined in this way.

The use of two photomultiplier tubes with a coincidence circuit resolved the difficulty in discriminating between the pulses caused by low-energy particles and the background pulses resulting from the dark current of the tube. The noise background, listed as (5) in Table 1, was caused by accidental coincidence of independent dark-current pulses from the two tubes. The more favorable signal-to-noise ratio was obtained with relatively low voltages on the tubes, but at a sacrifice in counting efficiency. To keep the counting efficiency constant, the requirements on the stability of photomultiplier voltage and gain of the linear amplifiers are rather stringent. The unduly high background count when the cell was filled with the liquid scintillator [(4), Table 1] may have been due to radioactive contamination of the apparatus or area.

It would appear from the results that the method is applicable to mμc amounts of C^{14}. The use of the method requires that the counting efficiency of a sample be determined by adding a radioactive standard to the sample after counting it, or by adding it to a nonradioactive duplicate of the sample.

It is possible that with a less restrictive solvent than xylene, such as dioxane, a larger number of compounds may be counted in this manner.

[1] The amount of C^{14} in the sample was determined by two standard methods, through the kindness of David Feller, Tufts College Medical School.

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A Recording Warburg Apparatus[1]

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During the past 20 years the Warburg manometer and vessel have become standard instruments of the biologist and chemist. As two fine monographs (*1, 2*) on the subject exist, we shall not discuss the directions for use, nor the method of calculating the results. We shall describe a simple and relatively inexpensive modification of the method that gives a graphical recording of the data.

[1] Work performed under Contract No. W-7405-eng.-26 for the Atomic Energy Commission.