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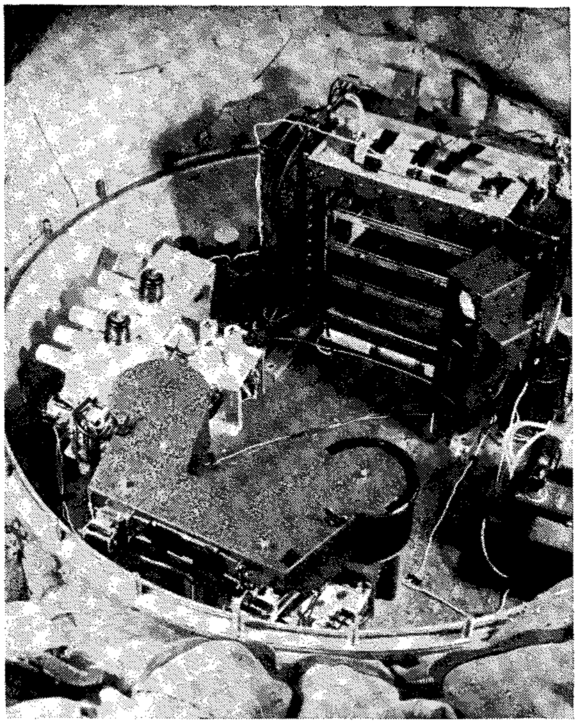

FIG. 2. General view of the whole apparatus. The pump and pressure switch are visible at the right; the Amglo motor is under the camera; the latching relay is on the near side of the large chassis. In the smaller chassis is mounted the coincidence circuit. Batteries are separately mounted underneath the fiberboard.

revolution of the motor drive shaft. A microswitch on a second drive shaft of the motor turns on an auxiliary light before the film moves so that a watch, compass, thermometer, and register may be photographed on the same frame as the inside of the cloud chamber. Small electromagnets made from relays are in parallel with the motor; these release the pressure plate of the 35-mm camera and allow the film to be more easily moved. After a prescribed number of revolutions a cam strikes another microswitch momentarily; the switch applies a pulse to the other coil of the latching relay, and so the motor is turned off. This second pulse also operates the register through another small relay. The inertia of the motor carries the cam past the position in which it is pressing the microswitch down.

Meanwhile the rear compartment of the cloud chamber is slowly brought up to operating pressure by a small aircraft instrument pressurization pump.[7] An S.P.D.T. pressure switch[8] turns off the motor at this pressure and at the same time turns on the filaments to the coincidence circuit.

The Cornell-Dubilier UP type electrolytic flashlamp condensers are continuously charged by four Burgess U200 300-v batteries in series. It is to be noted that in this application it is best to operate electrolytic condensers about 10 percent below their rated voltage, as they leak badly ($\sim$2 ma) at higher voltages.

Power for the filaments, motor, and compressor is supplied by Vitamite and Willard miniature rechargeable wet batteries, and otherwise the smallest dry cells compatible with the power requirements are used. The weight of batteries needed for an 8-hour flight is about 25 lb, which is roughly $\frac{1}{2}$ the total weight of the apparatus and its insulating cover.

A picture of the apparatus is shown in Fig. 2. The total resetting time of the chamber is about one minute at atmospheric pressure. Mounting of the chamber and apparatus in a gondola made from two spun aluminum hemispheres,[9] bolted together against a rubber *O*-ring seal assures reasonably constant inside pressure during the balloon flight.

I am indebted to Professor Kurt Sitte for many discussions and much helpful advice.

* Abstract from parts of the thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Syracuse University, June, 1952.
† Now at Smith College, Northampton, Massachusetts.
[1] R. B. Leighton, Rev. Sci. Instr. **19**, 274 (1948).
[2] Lofgren, Ney, and Oppenheimer, Rev. Sci. Instr. **20**, 48 (1949).
[3] Shutt, Johnson, and Thorndike, Rev. Sci. Instr. **20**, 398 (1949).
‡ Requiring that at least one of the two top counters and both of the two bottom counters be struck.
[4] I am indebted to Dr. E. P. Ney for several important features of the coincidence circuit and univibrator circuit.
[5] L. Fussel, Jr., Rev. Sci. Instr. **10**, 321 (1939).
[6] Amglo Corporation, Chicago, Illinois.
[7] Eastern Industries, Inc., Hartford, Connecticut, AN/APS 30.
[8] Barksdale Valves, Los Angeles, California, Meletron 420.
[9] Specially made by Spincraft, Inc., Milwaukee, Wisconsin.

An Ultracentrifuge Double Cell*

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(Received December 5, 1953)

THE analytical ultracentrifuge may be used both for the measurements of the molecular weights of substances in solution and for the determination of the amount of each molecular species in the solution. Two analytical ultracentrifuge procedures are in general use. The first is known as the sedimentation equilibrium method and the second as the rate of sedimentation method. In order to get high resolving power with the rate of sedimentation method it is necessary to make $4\pi^2N^2Rh$ as large as conveniently possible where N is the number of rps, R is the distance of the center of the cell from the axis of rotation, and h the radial length of the centrifuge cell.[1] This in turn requires the centrifuge cell to withstand very high stresses. Usually the cell windows are made of crystal quartz cut so that the light rays are accurately parallel to the optic axis. The remainder of the cell is made of some strong light material such as Duralumin. Although much effort has been made to reduce the cell distortion to a minimum, it remains a troublesome source of uncertainty especially in the determination of the concentration of the molecular species present in the solution by the rate of sedimentation method.

The purpose of this note is to describe a centrifuge double cell with which the effect of distortions may be eliminated to a first approximation. The double cell consists of two sector shaped cells side by side having the same quartz windows and cell housing. It is similar to the one we have used for some time in the equilibrium ultracentrifuge method.[2] Figure 1 shows an exploded view of the double cell. It is similar in size and design to the conventional cell except that the centerpiece contains two sectors instead of one. The Duralumin cylindrical cell housing shown is $1\frac{1}{16}$ in. o.d. with $\frac{3}{32}$ in. wall. The Duralumin centerpiece is 1 cm deep, and each sector cell subtends 2°44′ if projected to the axis. The radial length of each cell is 1.2 cm. Concentric grooves 0.003 in. deep around the periphery and straight grooves of the same depth running lengthwise the partition are machined into each face of the centerpiece. The faces of the centerpiece not covered by grooves are about 0.002 in. below the tops of the grooves. Each gasket is cut from a single piece of 0.003 in. polythene and covers the entire face of the centerpiece except the sector cells. The centerpiece is treated or covered by a protective coating if the solution is corrosive. Each of the sector shaped cells is filled through a small conventional filling hole not shown in Fig. 1 which is sealed with

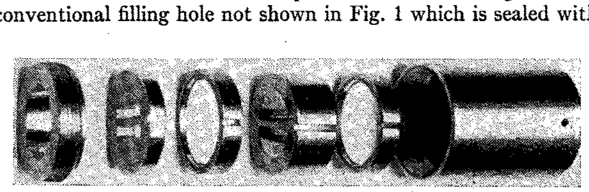

FIG. 1. Exploded view of double cell. From right to left are shown the cell housing, quartz window, centerpiece, quartz window, mask, and clamping ring.

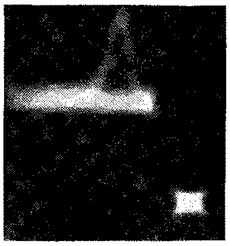

FIG. 2.

a screw and gaskets. The double cell when assembled is vacuum tight and the two cells are sealed from each other by the liquid tight partition. To carry out a measurement one of the sector shaped cells is filled with the solution containing one or more molecular species whose molecular weights (sedimentation constants) and concentrations are to be determined, and the other cell is filled with the solvent. The double cell is next placed in the ultracentrifuge rotor with the sides of the sectors accurately aligned with the radius. The conventional Thovert- Philpot-Svennson cylindrical lens and slit method[3] without modification is used for observing the sedimentation, although other refractive index methods such as the Lamm scale method[1] could be used. Figure 2 shows a photograph of the sedimentation of human albumin. It will be noted that the base line is automatically traced on the same photograph with that of the sedimenting component. Since the light passing through the two cells goes through the same quartz windows, the distortions are given by the base line to a first approximation. Consequently, from the area between the two traces the concentration of the sedimenting component can be determined with increased precision. The double cell should be of special value where the molecular species under investigation are dissolved in a solution containing NaCl or other low molecular weight compounds, since the base line can be made to give the sedimentation pattern of the low molecular weight compounds superposed upon the cell distortions. The double cell also is being used with the interferometer method for measuring sedimentation, the details of which will be reported later.

* Supported by the U. S. Navy Bureau of Ordnance Contract NOrd 7873 and U. S. Public Health Service Contract H-907C.
[1] Svedberg and Pedersen, *The Ultracentrifuge* (Oxford University Press, London, 1939).
[2] Beams, Robeson, and Snidow, Science **116**, 516 (1952).
[3] E. G. Pickels, Chem. Revs. **30**, 341 (1942).

A Cylinder-Symmetrical Film Balance with Expanded Possibilities of Use

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IN the course of research on synthetic detergents, a simple precision film balance with vertical torsion wire was constructed which is easy to use, dismount, and clean. In addition to its simplicity it has several other advantages over the usual types of film balances and offers new possibilities of investigating the behavior of monomolecular layers on liquid surfaces. With the use of suitable torsion wire, its sensitivity amounts to 2.10^{-3} dyne/cm. The principle can be seen in the accompanying Fig. 1.

The fundamental part of this balance is the cylindrical trough with a diameter of about 10–15 inches, turned from a ½-inch thick plate of polytetrafluoroethylene, polytrifluoromonochloroethylene, or lupolene, respectively. The nonwetting layer of paraffin or stearate, the cause of much trouble, can be dispensed with here. In the ring-shaped groove left free for the liquid substrate, there are a rigid barrier and, as usual, a floating and a movable barrier,

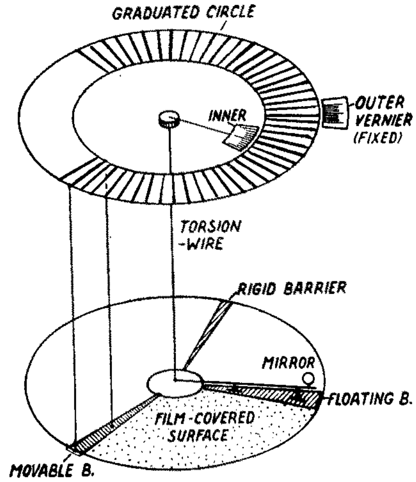

FIG. 1. Principle of the cylindrical film balance.

all made of the same material as the trough, but with a basic design that is not rectangular but segment-shaped. The floating barrier is sealed off by being "bridged over" with thicker lumps of powdered talcum or with the usual thin ribbons. The trough is mounted (screwed) by its underside to a metallic plate ¼ inch thick which is heated by a heating-coil lying beneath it. A contact thermometer fixed to the covering Perspex protective hood (not shown in Fig. 1) which dips into the surface layer is connected with the self-regulation part of an ultrathermostat. The values are read from the graduated circle and the two vernier dials on the head of the instrument. From the angles the size of the film-covered area and the amount of torsion power exerted can be easily determined. With the use of a photocell compensator the apparatus is also very well suited for automatic recording of force-area curves. For this purpose the mirror attached to the floating barrier indicates the zero position. An optical patch two meters long has been found adequate for ordinary purposes.

The cylinder-symmetrical construction guarantees uniform heating of the substrate to a high degree. The thick metallic base plate and the protective Perspex hood, which, for ease in handling, is provided with slots which may be tightly closed, have the combined effect of a thermostat box. The above-mentioned materials have very high lyophobic qualities and also permit the use of an organic substrate, which up to now was not possible.

Until now, thin layers of fatty acids on water and hexane, respectively, as well as on the interface water/hexane have been investigated at temperatures up to 60°C. The results will be published elsewhere.

Holder for Infrared Spectrophotometry of Small Samples on Silver Chloride

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(Received September 22, 1952)

IN some biological and bacteriological problems it is desirable to be able to obtain infrared spectra from samples of less than a milligram. Dried films of bacteria and of substances such as polysaccharides often have practically no energy loss due to scatter and have the advantage over solutions or suspensions of being free from interfering solvent or mineral oil bands. Silver chloride plates are therefore useful, since films may be dried on them from water suspension or solution.

A plastic holder has been constructed, with dimensions as shown in Fig. 1, which fits into the microcell adapter obtainable for the Perkin-Elmer Model 21 infrared double-beam spectro-