of the water and as the square root of the frequency of the radio wave.

We may now apply equation 1, with the known values of α, to bring into evidence the shortness of the range of transmission of radio waves through water. For example, the intensities of radio waves of wave-lengths 200, 80, 65 and 25 meters will be reduced to 10 per cent. of their value at the transmitter after passing through approximately 20, 11, 10 and 6 meters of Lake Michigan water, respectively. The corresponding distances for a reduction to one one-thousandth of the original intensity (irrespective of the strength of the transmitter) are 58, 35, 30 and 20 meters, respectively. Since the conductivity of sea water is approximately one thousand times as great as that of fresh water, the absorption coefficients of salt water will all be approximately thirty times larger and the distances, for a given ratio of intensities, will be only 3 per cent. of those in fresh water.

It may be concluded: (1) that radio waves can not be expected in appreciable intensity at any great distance from *deeply* submerged undersea craft unless the transmitter has considerable power; (2) that the longer wave-lengths will travel farther than the shorter ones, other conditions being the same; and (3) that greater distances will be reached in fresh than in salt water.

A test was also made in which the receiver was placed near the water, on the shore, while the transmitter was submerged a short distance under the water and moved parallel to the shore line, away from the receiver. Intensity readings were taken every 20 meters up to a distance of 140 meters when the transmitter was brought to the shore and then carried back on the land toward the receiver. Intensity readings were made on the return trip and gave practically the same shape intensity-distance curve as on the outward journey, lying slightly above the water values. Similar results were obtained with the receiver in one boat and the transmitter in or below a second boat. An intensity-depth curve for 47.3 meter waves, for d from 0 to 2.6 meters, was made when the boats were 20 meters apart and yielded an absorption coefficient of 0.00260, in exact agreement (fortuitously) with the theoretical value.

The measurements in these latter tests were not made as carefully as those reported in the first part of this paper and, hence, can not be used with the same degree of conviction in drawing conclusions. We might assume, however, that the radio waves came to the surface within a comparatively short distance from the transmitter and, because of the comparatively high index of refraction of water (around 9, for these waves), were sharply refracted and traveled through the air to the receiver, rather than taking the shorter but much more absortive path directly through the water.

If these conclusions are valid, then it should be possible to signal to considerable distances from a submarine which is submerged only a *short* distance below the surface of the water.

The writer wishes to express his sincere thanks to Mr. M. Romberg for placing his power boat at our disposal and to the South Shore Power Boat Club for the use of its wharf and club house.

J. BARTON HOAG

RYERSON PHYSICAL LABORATORY,
UNIVERSITY OF CHICAGO

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SPECTROCOLORIMETER FOR COMPARING THE SPECTRA OF SOLUTIONS OF DIFFERENT DEPTH[1]

IN matching colors and absorption bands it is desirable to have a simultaneous reference. A hand spectroscope mounted immediately above the prisms of a standard colorimeter of the Duboscq type provides two spectra in immediate juxtaposition when the adjustable slit of the spectroscope is placed perpendicular to the line of division of the two fields of light. This allows the instrument to be used as a regular colorimeter with the added advantage that specimens having an interfering color, such as urine- or bile-stained blood, can be more accurately matched and a correction made for the increased absorption of light by these interfering colors. A quick and accurate method is provided

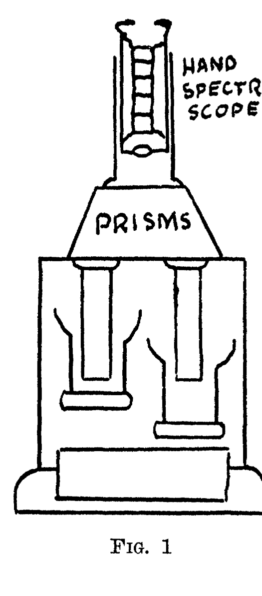

FIG. 1

[1] From the Littauer Pneumonia Research Fund, New York University College of Medicine, and the Medical Service, Harlem Hospital, Department of Hospitals, New York City, N. Y.

for identifying and determining the concentrations of substances having characteristic absorption bands, such as bilirubin, hematoporphyrin and methemoglobin.

ELY PERLMAN,
Research Fellow, Pneumonia Service, Harlem Hospital
NEW YORK UNIVERSITY COLLEGE OF MEDICINE

PERIODIC DISCHARGING OF LIQUIDS AND INTERMITTENT WASHING OF SOLIDS

A VERY efficient method of washing solids is an intermittent addition and draining of the solution. Also it is desirable in certain cases to add solution quickly for agitation but to drain slowly because of diffusion limitations from the surface or interior of the material being washed. Further, many substances such as shredded gels, being fragile, are partially lost in washing if agitation is done mechanically or by forcing gases through the bulk material.

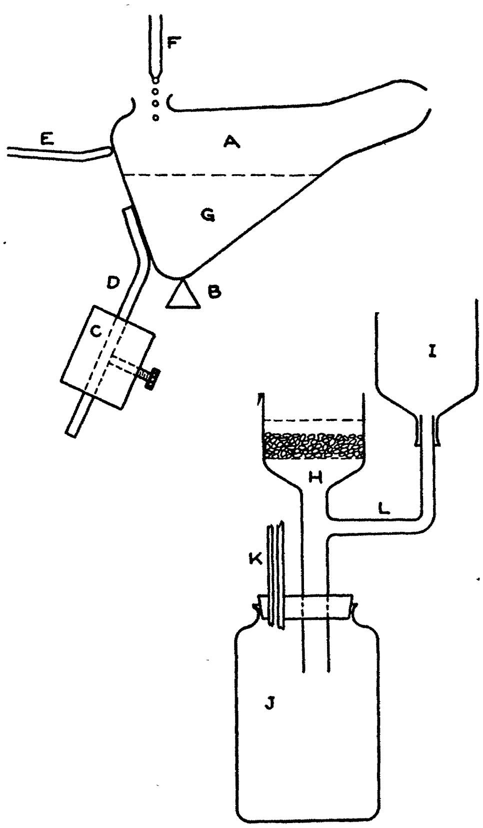

FIG. 1. Intermittent washing of solids.

We have devised a handy apparatus that can be set up in the laboratory. It is schematically shown in Fig. 1. A is merely an Erlenmeyer flask of appropriate dimensions with the mouth drawn down somewhat and a hole blown near the bottom. The flask rests on a fulcrum, B, and an adjustable weight, C, is attached to the flask by a rod D. B can include the holder for A, not shown in the diagram.

The sensitivity of the device depends on the unstable equilibrium, which in turn is influenced by the distance of the point of contact of the fulcrum from the center of gravity of the tilting flask containing liquid. With the appropriate dimensions the balance is maintained by moving C to the right position.

A stop bar, E, places the flask in the correct position for filling from a tube, F, and a slight adjustment of E also controls the amount of solution that will just dump. Obviously, the shape of the container is the cause of the mechanism shifting its center of gravity so that it functions on reaching a desired volume of wash solution. With a 500 cc flask the solution is delivered in 5 seconds.

The remainder of the figure is self-explanatory, H being a Buchner funnel and K a capillary that is adjustable. We have arranged that 500 cc drains in 3 minutes, while A fills in 5 minutes. The 111 mm inside diameter funnel will hold about 200 cc of material to be used. J is large enough to collect any sediment from the solid material so that K is not in danger of clogging.

The device is especially adaptable for washing such fragile material as shredded gelatin gels. The thinner the layer of material in the funnel the more uniform should be the washing. Funnels of larger diameter for the same weight of solid can be used for this purpose. No apparent difficulties are foreseen for making A any size desired.

C. L. GRAHAM
RAYMOND H. LAMBERT
RESEARCH LABORATORIES,
EASTMAN KODAK COMPANY

BOOKS RECEIVED

Bollettino di Pesca, di Piscicoltura e di Idrobiologia; GUSTAVO BRUNELLI, Direttore. Anno XV, Fasc. 2, Marzo-Aprile 1939. Pp. 107–271. Illustrated. R. Laboratorio Centrale di Idrobiologia, Roma.

INGRAM, G. W. *Radio Interference Suppression.* Pp. viii + 154. 56 figures. The Electrical Review, London. 5/–.

National Geographic Society. *U. S. Navy Solar Expedition of 1937 to Canton Island.* Pp. 394. Illustrated. The Society, Washington.

OSEEN, C. W. *Johan Carl Wilcke, Experimental-Fysiker.* Pp. 397. Illustrated. Almquist and Wiksells, Upsala.

Report of the First Scientific Expedition to Manchoukuo under the Leadership of Shigeyasu Tokunaga, June–October, 1933; Section V, Division I, Part I, Division II, Part IV. Illustrated. Faculty of Science and Engineering, Waseda University, Tokyo.

SILVERMAN, ALEXANDER and ABRAHAM L. ROBINSON. *Selective Experiments in General Chemistry.* Pp. xi + 310. Illustrated. Van Nostrand.

VERZÁR, F. *Die Funktion der Nebennierenrinde.* Pp. 266. 16 figures. Benno Schwabe, Basel, Switzerland. Gebunden Fr. 25.

WINTERS, LAURENCE M. *Animal Breeding.* Third edition. Pp. viii + 316. 118 figures. Wiley. $3.50.