same type have shown that these results are reproducible. It therefore appears that the principal influence of D_2O on photosynthesis is to retard the dark reaction, and that D_2O affects the photochemical stage of the process very little, if at all.

Through the use of the rotating disk the amount of light received by the cells per minute was reduced approximately 93 per cent., but in neither D_2O nor H_2O was photosynthesis reduced commensurately with the amount of illumination. Computations based on the data plotted in Fig. 2 show that per unit amount of light supplied, the amount of photosynthesis was increased in intermittent illumination approximately 175 and 615 per cent. in H_2O and D_2O, respectively. Since the methods employed to obtain intermittent illumination differed somewhat from those of other investigators,[5] the values given here can not be compared with the data published by these writers for photosynthesis in H_2O.

Perhaps the most important implication of our experimental results is that H_2O as well as D_2O enters into the dark stage rather than into the photochemical stage of photosynthesis.

We hope to present elsewhere a detailed account of these and other experiments in which the D_2O concentration, CO_2 concentration, temperature and ratio of dark interval to light interval were varied.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD OF MEASURING ROTATIONAL SPEEDS

THE development of the ultracentrifuge has made it necessary to measure rotational speeds over wide ranges. In some of our previous experiments the speed was varied from about a hundred to over twenty thousand revolutions per second. Usually the working speeds are between 500 r.p.s. and 3,000 r.p.s.[1] Several different methods of measuring speeds of rotation in this range may, of course, be used, but in practice they are comparatively complicated and require special or expensive equipment. Also, as in the case of some forms of the stroboscopic method, care must be taken by the observer to distinguish between the fundamental and its harmonics.

A method is described in this paper which is practically free from the above objections and is almost ideally suited to the measurement of rotational speeds over much wider ranges than necessary at present. Fig. 1 shows a schematic diagram of the apparatus.

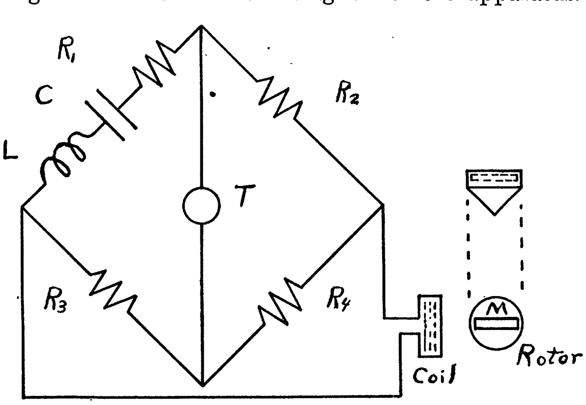

FIG. 1

A small magnet M fastened to the high speed rotor or driving turbine induces an alternating current in the coil, which is connected across a bridge that can be balanced at only one frequency. An inspection of the circuit shows that the bridge will balance when

$$\frac{R_1}{R_2} = \frac{R_3}{R_4} \text{ and } Lw = \frac{1}{Cw} \text{ or } N = \frac{1}{2\pi\sqrt{LC}}$$

where R_1, R_2, R_3 and R_4 are non-inductive resistances; L inductance, C capacity and N the frequency of the alternating current in the bridge. Therefore, the procedure in measuring the rotational speed of the rotor is simply to vary either C or L until T indicates that the bridge is balanced. Then from the known value of L and C the number of revolutions per second N is computed. The indicating instrument T may be a loud speaker, telephone receiver, thermocouple galvanometer, etc., used either with or without an amplifier, depending upon the sizes of the rotating magnet and coil as well as their distance apart. In our experiments the magnet was either a piece of sewing needle (1 to 2 cm in length) or a small cobalt steel magnet. These small magnets when properly mounted do not disturb the balance of the high-speed rotors or turbines. The resistances $R_2 = R_4 = 300$ ohms, and $R_3 = 100$ ohms. They were ordinary non-inductive wire-wound resistances. $R_1 = 100$ ohms and included the resistance of the inductance L. Three fixed mica condensers were used in various combinations as the capacity C, while L was a variable inductance (5 to 25 millihenries). The capacity could thus be varied in large steps, while L could be varied continuously. Table I shows values for the rotational speed com-

[1] Beams and Pickels, *Rev. Sci. Instruments*, 6: 299, 1935.

[5] R. Emerson and W. Arnold, *Jour. Gen. Physiol.*, 15: 391–420, 1932; 16: 191–205, 1932. Warburg, *loc. cit.*

TABLE I

N Bridge	N Stroboscope
551 r.p.s	545 r.p.s.
627	612
870	858
1108	1090
1244	1250
1355	1333
1417	1412
1548	1540
1745	1738
1915	1936
2156	2182

puted from settings on the bridge and from simultaneous stroboscopic determinations made with a rotating slotted disk. It will be observed that they are in good agreement. As a matter of fact, the values obtained stroboscopically were much less precise than those obtained with the bridge. The settings on the bridge were so "sharp" that the precision was limited only by the precision with which the scale on the inductance could be read. With fixed capacities, the scale on the inductance can be calibrated directly in revolutions per second.

The above method therefore possesses the following advantages: (1) The apparatus is inexpensive, simple to operate and easily obtainable or constructed. (2) The rotational speed is read directly, and no special skill is required of the observer, since only one frequency will balance the bridge. (3) Its calibration does not change. That is, the settings are independent of the strength of M and the position of the coil. (4) The readings can be made about as accurately and quickly as desired, and this makes it possible to follow rapid fluctuations in the speed of the rotor. (5) The balance of the bridge also may be used indirectly to control the rotational speed when this is desirable.

It is indeed a pleasure to acknowledge a grant from the Rockefeller Foundation for the development of the ultracentrifuge.

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INSTRUMENT TENTS

SEVERAL visitors at this laboratory have regarded with interest a simple arrangement which is in use here for protecting a large spectrophotometer from the accumulation of dust or exposure to spilled material or humid atmosphere. At the risk of duplicating any current information, one visitor's suggestion that a brief note be published on the matter has been adopted.

Ordinary cloth sheets, towels or black cloths, placed over colorimeters, microscopes, spectroscopes or other optical instruments afford little more than superficial protection against moisture, and defeat another purpose by actually leaving deposits of dust and lint upon exposed optical surfaces. Yet when an instrument is in frequent use, or must remain for some hours in an undisturbed position, or is without a wooden case (all three of which contingencies apply to this spectrophotometer) it is desirable to protect it from dust and moisture. To meet such needs, we have had a large tent of specified shape and dimensions constructed out of yellow oiled silk, such as is used in wet surgical dressings, shower-curtains, etc.; some Cellophane derivative might serve as well.

Tents of such material in any specified shape or size can be constructed readily, usually by local companies. The material is transparent enough that the instrument may be seen when covered, tough, pliable, washable, lasting, light enough to be removed and replaced readily without risking accidental disturbances to adjustment of verniers, settings, mirrors, etc., and affords gratifying protection against dust and moisture.

For the covering of large instruments, use may be made of the simple contrivance employed here: a narrow strip of canvas, sewn along the midline at the top of the spectrophotometer-tent, supports a series of small metal rings, by which the whole tent is suspended by strings to a light dowel extending the length of the tent. The dowel is in turn suspended from the ceiling by a pair of small cords running over pulleys. Thus when the instrument is to be used, the light tent is easily drawn up and hung out of the worker's way. When desired, it can be readily relowered over the instrument. It is important that the tent cover the instrument completely, its bottom edges meeting the table surface.

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BOOKS RECEIVED

AKELEY, MARY L. J. *Restless Jungle.* Pp. xiii + 313. Illustrated. McBride. $3.00.

BELL, E. T. *Men of Mathematics.* Pp. xxi + 592. 30 plates. Simon and Schuster. $5.00.

HAMILTON, LEICESTER F. and STEPHEN G. SIMPSON, Editors. *Talbot's Quantitative Chemical Analysis.* Eighth edition. Pp. xiv + 297. 12 figures. Macmillan. $2.50.

HOFFMAN, FREDERICK L. *Cancer and Diet; With Facts and Observations on Related Subjects.* Pp. xx + 767. Williams and Wilkins. $5.00.

HORNEY, KAREN. *The Neurotic Personality of Our Time.* Pp. xii + 299. Norton. $3.00.

HUMPHREYS, W. J. *Weather Rambles.* Pp. 265. Illustrated. Williams and Wilkins. $2.50.

KELLY, HOWARD A., AUDREY W. DAVIS and H. C. ROBERTSON. *Snakes of Maryland.* Pp. 102. 33 figures. 10 plates. Natural History Society of Maryland, Baltimore.

LOOMIS, FREDERIC B. *Physiography of the United States.* Pp. viii + 350. 212 figures. Doubleday, Doran. $2.75.

New Jersey Pharmacy Laws and Regulations, June 30, 1936. Pp. 122. Board of Pharmacy of the State of New Jersey. $1.00.

PRENTISS, AUGUSTIN M. *Chemicals in War.* Pp. xviii + 739. 139 figures. 2 plates. McGraw-Hill. $7.50.

Report of the Department of Scientific and Industrial Research for the Year 1935–36. Cmd. 5350. Pp. 195. His Majesty's Stationery Office, London.