experience in this field. The book has value and fills a distinct need. It deserves a wide distribution.

Tissue Culture in Relation to Growth and Differentiation. By T. S. P. STRANGEWAYS, lecturer in special pathology in the University of Cambridge. W. Heffer & Sons, Ltd., Cambridge, 1924, pp. 50.

IN this book of fifty pages is given a general survey of the results obtained by the author from certain experiments with the cultivation of tissues "in vitro," together with his interpretation of these results in relation to various biological problems, such as mitosis, differentiation, inflammation and repair, etc. A careful reading of this book has given me the impression that the material contained in it, although of value, will not have a general appeal either to workers in this field or to the average reader.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CATHODE RAY OSCILLOGRAPH FOR SEVERAL SIMULTANEOUS WAVES WITH STABILIZED LINEAR TIME AXIS

A LINEAR time axis[1] for cathode ray oscillograph is obtained by repeatedly charging a condenser through a saturated thermionic rectifier and discharging through a neon lamp when a critical voltage is reached. The period, controlled by condenser capacity and rectifier filament current, can be made approximately synchronous with any periodic phenomenon under study, so that the oscillograph shows a nearly stationary wave or curve plotted against time in rectangular coordinates. Although, under these conditions, the wave may shift, it can be inspected and has proved highly satisfactory for certain purposes, *e.g.*, the graphical demonstration of heart sounds.[2]

For the study of physical phenomena, as alternating currents and voltages, it is desirable to have the wave or curve absolutely stationary, and, furthermore, to obtain two or more such waves simultaneously for precise comparison of phase, amplitude, frequency and wave form. In certain cases a synchronous contactor may be employed to obtain precise synchronism of the condenser discharge with the phenomenon under study, thus stabilizing the time axis and making stationary the wave. We have found this method satisfactory, but limited in its application and involving unnecessary auxiliary equipment. The desired end, however, is simply and satisfactorily obtained by tickling the neon lamp with a small alternating electromotive force[3] of the same frequency, whether it be high or low, as the periodic phenomena being studied, thus synchronizing the discharge of the condenser, without affecting its uniform rate of charge. This gives an absolutely stationary wave which may be photographed, or copied precisely on tracing cloth or by binocular vision.

A number of curves are readily obtained simultaneously by a motor-driven switch making connection to the several sources in rapid succession, the curves all appearing continuous and simultaneous due to persistence of vision. We have obtained three or four simultaneous curves (all absolutely stationary) with complete satisfaction and believe six or more could be obtained if needed. It has proved a convenient way of comparing wave forms of transformer input and output, showing the amount of distortion and amplification under different conditions. Any shifting of the curves would lead to confusion.

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SPECIAL ARTICLES

THE ISOLATION OF A CRYSTALLINE PROTEIN WITH TUBERCULIN ACTIVITY[1]

BEGINNING with Koch in 1891, many attempts have been made to separate from tuberculin the principle responsible for eliciting a skin reaction in tuberculous subjects. The exact nature of this substance has been a riddle and while most opinions proclaim it to be protein in nature, there have been many dissenting voices. A series of experiments consecutively carried out in this laboratory, and appearing in the May issue of the *American Review of Tuberculosis*,[2] seem to prove more or less definitely that the substance is of protein nature.

Briefly, these experiments show that the substance responsible for the activity of tuberculin is com-

[1] Austin Bailey, *Physical Review* (2), 25, p. 585, April, 1925.

[2] Apparatus for this purpose, developed by the Western Electric Company, was exhibited by Dr. H. Clyde Snook, 1925, at Kansas City meeting A. A. A. S. and was previously exhibited at Atlantic City meeting Am. Med. Assoc.

[3] This may be conveniently applied through a potentiometer in series with the lamp.

[1] From the Department of Pathology of the University of Chicago and the Otho S. A. Sprague Memorial Institute, aided by a grant to Dr. Esmond R. Long from the Medical Research Committee of the National Tuberculosis Association.

[2] The Chemical Composition of the Active Principle of Tuberculin. I–VII. E. R. Long and F. B. Seibert, *Amer. Rev. Tuberc.*, 1926, XIII, 393.