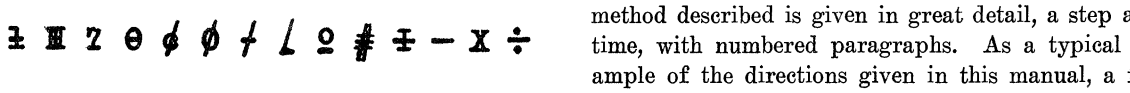
all the mathematician's requirements on the typewriter and still have a machine which is suitable for ordinary service. But possibly we might provide him with two machines which would provide nearly all the characters commonly used. Say one machine with forty-two typebars and single shift carrying the characters usually found on a keyboard and with perhaps six special characters; another machine of the same size and make would carry the alphabet in twenty-six special capital letters, ten large numerals and ten small numerals for exponents and subscripts and arranged so as to be available for fractions, thirty-eight of the more commonly used mathematical characters. Manuscript would go through machine number one first, leaving blank spaces for such expressions as had to be filled in on the other machine. Finally the sheet would be put through the second machine in much the same way that a printed paper of any kind is now filled in on a typewriter.

By striking twice in a single space and by turning the roll as required, it is possible to produce a considerable number of special characters from the standard keyboard:



A name for some of these may be derived from the components, as when we abbreviate *hyphen-one* to read *hyon.*

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RADIO INFORMATION

RECENTLY a friend of mine here listened in on a radio talk broadcast by the New Jersey Experiment Station on the subject of clovers. In this talk the speaker mentioned the excellence of foreign clovers as shown in the experiments conducted by the New Jersey station, and stated that it was quite all right for American farmers to use foreign seed. The speaker did not state at any time during his talk that the statements he was making were to be considered as applying to his particular state only and not to the country as a whole.

We find that in this state the foreign clovers are very susceptible to anthracnose and therefore undesirable for our use here, whereas our own varieties are not so susceptible, and in cases where selection has been made, highly resistant strains of American clovers have been developed. Our farmers, listening in on some other state broadcasting what would be true under their own conditions, would not know that such might not be true for some other locality.

The speaker, broadcasting over the radio, sometimes forgets that his words are being heard over a wide expanse of country. It seems to me that there should be emphasis placed by each experiment station broadcasting that their findings and recommendations are for their *own conditions only,* unless indeed they are bringing together the results of research from many stations, in which case it would be equally necessary to so state. What is information in one place becomes misinformation in another place, and too much emphasis can not be put upon the limitations that should accompany recommendations.

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SCIENTIFIC BOOKS

The Technique of Tissue Culture "In Vitro." By T. S. P. STRANGEWAYS, lecturer in special pathology in the University of Cambridge. W. Heffer & Sons, Ltd., Cambridge, 1924, pp. 80.

As indicated in the title this little volume contains a description of the technique employed in the cultivation of tissues "in vitro." In every instance the method described is given in great detail, a step at a time, with numbered paragraphs. As a typical example of the directions given in this manual, a few paragraphs may be quoted from page 58 in which Professor Strangeways gives directions for the simple operation of transferring plasma from a thermos bottle to a capillary pipette.

(1) Open one of the Thermos flasks, and with a pair of forceps remove the container of the plasma tube from the flask by means of the string handle.
(2) Remove the cork of the container, and with a pair of sterile forceps carefully lift out the tube containing the plasma.
(3) With a pair of sterile forceps remove the cork from the plasma tube, and place it on a sterile surface.
(4) Take a sterile paraffined pipette (Section XXV), and draw into it about ½ cc of plasma without touching the side of the plasma tube.
(5) Place the pipette in a glass jar so that the end near the bulb rests on the roll plasticine (Section XI).
(6) Recork the plasma tube, using sterile forceps, and place it in its container.
(7) Recork the container and replace it in ice in the Thermos flask.
(8) Cork and cap the Thermos flask.

The technique for the cultivation of tissues "in vitro" is generally regarded, and rightfully so, as being difficult to acquire. A careful following of the specific directions in this book would seem to make it possible for any one to acquire proficiency in tissue culture methods, even though he had had no previous

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.