Use of a Radial Deflection Cathode Ray Oscillograph as a Time Comparator

THE comparator principle is well known in the accurate determination of lengths. It may also be applied to the measurement of time intervals. By installing an extra electrode system in a standard type of cathode ray tube, radial deflections and spiral time bases are readily produced. Such a modified tube has advantages over the ordinary tube when the latter is used to obtain radial deflections, whether by anode voltage modulation [1,2,3,4], or by auxiliary apparatus[5].

With a spiral, one convolution of which is performed in 1/1,000 second, and assuming a resolution of 1° on the photographic record, the maximum error in the determination of a time mark would be approximately 3 micro-seconds. Thus, if two pendulums nominally beating seconds were arranged to record their transits at the beginning and end of ten swings, a difference of one micro-second in their periods would be detectable. That is to say, an observation lasting only ten seconds could be utilised to reveal a difference of periods such that in a week the faster would have scarcely gained a beat on the slower. The corresponding use of the tube as a 'time microscope' is obvious.

Having already developed a practical form of radial deflection cathode ray oscillograph, we are now investigating in this laboratory the possibilities of this, among other, applications of the tube.

JOHN J. DOWLING.
THOMAS G. BULLEN.

University College,
Dublin.
Jan. 8.

[1] Lilienfeld, 'Oszillographenröhre', German Patent 373,834.
[2] Dye, *Proc. Phys. Soc.*, **37**, 158 (1925).
[3] Kipping, *Wireless World*, **13**, 705 (1924).
[4] Gouban and Zenneck, *Z. Hochfrequenztechnik*, **37**, 207 (1931).
[5] Radio Research Board, Slough, *J. Inst. Elect. Eng.*, **71**, 82 (1932)

Points from Foregoing Letters

SIR JOSEPH LARMOR states that the identity of mass and energy is now being questioned, and points out that it was originally deduced from the relativity principle. He considers that energy, whilst possibly equivalent to the abstract mass concept of the four-dimensional space-time, has little to do with the inertial mass as directly measured in the laboratory.

Certain 'extra' rings have been observed by Dr. G. I. Finch and H. Wilman in the diffraction patterns obtained by the passage of electron beams through flakes of graphite, as compared with electron patterns from thick crystals, or those obtained with X-rays. The authors show diagrammatically how these 'extra' rings may result: owing to difference in the density of atoms along different planes, certain Bragg spacings between planes, not effective in ordinary crystals, become effective when thin flakes are used.

Photographs of electron-positron 'pairs' are submitted by Prof. D. Skobeltzyn and E. Stepanowa as further evidence of the production of positrons by β-rays (electrons) during their passage through matter. The authors add that the absorption of the primary electron is sometimes accompanied by a single positron. The effective cross-section appears to be of the order 10^{-24}–10^{-23} cm.^{2}.

When γ-rays pass through heavy hydrogen, some of the deuterium atoms are split, with production of charged particles the energy of which can be measured by the 'kick' produced in a galvanometer. From the number and intensity of such 'kicks', Prof. G. Ising and Matts Helde calculate the mass of the neutron as 1·0080, somewhat lower than the previously calculated value 1·0084.

Photographs showing gradual changes in the X-ray diffraction pattern on transition from the vitreous silica to a crystalline mixture of crystobalite and tridymite (microcrystalline forms of quartz) are submitted by N. Valenkof and E. Poray-Koshitz. The authors state that similar transition patterns were obtained with soda-silica glass, rising temperature and increased duration of heating leading to the gradual appearance of the crystalline pattern.

By introducing liquid air traps in an apparatus for the production of nitric oxide from equimolecular mixtures of nitrogen and oxygen at 5–10 mm. pressure, Dr. J. Willey finds about ten times more nitric oxide near the electric arc than at a distance from it. He ascribes this to the simultaneous formation of active nitrogen which can decompose some of the nitric oxide formed. This effect can be prevented by inserting a plug of copper oxide or by introducing excess oxygen, a fact which explains why excess oxygen rather than the theoretically calculated amount is used in practice.

Contrary to current opinion, the optical rotation of glucose is found by Prof. P. S. Tang and P. N. Sung to be changed in boric solutions, showing a minimum at $M/7{\cdot}5$ boric acid (pH 4). This fact may have a bearing on the rate of respiration of certain strains of yeast in boric acid solutions.

Emulsions of thallous bromide are found by W. J. G. Farrer to have the property, hitherto only observed in silver preparations, of recording under the influence of light an invisible image which can afterwards be developed by suitable treatment. This involves first bathing the exposed thallous bromide in silver nitrate solution, and then following with the usual procedure as in the case of a photographic plate. The present theory of the photographic image may have to be revised to account for these new findings.

Exposure to strong magnetic fields (5,000 gauss) produces no observable change in the arrangement of chromosomes or the growth of cells cultivated *in vitro*, according to Ruby Payne-Scott and W. H. Love. There was some indication of a slight tendency to protoplasmic disintegration in some of the resting cells in certain exposed cultures.

The way in which the current in a receiving frame aerial varies with the direction of propagation and length of wave is discussed by Prof. L. S. Palmer. He points out that with short waves there is only one position for which the frame current is zero, as against several positions in the case of long waves.

A photograph showing the spectrum of light emitted by an artificial crystal of potassium bromide under the influence of X-rays is submitted by Prof. P. W. Burbidge and T. G. Moorcraft.