

and other gases in the breakdown processes, and the results will be published in due course. The present results are sufficient to show, however, that most of the high and reproducible values of the breakdown strength reported hitherto referred to *n*-hexane containing a substantial proportion of dissolved oxygen.

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- <sup>1</sup> Lewis, T. J., *Proc. Inst. Elect. Eng.*, **100**, Pt. IIA, No. 3 (1953),  
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### A Proposed Method for the Measurement of the Velocity of Light

THE precision of optical methods of measuring the velocity *c* of electromagnetic radiation in free space is restricted by the upper limit of the frequency at which a light wave may be amplitude-modulated. Bergstrand<sup>1</sup>, in his recent measurements, used a modulation frequency of 10 Mc./sec. and consequently his base-lines were several km. long. The highest modulation frequency so far reported seems to be 300 Mc./sec. by Rao and Murty<sup>2</sup> using diffraction by ultrasonic waves in a crystal. It would be desirable to increase this limit so that an optical standard of length could be used directly in a determination of *c*. The correlation of photons in coherent light, which now seems well established<sup>3</sup>, eliminates the necessity for a direct modulation of a light source. Two wave trains of optical frequencies  $\nu_1$  and  $\nu_2$ , falling on a photosensitive surface, will give<sup>4</sup> a component in the photo-current at a frequency  $(\nu_1 - \nu_2)$ . If the wave trains are divided at a half-silvered mirror and fall on two photocells  $P_1$  and  $P_2$ , the outputs  $S_1$  and  $S_2$  of these cells at a frequency  $(\nu_1 - \nu_2)$  may be added and will interfere to give an output  $S_3$ , the amplitude of which depends on the relative phases of the two signals  $S_1$  and  $S_2$ . It may readily be shown that if  $P_1$  is kept fixed and  $P_2$  is moved radially away from the source, the amplitude of  $S_3$  will have minima separated by a distance  $\frac{1}{2}c/(\nu_1 - \nu_2)$  if the source can be considered to be a distant point.

At the moment the method is impracticable because the signal-to-noise ratio achievable with existing light sources would be far too small. The proposed development<sup>5</sup> of a maser working in the visible region would, however, yield a light source with a very much smaller frequency width than has hitherto been obtained. Ideally, for the application suggested here, the source should emit light in two narrow bands  $(\nu_1 - \nu_2)$  apart, each having a frequency width very much narrower than  $(\nu_1 - \nu_2)$ . The latter criterion, according to the example taken by Schawlow and Townes<sup>5</sup>, could, if  $(\nu_1 - \nu_2)$  were of the order of 1–10 kMc./s., be achieved in the optical maser. The separation of the two components could be obtained by the Zeeman splitting of the line emitted by the maser. The use of such a high value of  $(\nu_1 - \nu_2)$  precludes the use of the conventional photomultiplier; but there seems no reason why a

suitable photosensitive device<sup>4</sup> should not be designed for use at such frequencies.

The ultimate precision of this proposed method depends on the signal-to-noise ratio which can be achieved when: (a) the sizes of the light source and of the detecting surfaces are restricted within narrow limits, and (b) the frequency  $(\nu_1 - \nu_2)$  is defined by a narrow-band receiver. Successful operation of the optical maser would allow the precise determination of *c* in the visible region over much shorter baselines, and possibly with higher precision than has hitherto been achieved. It would also provide a light source which would allow an even more convincing demonstration of photon correlation than that of Twiss, Little and Hanbury Brown<sup>3</sup>.

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<sup>3</sup> Twiss, R. Q., Little, A. G., and Hanbury Brown, R., *Nature*, **180**,  
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<sup>4</sup> Forrester, A. T., Gudmundsen, R. A., and Johnson, P. O., *Phys. Rev.*,  
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<sup>5</sup> Schawlow, A. L., and Townes, C. H. (to be published).

### An Experimental Method for Diffusion and Extraction Studies across the Liquid-Liquid Interface

THE prototype apparatus shown schematically in Fig. 1 offers a promising experimental approach for diffusion and extraction studies across the interface between certain aqueous-organic systems uncomplicated by diffusion control in the adjacent bulk phases. It may also prove an effective probe of factors which influence the behaviour and 'structure' of the interface. The apparatus is operated in the following way. The substance being extracted (with tracer) is dissolved in 1 cm.<sup>3</sup> of static aqueous phase placed so the aqueous surface formed at the bottom of the 'Teflon' slit (0.25 in. × 0.001 in.) is oriented lengthwise across the width of the rim, and about 0.006 in. above the wheel. Individual organic drops, at 1–5 drops/sec., are dropped on the 'Teflon' rim spinning at 10–200 r.p.m. Each drop is squeezed past the slit where it makes brief 'contact' with the aqueous phase before being almost entirely dragged away from the slit, wiped off, and collected at the bottom of the wheel. The activity/cm.<sup>3</sup> of substance in the extract multiplied by the rate of production of drops is a measure of the 'apparent extraction rate', a parameter sensitive to the concentration of constituents involved in the extraction process.

In a study at 100 r.p.m. of the simultaneous extraction of radioactive iron(III) and caesium(I) from a 1 M nitric acid/water solution with pure tributyl phosphate, the ratio of the activity of caesium to that of iron in the extract was  $0.80 \pm 0.02$  compared to the original value in water of  $1.18 \pm 0.03$ . The activity/cm.<sup>3</sup> in this extract was about  $10^{-3}$  times that of the aqueous phase, but it was about ten times more than is picked up by tributyl phosphate in a single equilibrium extraction with the same volume. These results indicate that a 'stable' interface with diffusive flow across it was achieved and that a differential rate of extraction in favour of iron(III) over caesium(I) was obtained. Furthermore, the ratio of caesium to iron in the extract differed markedly from the equilibrium value