

and particularly suitable for use in the microwave region between about 2 and 20 cm. The present measurements, however, have been restricted to those frequencies for which suitable oscillators could be obtained.

Results have been obtained over the range from 8 to 14 cm., on a low-carbon content iron wire (0.04 per cent carbon), and a steel wire (0.50–0.55 per cent carbon), both specimens being tested in the hard-drawn (bright) condition and also after white annealing. Measurements have also been made with a commercial nickel wire (higher than 99.5 per cent nickel). The results, together with the D.C. initial permeabilities, are given in the accompanying table :

Frequency (Mc./s.) Wave-length (cm.)	D.C.	2300 13	2600 11.5	3000 10	3400 8.8
Iron, bright	101	50	65	63	61
Iron, white annealed	140	41	60	67	65
Steel, bright	65	38	34	39	25
Steel, white annealed	102	31	31	28	28
Nickel	13	7	8	10	8

The probable error in these results is of the order of 10 per cent.

The measurements are now being extended to other frequencies and ferromagnetic materials. A fuller account of these measurements, together with their bearing on the theoretical considerations advanced by Becker<sup>5</sup> and Kittel<sup>6</sup>, will be published in due course.

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<sup>1</sup> Allanson, *J. Inst. Elect. Eng.*, Pt. 3, **92**, 247 (1945).

<sup>2</sup> Arkadiev, *Ann. Phys. Lpz.*, **81**, 649 (1926).

<sup>3</sup> Eichholz and Hodsmans, *Proc. Leeds Phil. and Lit. Soc.*, **4**, 303 (1946).

<sup>4</sup> Willis Jackson, "High-Frequency Transmission Lines" (Methuen).

<sup>5</sup> Becker, *Z. Tech. Phys.*, **19**, 542 (1938).

<sup>6</sup> Kittel, *Phys. Rev.*, **72**, 81 (1946).

tion by 3650 Å. and by 2537 Å., but in addition the shorter wave-length produces a long-duration exponential decay of phosphorescence which is strongly dependent on temperature and is associated with a thermoluminescence characteristic of a single depth of electron trap of 0.75 eV. as derived from the relations developed by Randall and Wilkins<sup>4</sup>. Excitation by the short wave-length also causes photoconduction, but this is not closely associated with the luminescence processes in the material. Under all wave-lengths of excitation the emission spectrum consists of a broad band in the visible region with maximum in the green, and does not compare with the usual spectra of salts and solutions of salts of europium<sup>5</sup>.

So far, studies have been of a preliminary nature and little is known of the location of the europium ion in the silicate lattice. The studies of electron trapping show that the traps are specific to the centres and may be either within each centre or very near it. The efficiency of the luminescence is about 0.1 of that for a willemite phosphor excited by the short wave-length of 2537 Å.

We have found such low transition probabilities in dye molecules when adsorbed on to solid surfaces after the method of Travnicék<sup>6</sup>, the mean life-times being of the order of 1.6 sec. for such molecules as carbazol, æsculin and phenanthrene. Such decay processes may also be followed by a temperature-dependent decay of longer duration.

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<sup>1</sup> Randall, J. T., and Wilkins, M. H. F., *Proc. Roy. Soc.*, A, **184**, 347 (1945).

<sup>2</sup> Garlick, G. F. J., and Wilkins, M. H. F., *Proc. Roy. Soc.*, A, **184**, 408 (1945).

<sup>3</sup> Thosar, B. V., *Phil. Mag.*, **26**, 380, 878 (1938).

<sup>4</sup> Randall, J. T., and Wilkins, M. H. F., *Proc. Roy. Soc.*, A, **184**, 366 (1945).

<sup>5</sup> Tomashcek, R., *Trans. Farad. Soc.*, **35**, 148 (1939).

<sup>6</sup> Travnicék, M., *Ann. Phys.*, **30**, 224 (1937).

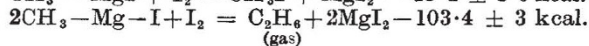
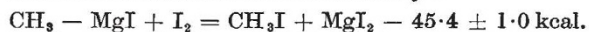
## Decay of Luminescence due to Forbidden Optical Transitions

It is well known that the exponential, temperature-independent decay of luminescence in solids such as sulphides and silicates of zinc and ruby is characteristic of forbidden optical transitions within the specific luminescence emission centres, and the mean life-time of such decays can be of the order of milliseconds in these materials<sup>1,2</sup>. The nature of these transitions in the chromium centres of ruby has been thoroughly studied by Thosar<sup>3</sup>, and the resulting decay of luminescence by Garlick and Wilkins<sup>2</sup>. In 1943, Dr. A. F. Wells, working in this laboratory, found that manganese centres in certain fluoride crystal lattices produced such decays with time constants of the order of 10 sec.<sup>-1</sup>, that is, the mean decay time being 100 msec.

We have recently studied the function of rare earth impurity in some silicate phosphors, and find that the emission centres formed by inclusion of europium ions in strontium silicate give rise to an exponential decay of luminescence which is independent of temperature (experimental range 90°–600° K.) and has a mean life-time of 2.3 sec., this decay being preceded by a faster component of very short life-time. Both components appear for excita-

## Bond-Strengths of Methyl-Iodine and Methyl-Magnesium

THE heats of the following reactions in ether solution have been determined calorimetrically :



Using these values, and published data<sup>1</sup> for the heats of atomization of solid iodine, for the bond-strength  $D(\text{CH}_3 - \text{CH}_3)$  and for the latent heats of volatilization of ethyl ether and methyl iodide, the bond-strength is calculated

$$D(\text{CH}_3 - \text{I}) = 54.75 \pm 1.4 \text{ kcal.,}$$

in good agreement with the value of 54 kcal. obtained from kinetic data<sup>2</sup>.

A (less reliable) value of the bond-strength

$$D(\text{CH}_3 - \text{Mg}) = 67.0 \text{ kcal.}$$

can also be computed from the calorimetric data.

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<sup>1</sup> Bichowsky and Rossini, "The Thermo-Chemistry of Chemical Substances" (Reinhold, 1936).

<sup>2</sup> Butler and Polanyi, *Trans. Farad. Soc.*, **39**, 27 (1943).