

A more complete description of these experiments will be published soon.⁹

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On the Faraday Effect at Microwave Frequencies†

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A MICROWAVE analog of the Faraday effect has been found experimentally at a wave-length of 3.338 centimeters. The sensitivity of the apparatus was adequate to measure Verdet constants as small as 0.5×10^{-3} , with a probable error of 25 percent under worst conditions.

The effect was found by use of a TE_{11} wave in circular pipe. The dielectric was placed within this pipe, and the pipe inserted on the longitudinal axis of a solenoid having a maximum field strength of 1350 gauss. Position of the electric vector within the pipe was determined by side probes extending into the pipe at each end of the solenoid. Angular displacement of the electric vector caused by the applied magnetic field was measured by rotating one of the side probes about the axis and reading the angle on a scale accurate to one minute of arc.

Two of the materials measured have Verdet constants of the customary order of magnitude. The materials are paramagnetic salts, $MnCl_2 \cdot 4H_2O$ and $MnSO_4 \cdot H_2O$. These salts are known to exhibit microwave absorption at 3 and 10 centimeters in the presence of a magnetic field.¹ The chief results for these two salts are given in Table I.

The basic equation for the Faraday effect is $\theta = RLH$, where θ is the angular rotation of the polarization plane in

TABLE I.

Substance: manganous sulfate; $MnSO_4 \cdot H_2O$					
L (cm)	H (gauss)	λ (cm)	θ (min.)*		R ($\times 10^3$)
9.2	1350	3.34	9.5		0.766
9.2	1350	3.45	12.5		1.01
9.2	1350	3.338	12.5		1.01
Substance: manganous chloride; $MnCl_2 \cdot 4H_2O$					
L (cm)	H (gauss)	λ (cm)	θ (min.)*	Dev.	R ($\times 10^3$)
9.2	1350	3.338	22.7	$\pm 35\%$	1.83 (a)
9.65	1350	3.338	28.7	$\pm 19\%$	2.21 (b)
23.4	1350	3.338	61.5		**1.94 (c)
30.5	1350	3.338	73.3	$\pm 13\%$	1.78 (d)
30.5	920	3.338	55.2	$\pm 17\%$	1.96 (e)
30.5	460	3.338	25.9	$\pm 23\%$	1.84 (f)
30.5	1350	3.442	25.7	$\pm 23\%$	***0.62 (g)
30.5	1350	3.553	46.9	$\pm 12\%$	***1.14 (h)

* Rotation to left when wave was in direction of magnetic field.
 ** Percentage deviation ± 14 percent; additional possible error 15 percent; total possible error 29 percent. Material in this specimen was loosely packed. Mean Verdet constant for values (a-f) = 1.90×10^{-3} .
 *** One large deviation omitted from percentage calculation.

TABLE II.

Ethyl alcohol	Polystyrene (clear)
Nitrobenzene	Ammonia (gas)
Carbon disulfide	Sodium chloride
Methyl alcohol	Glycerine
Ammonium nitrate	Ferrous sulfate (crystal)
Ammonium hydroxide	Ferric chloride (powder)
Water (distilled)	Carbon tetrachloride
Ether (anhydrous)	Manganous carbonate
Chloroform	Ferric nitrate
Ethylene chloride	Ferric sulfate
Methylene chloride	Cobalt chloride
Benzene	Cobalt sulfate
	Ferrous ammonium sulfate

minutes, L is the path length, H is the magnetic field strength, and R is the Verdet constant (a function of wave-length).

For the material most thoroughly investigated, manganous chloride, three principal observations may be made from the table:

- (1) The Faraday rotation was proportional to the path length L ; see table values (a) and (d).
- (2) The Faraday rotation was proportional to the field strength H ; values (d) and (f).
- (3) There was some variation in the Verdet constant with wave-length; values (d), (g), (h). This suggested an absorption band within the wave-length region measured; however, available data was not adequate to substantiate this.

The salts were in crystalline form, in general no greater than 2 millimeters in the largest dimension. The crystals were tamped slightly when inserted into the pipe.

A large number of materials gave no measurable effect; these are listed in Table II. For some of these, measurement was doubtful, since very small path lengths L were used because of high attenuation. The substances were in various forms; ammonia gas was at atmospheric pressure.

† Abstract of M.A. thesis, submitted by the first author at Dartmouth College, June 1948.

¹ R. L. Cummerow and D. Halliday, Phys. Rev. **70**, 433 (1946); *ibid.* **72**, 173 (1947).

The Change of Photo-Conductivity of Cadmium Sulfide between Room Temperature and the Temperature of Liquid Air

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THE photo-conductive properties of cadmium sulfide crystals have been described by R. Frerichs.¹ He showed that crystals prepared by a reaction between cadmium and H_2S become conductive when exposed to light and lose their conductivity after illumination with a certain decay time. He showed that at liquid air temperature the decay period is increased and that delay is also observed between the onset of illumination and the time when conductivity begins. In our experiments we examined the photo-conductivity of such cadmium sulfide crystals at intermediate temperatures between room temperature and that of liquid air. Two facts were observed: (1) When using unfiltered radiation from a metal filament as illumi-