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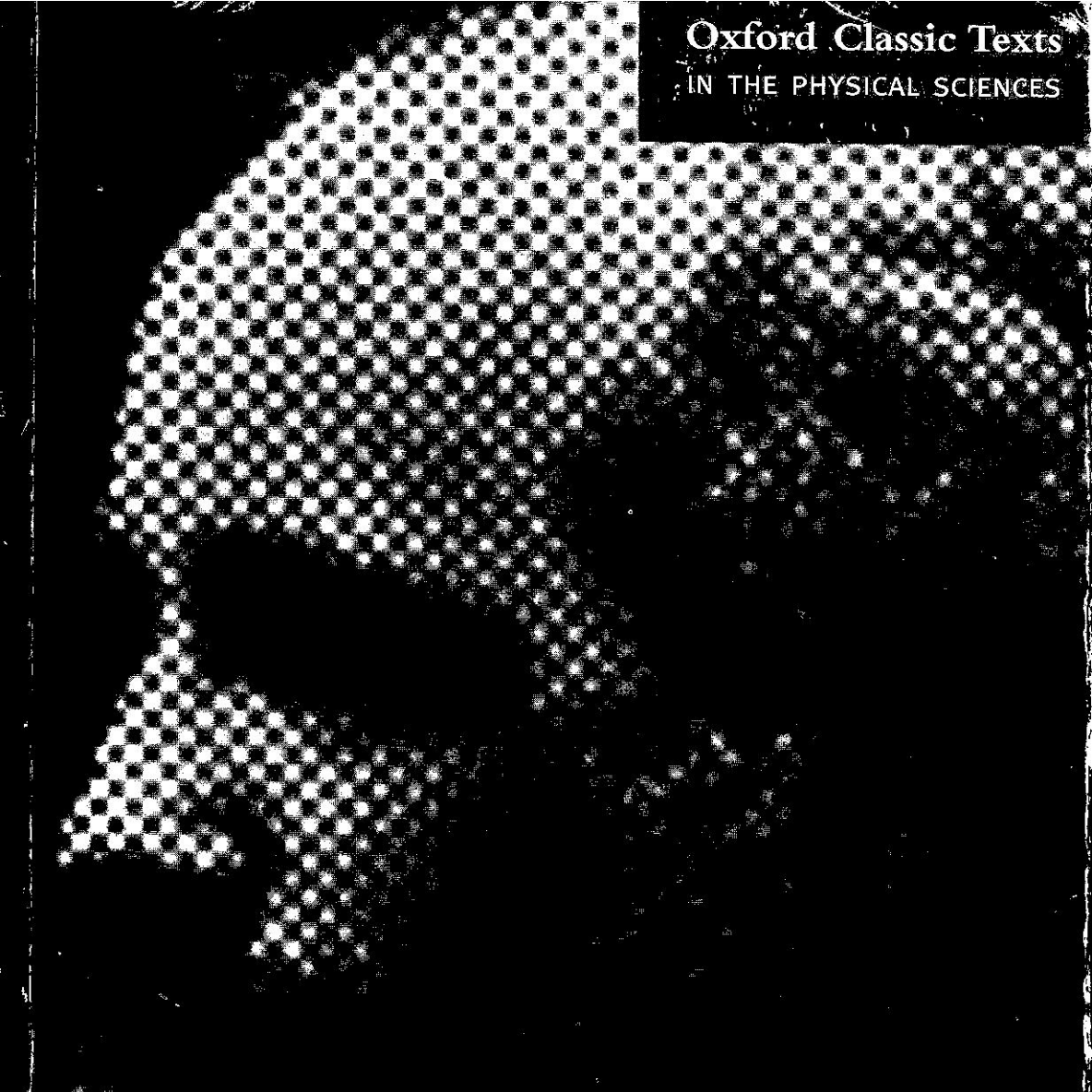
IN THE PHYSICAL SCIENCES



A Treatise on Electricity and Magnetism

VOLUME TWO

James Clerk Maxwell

If P, Q, R are the components of the electromotive intensity,

$$f = \frac{K}{4\pi} P, \qquad g = \frac{K}{4\pi} Q, \qquad h = \frac{K}{4\pi} R; \tag{16}$$

and since there is no motion of the medium, equations (B), Art. 598, become

$$P = -\frac{dF}{dt}, \qquad Q = -\frac{dG}{dt}, \qquad R = -\frac{dH}{dt}. \tag{17}$$

Hence $$u = -\frac{K}{4\pi}\frac{d^2F}{dt^2}, \quad v = -\frac{K}{4\pi}\frac{d^2G}{dt^2}, \quad w = -\frac{K}{4\pi}\frac{d^2H}{dt^2}. \tag{18}$$

Comparing these values with those given in equation (14), we find

$$\left.\begin{aligned} \frac{d^2F}{dz^2} &= K\mu\frac{d^2F}{dt^2}, \\ \frac{d^2G}{dz^2} &= K\mu\frac{d^2G}{dt^2}, \\ 0 &= K\mu\frac{d^2H}{dt^2}. \end{aligned}\right\} \tag{19}$$

The first and second of these equations are the equations of propagation of a plane wave, and their solution is of the well-known form

$$\left.\begin{aligned} F &= f_1(z - Vt) + f_2(z + Vt), \\ G &= f_3(z - Vt) + f_4(z + Vt). \end{aligned}\right\} \tag{20}$$

The solution of the third equation is

$$H = A + Bt, \tag{21}$$

where A and B are functions of z. H is therefore either constant or varies directly with the time. In neither case can it take part in the propagation of waves.

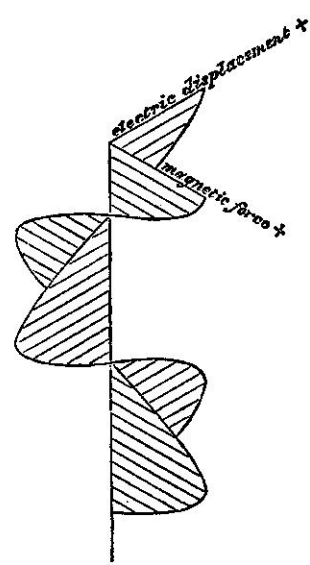


Fig. 67.

791.] It appears from this that the directions, both of the magnetic and the electric disturbances, lie in the plane of the wave. The mathematical form of the disturbance therefore agrees with that of the disturbance which constitutes light, being transverse to the direction of propagation.

If we suppose $G = 0$, the disturbance will correspond to a plane-polarized ray of light.

The magnetic force is in this case parallel to the axis of y and

Volume I. Typical Maxwell gobbledegook

$$+(9a^2b^{17}+280a^5b^{14}+735a^7b^{12}+192a^8b^{11}+780a^9b^{10}$$
$$+144a^{10}b^9+375a^{11}b^8+72a^{13}b^6)c^{-19}+\ldots. \quad (22)$$

$$q_1=a^2c^{-2}+4a^5b^3c^{-8}+(6a^7b^3+9a^5b^5)c^{-10}$$
$$+(8a^9b^3+18a^7b^5+16a^5b^7)c^{-12}$$
$$+(10a^{11}b^3+30a^9b^5+16a^8b^6+40a^7b^7+25a^5b^9)c^{-14}$$
$$+(12a^{13}b^3+45a^{11}b^5+60a^{10}b^6+80a^9b^7$$
$$+72a^8b^8+75a^7b^9+36a^5b^{11})c^{-16}$$
$$+(14a^{15}b^3+63a^{13}b^5+150a^{12}b^6+140a^{11}b^7+342a^{10}b^8$$
$$+175a^9b^9+209a^8b^{10}+126a^7b^{11}+49a^5b^{13})c^{-18}$$
$$+(16a^{17}b^3+84a^{15}b^5+308a^{14}b^6+224a^{13}b^7+1050a^{12}b^8$$
$$+414a^{11}b^9+1222a^{10}b^{10}+336a^9b^{11}+488a^8b^{12}+196a^7b^{13}$$
$$+64a^5b^{15})c^{-20}+\ldots. \quad (23)$$

$$=3a^3b^3c^{-6}+6a^3b^5c^{-8}+10a^3b^7c^{-10}+(12a^6b^6+15a^3b^9)c^{-12}$$
$$+(27a^8b^6+54a^6b^8+21a^3b^{11})c^{-14}$$
$$+(48a^{10}b^6+162a^8b^8+158a^6b^{10}+28a^3b^{13})c^{-16}$$
$$+(75a^{12}b^6+360a^{10}b^8+48a^9b^9+606a^8b^{10}$$
$$+372a^6b^{12}+36a^3b^{15})c^{-18}+\ldots. \quad (24)$$

$$=a^3c^{-3}+6a^6b^3c^{-9}+(9a^8b^3+18a^6b^5)c^{-11}$$
$$+(12a^{10}b^3+36a^8b^5+40a^6b^7)c^{-13}$$
$$+(15a^{12}b^3+60a^{10}b^5+24a^9b^6+100a^8b^7+75a^6b^9)c^{-15}$$
$$+(18a^{14}b^3+90a^{12}b^5+90a^{11}b^6+200a^{10}b^7$$
$$+126a^9b^8+225a^8b^9+126a^6b^{11})c^{-17}$$
$$+(21a^{16}b^3+126a^{14}b^5+225a^{13}b^6+350a^{12}b^7+594a^{11}b^8$$
$$+525a^{10}b^9+418a^9b^{10}+441a^8b^{11}+196a^6b^{13})c^{-19}+\ldots. \quad (25)$$

$$=4a^4b^3c^{-7}+10a^4b^5c^{-9}+20a^4b^7c^{-11}+(16a^7b^6+35a^4b^9)c^{-13}$$
$$+(36a^9b^6+84a^7b^8+56a^4b^{11})c^{-15}$$
$$+(64a^{11}b^6+252a^9b^8+282a^7b^{10}+84a^4b^{13})c^{-17}+\ldots. \quad (26)$$

$$=a^4c^{-4}+8a^7b^3c^{-10}+(12a^9b^3+30a^7b^5)c^{-12}$$
$$+(16a^{11}b^3+60a^9b^5+80a^7b^7)c^{-14}$$
$$+(20a^{13}b^3+100a^{11}b^5+32a^{10}b^6+200a^9b^7+175a^7b^9)c^{-16}$$
$$+(24a^{15}b^3+150a^{13}b^5+120a^{12}b^6+400a^{11}b^7+192a^{10}b^8$$
$$+525a^9b^9+336a^7b^{11})c^{-18}+\ldots. \quad (27)$$