problem and thus produced in fact the earliest electric motor. He was resolved that such suspicion should not occur again. See various indications in his carefully prepared additions in vol. 2 of his "Electrical Papers"; also Clerk Maxwell's trenchant remarks in a reference that has escaped my memory. The scientific interest of the note now revealed lies perhaps in the expression of his conviction that the velocity of propagation of magnetic influence would prove to be small enough to be measurable.

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Diffraction of Light by Supersonic Waves in Solids

RECENTLY one of us[1] pointed out that the optical diffraction effects by supersonic waves in solids are to be interpreted on the basis of the Raman-Nath[2] theory, taking due cognisance of the photo-elastic effects arising from the strains caused by the sound waves. A refined further development of this idea enables us now to offer an explanation for a curious effect observed by Hiedemann and Hoesch[3]. Their experiments with glasses show two diffraction patterns of different spacings. With crossed Nicols normal and parallel to the sound-wave, only the pattern with the larger spacing is observed. It consists of the first orders only, with the central one missing. With the crossed Nicols at $\pm 45°$ to the sound-wave, only the pattern with the smaller spacing appears, showing many orders, including the central one.

This effect is characteristic for solids. For liquids no diffraction effects appear for crossed Nicols. As Schaefer and Bergmann[4] first pointed out, the existence of two patterns is due to the fact that in solids longitudinal and transversal sound-waves of the same frequency but different wave-lengths can travel simultaneously. Hence the theoretical problem consists in finding the propagation of a light-wave in a medium containing both types of waves.

We can gain an insight into the probable theoretical results by considering first the diffraction effects of either type of waves alone. Since transversal waves travel slower than longitudinal waves, their wave-length λ_T is smaller than λ_L, and the pattern with the larger spacing must be ascribed to the transversal wave. A transversal sound-wave, the directions of oscillation and propagation of which are normal to the light beam, produces a photo-elastic effect characterized by an index ellipse the axes of which are at 45° to the sound-wave. The principle indices of refraction suffer fluctuations μ and $-\mu$ which are equal in magnitude but opposite in phase. If the incident light is polarized parallel to the sound-waves, the two light-components parallel to the axes travel independently and their nth order has components of magnitudes $J_n(2\pi\mu L/\lambda)$ and $J_n(-2\pi\mu L/\lambda)$, where J_n is the Bessel function of nth order, L the width of the supersonic field and λ the wave-length of the incident light. These components are in phase or in opposite phase as n is even or odd. Hence it is easily seen that all even orders, including the central one, have the same polarization as the incident light and are therefore not visible through crossed Nicols. Only the odd orders can appear, in conformity with the observation of Hiedemann and Hoesch. If the crossed Nicols are at 45° to the sound-wave, that is, parallel to an optical axis, the diffraction effect by transversal waves must vanish.

For a longitudinal sound-wave the axes of the index ellipse are normal and parallel to the wave and the index fluctuations μ_1 and μ_2 are in phase but of different magnitude. With crossed Nicols parallel or normal to the sound-wave, the diffraction effects due to the longitudinal wave vanish. If the polarizing Nicol is at 45° to the sound-wave, all diffracted orders are plane polarized, but with a plane of polarization different from that of the incident light. Hence all orders are visible through crossed Nicols, but each order can be made to vanish by rotating the analysing Nicol. In the case of standing sound-waves, the intensity of the various orders passes through a minimum which is different from zero.

These are, of course, preliminary considerations for the development of a more complete theory considering the simultaneous existence of both types of waves. Work along this line has already shown that the diffraction angles φ are generally given by $\sin\varphi = n\lambda/\lambda_L + m\lambda/\lambda_T$, where n and m are integers, but if the light is polarized parallel to the sound-waves, only even m's enter for parallel, and only odd m's enter for crossed Nicols.

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Magnetic Moments of the Proton and the Neutron

IT is well known that the magnetic moment of the proton and the neutron cannot be explained by Dirac's relativistic wave equation. It was first suggested by Wick[1] that the surplus moment of the proton may be explained by Fermi's β-theory, according to which the proton spends a certain fraction of its life in a virtual state as a neutron plus a free positive electron and neutrino. Since the electron has a large magnetic moment, this state will contribute considerably to the magnetic moment of the proton. Since, however, the β-decay constant is exceedingly small in nuclear dimensions, it has not been possible to account for the observed momenta in this way.

A new hope for such an 'exchange theory' of the magnetic moments is perhaps offered by the probable existence of a hitherto unknown type of particle constituting the hard component of cosmic radiation. It has been suggested that they are 'heavy electrons' with a mass somewhere between that of the electron and the proton. Since these particles are certainly not stable, it might be plausible to assume that they can be emitted and absorbed by nuclear particles in a similar way as in the β-decay. We therefore assume that, in suitable circumstances, a proton (or neutron) can emit a positive (or negative) heavy electron, transforming itself into a neutron (or proton). Hence it would follow that heavy electrons have no spin and satisfy Bose statistics. In order to account for the magnetic moment of the proton and neutron, it is necessary to choose an interaction between the heavy particles and the heavy electrons depending on the relative directions between the spin of the proton (neutron) and the angular momentum