Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 646.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Diffraction of Light by Ultra-Sonic Waves

F. H. SANDERS[1], in a recent note in these columns, has reported excellent agreement between our theory and his experimental results. His note, however, calls for a statement from us clarifying the theoretical position. As is well known, Debye and Sears in America and Lucas and Biquard in France discovered, in 1932, that a beam of light after passing through a supersonic field breaks up into a fan of diffraction spectra. Following this discovery, Prof. R. Bär, of Zurich, carried out extensive investigations regarding the nature of the phenomenon ; he obtained numerous beautiful results concerning the manner in which the relative intensities of the various diffraction spectra depend on the wave-length of light, the supersonic intensity and the thickness of the cell. He also discovered that the frequencies of light in the diffracted spectra are modulated by the sound field in a very peculiar manner depending on the order of the spectrum.

As has been remarked by many investigators, these results of Bär, and even the appearance of a large number of diffraction spectra, found no explanation in terms of the theory of Brillouin. Indeed, the existence of higher orders had been erroneously ascribed to the existence of overtones in the supersonic field. In the theory of Lucas and Biquard, which was mentioned by Sanders in his note, the laws of geometrical optics were applied to the problem, and it was assumed that the individual rays of the incident light follow paths independent of one another. This theory ignores the interference effects which are fundamental to the problem, and does not succeed in explaining the characteristic features observed in experiment.

The theory of the phenomenon initiated by us is set out in a series of papers[2]. At the outset, our purpose was to develop a theory of the simplest possible character which would satisfactorily account for Bär's experimental results. A simplification was effected by assuming that the wave-length of the sound is not too small and the thickness of the cell is not too large; in which circumstances, it can be shown theoretically from Fermat's principle that only the phase changes occurring in the passage of light through the cell need be considered. Indeed, Bär[3] reported later that the results in our papers I, II and III agreed qualitatively with most of the observed features of the phenomenon even in the general case, and in a perfectly quantitative manner when the experimental restrictions postulated by us were actually satisfied. In our papers IV and V, the restrictions mentioned above were dispensed with and the theory of the phenomenon was developed quite figorously on the basis of the electromagnetic wave-equations. This general theory has been fully worked out by one of us (N. S. N.) and leads to a satisfactory explanation of some remarkable experimental results obtained by Dr. S. Parthasarathy[4] at this Institute. It is found that, when the light is incident obliquely to the sound waves and the latter are of sufficiently high frequency, the intensity of the diffraction spectra shows very marked asymmetry and that particular orders attain maximum intensity at characteristic angles of incidence given by a formula of the Bragg type. This is in agreement with the deductions from the theory.

Another aspect of the problem has been worked out by one of us (N. S. N.) in a paper now under publication. It has been explained why the supersonic waves can be seen directly through a microscope focused on a plane to the rear of the sound-wave cell. The theory predicts the interesting result that the grating-like pattern observed through the microscope repeats itself periodically as the focal plane of the microscope is moved away from the cell by integral multiples of a definite distance. This prediction has been confirmed quantitatively in a very recent (as yet unpublished) investigation made at this Institute by Dr. Parthasarathy. Other peculiar features of the sound field as optically observed—for example, a doubling of the number of fringes in certain positions of the microscope, and a disappearance of the fringes at certain other positions—are also indicated by the theory and are beautifully confirmed by the experiments.

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[1] F. H. Sanders, NATURE, 138, 285 (1936).
[2] C. V. Raman and N. S. Nagendra Nath, *Proc. Ind. Acad. Sci.*, 2, 406 and 413 (1935); 3, 75, 119 and 459 (1936). N. S. Nagendra Nath, *Proc. Ind. Acad. Sci.*, 4, 222 (1936).
[3] R. Bär, *Helv. Phy. Acta*, 9, 265 (1936).
[4] S. Parthasarathy, *Proc. Ind. Acad. Sci.*, 3, 549 (1936).

Surface Markings on a Diamond

ACCORDING to the mosaic hypothesis, it is postulated that the uniform lattice structure of an ideal crystal is interrupted over narrow regions distributed periodically throughout the crystal at distances large compared with the size of the unit cell. Various forms of the hypothesis have been devised to explain anomalies in the intensity of reflection of X-rays, breaking strength and other 'structure-sensitive' properties of crystals, but the subject is at present highly controversial. Whilst many facts undoubtedly fit the hypothesis, several workers claim that some half dozen other types of fact do not fit[1]. All forms of the hypothesis including the 'lineage structure' proposed by Buerger[2] would predict non-uniformity

(*Continued on p.* 641.)