Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 258.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Optical Observation of the Debye Heat Waves in Crystals

MANY years ago[1], it was pointed out by one of us that Debye's concept identifying the thermal energy of a solid with the energy of elastic vibrations within it having a wide range of frequencies has an important optical consequence, namely, that a beam of light traversing a transparent solid would be scattered to an extent depending upon the energy of thermal agitation. This conclusion was also verified experimentally in a semi-quantitative fashion[2]. The principal experimental difficulty in studying the subject was that of obtaining crystals sufficiently large and at the same time free from imperfections or inclusions, these conditions being necessary to prevent the feeble thermal opalescence being overpowered by parasitic diffuse light. The same difficulty appears in attempting to investigate the thermal opalescence in crystals by spectroscopic methods. The elastic waves, longitudinal or transverse as the case may be, which scatter the light being progressive, they should give rise to Brillouin-Doppler shifts of optical frequency corresponding to their respective acoustic velocities. If parasitic light be present, the unmodified scattering and the hyperfine structure components usually accompanying the same would overpower the Brillouin-Doppler components to be expected.

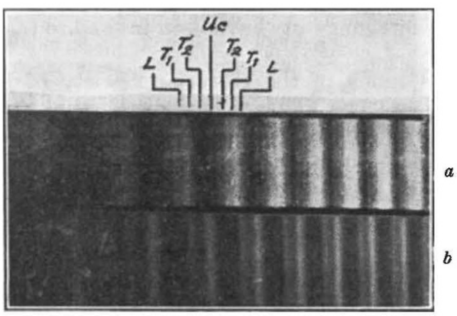

Fig. 1.
(*a*) DIRECT LIGHT; (*b*) SCATTERED LIGHT.

It is significant, in view of the foregoing remarks, that E. Gross[3], who claimed, some years ago, to have obtained evidence of a Doppler shift due to the longitudinal waves in crystals, offered neither photographs nor measurements confirmatory of the claim. Even in a recent communication[4] in which the same author points out that with crystals there should be three components on either side in the scattered light corresponding to the three sheets of the acoustic wave-surface, no such convincing experimental evidence has been presented. Indeed, a perusal of the communications quoted leaves the impression that the results so far obtained by E. Gross suggest, rather than demonstrate, the existence of such Brillouin-Doppler shifts in the light scattered by crystals.

The thermal scattering of light in crystals has been under investigation in this laboratory during the past few years, and we have at last succeeded in obtaining satisfactory photographs which show in an unmistakable way the physical reality of the Debye heat waves in crystals. Fig. 1 (*a*) shows the interference pattern taken with a Lummer Gehrcke plate of 4046 A. radiation of a water-cooled mercury lamp. Fig. 1 (*b*) shows the pattern, under exactly the same conditions, of this radiation scattered transversely within a large crystal of gypsum. The latter had been previously examined in a strong beam of sunlight, and a portion which showed a clear blue thermal opalescence and was free from inclusions was chosen for illumination. On a comparison of the two pictures which have been carefully set side by side to correspond, it will be seen that the two patterns are completely different. Measurements show that the principal component of the incident radiation, which is very feebly present in the scattered light, gives rise to three components on either side displaced by 0·59, 0·36 and 0·2 cm.$^{-1}$ of which the first is the most intense. From the Brillouin formula, these three shifts correspond respectively to acoustic velocities 3,350, 2,050 and 1,100 metres per second. Of these, the first is presumably due to the longitudinal waves and the other two due to the transverse ones.

C. V. RAMAN.
C. S. VENKATESWARAN.

Department of Physics,
Indian Institute of Science,
Bangalore.
July 8.

[1] Raman, C. V., NATURE, **109**, 42 (1922).
[2] Raman, C. V., NATURE, **111**, 13 (1923).
[3] Gross, E., NATURE, **126**, 211 (1930); and *Z. Phys.*, **63**, 685 (1932).
[4] Gross, E., *C.R.*, U.R.S.S., **18**, 93 (1938).

Bright Solar Eruptions and the Ionosphere

AN investigation of the ionospheric conditions during a bright solar eruption shows that at such times an increase of ionization can be produced within the normally reflecting regions of the ionosphere.

The accompanying photograph shows such an increase of ionization to have occurred quite suddenly at 0927 G.M.T. on October 1, 1937, at an equivalent height of 125 km., or slightly higher than the normal *E* region. A solar eruption of intensity 1 reported