

where m_{\max} is the *maximum* misplacing of a line in the grating and l is the length of the grating.

For $l = 1$ mm. we get :

if $m_{\max} = 0.0005$ mm.	$a = 0.001 \lambda$
„ $= 0.00025$ „	$a = 0.0005 \lambda$
„ $= 0.0001$ „	$a = 0.0002 \lambda$

The X-ray measurements considered are, as said above, of considerable interest on account of their importance as regards the value of the electronic charge (e). Now a certain error in the wave-length gives rise to an error in e three times as large. From the above discussion it appears that the error in e originating from the grating errors is very likely to amount to values comparable to the total error in e stated by some authors. The object of this paper is thus to direct attention especially to the fact that the quality of the grating is of decisive importance to the accuracy of the value of e deduced from X-ray measurements.

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New Types of Emission Spectra.

THE emission spectra which we observe in the visible and ultra-violet region are divided into line and band spectra, of which the first type corresponds to electronic changes of state of single atoms either in neutral or in an ionised state. The band spectra originate from molecules, and the energy quanta emitted in a certain spectral line draw their energy from three sources : (1) change of electronic orbits, (2) change of vibrational energy, and (3) change of rotational energy.

The study of the luminescence from solidified gases at very low temperatures has revealed a new type of spectra, which is a combination of electronic jumps and atomic oscillations, and we obtain a type of vibrational band spectra free from the influence of rotational energy. Since their discovery in 1924 (*Comm. Lab. Leiden*, No. 175) a considerable number of spectra of this new type has been studied, and numerous lines have been classified into vibrational series and systems of such series. (See, for example, *Ann. d. Phys.*, **79**; 1926; and *Comm. Lab. Leiden*, No. 183, 200, and Suppl. No. 59.)

Now it appears that most of the series are not composed of single lines, but of two or more components. This splitting up of the lines is more pronounced at the temperature of liquid helium than at that of liquid hydrogen and for such series which appear strong in the afterglow spectra, and are undoubtedly emitted from matter in the solid state. The multiplicity of lines is therefore not due to rotational energy.

It might, then, at first sight seem reasonable to ascribe the splitting up of the lines to a multiplicity of the electronic terms. Following up this idea, however, we meet with the difficulty that series with quite different electronic terms and different principal vibrational frequencies show very nearly the same frequency difference between successive components. Thus the series called *C*, *D*, and *E* show a separation of about 45 cm.^{-1} , and about the same difference is found for the doublets of the ϵ -system. In the case of the principal series of the ϵ -system (the η -series), we find, under certain conditions, that the 'lines' are split up into 4-7 components, with an approximately constant difference between successive components of about 40 cm.^{-1} . The α -series gives a separation of 69 cm.^{-1} . A multiplicity of this type cannot be accounted for by the theory of electronic terms.

Now the α -form of solid nitrogen was shown (*Zeits. f. Phys.*, **58**, 497; 1929. *NATURE*, Aug. 17, 31; 1929) to have a pronounced molecular structure, and the

atomic distance and dissociation energy of the molecular elements of the lattice were found to be approximately identical with those of the gaseous molecules. The ordinary oscillatory series correspond to atomic oscillations of the atoms of molecular elements in various states of electronic excitation. The strong binding between the two atoms of a molecule corresponds to the high principal vibrational frequencies of the order of magnitude $1200\text{-}2400 \text{ cm.}^{-1}$. But a molecule with vibrating atoms may itself be vibrating on account of the forces which bind the molecules in the crystal lattice, and which are closely related to the elastic forces of the crystal.

As the distance between the molecules is much greater than that between the atoms of a molecular

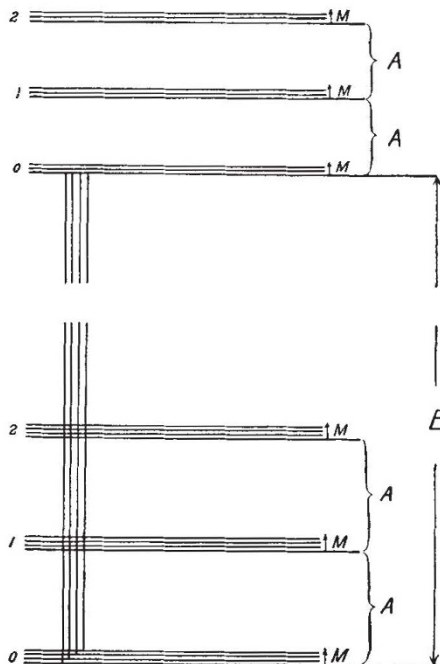


FIG. 1.

E—Change of energy of electronic states.
A—Change of energy of atomic vibrations.
M—Change of energy of molecular vibrations.

element, it is to be expected that the internal state (either electronic or vibrational) of the molecule will have little influence on the molecular vibrations, and thus we may understand that the separation of lines on account of molecular vibrations may be approximately the same for series corresponding to different internal states of the molecular elements.

Thus we are dealing with a type of spectrum where the frequencies are modified from the following three causes : (1) Change of electronic states. (2) Change of vibrational energy of the atoms of a molecular element. (3) Change of vibrational energy of the molecular elements in the crystal lattice.

The formation of a spectrum of this type is shown in Fig. 1.

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Recovery from Parasitism.

THE pine shoot moth, *Evetria buoliana*, Schiff., one of the best known Lepidopterous pests of young Scots pine in Europe, has during the past decade been causing much concern by its increasing prevalence in the numerous young pine plantations in East Anglia. Just over a year ago a thorough study was begun of