A fuller account of this work and its application to the spark discharge will appear in due course. I am indebted to my colleague, L. A. King, for much of the experimental work.

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Photography on Selenium

IT was observed many years ago that the crystallization of amorphous selenium is promoted and accelerated by illumination[1],[2]. I rediscovered this in the summer of 1941 and succeeded in producing true photographic images by means of this effect, using the initial product of selenium manufacture, namely, aluminium or steel disks covered with a film of selenium, as photosensitive plates. To do this, the mirror-like surface of the selenium must be polished with a soft material, such as tissue paper. The disk is then placed on a metal plate, preheated at 90–95° C., and an image, preferably a diapositive, projected on the surface of the selenium. During exposure, 'self-development' takes place and in 1–2 minutes a somewhat faint but in other respects perfect image will appear. The photographic process is then complete and the disk can be removed from the hot plate.

The image is produced by progressive crystallization of the amorphous selenium. It causes the selenium surface to lose its lustre, to become velvet-like in texture, diffusing the light and changing its colour from black to grey, gradually and in proportion to the intensity of the incident light, that is, with the brightness of the different parts of the projected image. In consequence of this the copy of a positive image will be also a positive. Over-exposure rapidly deteriorates the image and turns it finally into a roughly crystalline uniform surface of grey colour.

The 'trick' of polishing (that is, covering the surface with very fine scratches) is of decisive importance : it facilitates the crystallization and makes this capricious process uniform and regular. Pure selenium crystallizes slowly : the selenium we used was mixed with 0·07 per cent iodine ; increasing the iodine content would probably be advantageous.

Another method of 'selenography'—also in connexion with rectifier manufacture—is based upon my observation that the imperfectly reflecting black surface (at 100–120° C.) of hot-pressed, crystalline selenium changes to a light grey-coloured one ; this takes place in the usual second heat treatment at about 210° C., and is also promoted by illumination.

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Collision Broadening of the Ammonia Inversion Spectrum at High Pressures

THE collision broadening of the inversion spectrum of ammonia has been studied by Bleaney and Penrose[1] at pressures up to 600 mm. mercury. The linewidths, measured at a pressure of 0·5 mm. mercury, give values for the collision diameters (for self-broadening) varying between 8·7 A. and 14·2 A., with a mean value (weighted according to the line strengths) of 13·2 A. Between 0·5 mm. and 100 mm. pressure, the shape of the absorption curve agrees closely with that calculated from the intensity and position of the individual lines, assuming that their widths vary linearly with the pressure. At 600 mm. pressure, however, the absorption maximum has shifted to less than 0·6 cm.$^{-1}$, and the curve shape is no longer consistent with that calculated from the structure factor of Van Vleck and Weisskopf[2], and Fröhlich[3], using the extrapolated line-widths.

These measurements have been extended to delineate the absorption curve in ammonia gas over the frequency-range 0·1–1·2 cm.$^{-1}$ at pressures up to six atmospheres. The absorption was determined from the damping of a resonator caused by the admission of the gas, by a technique similar to that of Bleaney and Penrose[4]. A cavity resonant in the H_1 mode was used, however, in order to avoid errors due to the tails of other resonances, which can occur in an H_0 cavity when filling it with a fluid of appreciable dielectric constant (see Bleaney, Loubser and Penrose[5]).

At high pressures the widths of the individual lines of the ammonia spectrum become large compared with their separation, and it should be possible to represent the observed line by the formula

$$\frac{\alpha}{\bar{\nu}^2} = \frac{4\pi^2}{3kT} \sum_{J,K} N_{J,K} \,|\,\mu_{J,K}\,|^2$$

$$\left\{ \frac{\Delta\bar{\nu}}{\Delta\bar{\nu}^2 + (\bar{\nu}_0 - \bar{\nu})^2} + \frac{\Delta\nu}{\Delta\bar{\nu}^2 + (\bar{\nu}_0 + \bar{\nu})^2} \right\}. \quad (1)$$

The whole resonance curve is thus treated as if due to a single line of resonant frequency $\bar{\nu}_0$, with a linebreadth constant $\Delta\bar{\nu}$, and an intensity corresponding to the sum of the intensities of the individual lines. It is found that above 10 cm. pressure, the experimental absorption curves can be adequately represented by this formula using empirical values of $\bar{\nu}_0$ and $\Delta\bar{\nu}$ to give the best fit at each pressure. The variation of these values is shown in the accompanying graph, where $\bar{\nu}_0$ and $(\Delta\bar{\nu}/p)$ are shown as functions of the pressure (p in atmospheres). At zero pressure $\bar{\nu}_0 = 0·78$ cm.$^{-1}$ corresponds to the centre of gravity of the absorption band, and $\Delta\bar{\nu}/p = 0·62$ cm.$^{-1}$ per atmosphere corresponds to the average collision diameter of 13·2 A. As the pressure increases, the resonant frequency $\bar{\nu}_0$ shifts steadily downwards, becoming substantially zero at 2 atmospheres and above. At the same time, the value of $(\Delta\bar{\nu}/p)$ decreases, showing that the collision frequency no longer increases linearly with the pressure. (Here the dotted curve at low pressures has no meaning, since the rotational fine structure of the inversion band gives an artificial width not due to collision broadening.)

The initial portion of the $(\Delta\bar{\nu}/p)-p$ curve (up to about 2 atmos.) can be represented by the formula

$$\Delta\bar{\nu} = 0·62\, p\, (1 - bp) \text{ cm.}^{-1} \ (p \text{ in atmospheres}), \ . \ . \ (2)$$