

## Excitation of Gamma Rays in Boron

By using pure metallic boron, we have recently confirmed the emission of gamma rays from this element in the presence of slow neutrons. By comparing the intensity of gamma rays with that of those emitted from cadmium, and assuming that every absorption process of a slow neutron by a cadmium atom is accompanied by the emission of a gamma ray quantum, we were able to estimate the cross-section of the boron atom for the emission of gamma rays to be about one twentieth of the total absorption cross-section. On account of their low intensity, we have not yet been able to determine their quantum energy. These gamma rays may either be accompanying the well-known disintegration process found by Chadwick and Goldhaber, and Fermi and his collaborators, or they may be emitted by the capture process by  $B^{10}$  to form  $B^{11}$ . The capture process by  $B^{11}$  is excluded, for  $B^{12}$  is radioactive<sup>1</sup>, decaying with a period shorter than a second and emitting very fast beta rays, which were not observed in our case.

Though the fact that boron emits gamma rays in the presence of slow neutrons is not of special importance, it is important from the experimental side, for this element is always used as the 'shutter' for slow neutrons in investigations on the emission of gamma rays under the bombardment of neutrons.

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<sup>1</sup> H. R. Crane, L. A. Delsasso, W. A. Fowler and C. C. Lauritsen, *Phys. Rev.*, **47**, 887 (1935).

## Band Spectrum of the Sulphur Molecule

In a recent investigation Maxwell, Hendricks and Mosley<sup>1</sup> have determined the internuclear distance of the sulphur molecule by means of electron diffraction patterns in heated sulphur vapour. They find this distance (for  $S_2$ ) to be  $r'' = 1.94 \pm 0.03$  A., which they state is definitely higher than the band spectra values. From the rotational analysis of six bands, belonging to the main system of the absorption spectrum, however, I have been able to determine this distance as 1.88 A., which must be substituted for the value 1.60 A. hitherto accepted<sup>2</sup>, though according to Badger<sup>3</sup> it is incorrect. The agreement between the two determinations is now satisfactory, within the limit of error, but it may be pointed out here that the method of electronic diffraction must be expected to give a slightly greater value for  $r$ , because it does not refer to vibrationless molecules.

The excited state of the main system, which has proved to be of the  ${}^3\Sigma_u^- \rightarrow {}^3\Sigma_g^-$  type (even levels missing in the ground state), is subject to strong perturbations, as is well known from the vibrational analysis. According to Naudé and Christy, the levels  $v'=1$  and 3 are perturbed and  $v'=2$  unperturbed, but my investigation of the rotational structure shows clearly that the reverse is true. In the bands  $v'=2 \rightarrow v''=n$ , the sub-levels  $F_3$  and  $F_2$  are displaced by 10  $\text{cm.}^{-1}$  and 20  $\text{cm.}^{-1}$ , respectively, from  $F_1$ . The perturbations are thus of the 'vibrational' type, and not of the 'resonance' form which is common in light molecules. The reason for this is easy to see. The 'resonance' form is dependent on the rapid

growth of the energy difference ( $B_a - B_b$ ).  $K(K+1)$ . Now as  $B$  is small in the case of a heavy molecule (for  $S_2$ ,  $B' = 0.22 \text{ cm.}^{-1}$ ), the difference ( $B_a - B_b$ ) is also necessarily very small and the perturbation will extend over a much greater range of  $K$  than in the light molecules hitherto studied.

A full account of the experimental details will shortly be published.

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<sup>1</sup> *Phys. Rev.*, **49**, 199 (1936).

<sup>2</sup> Naudé and Christy, *Phys. Rev.*, **37**, 490 (1931).

<sup>3</sup> *Phys. Rev.*, **48**, 1025 (1934).

## Aluminium Bells

NEARLY eighty years ago, Henri Sainte Claire Deville wrote that he had cast an aluminium bell and presented it to the Royal Institution of London. He remarked in his great book, "De l'Aluminium, Ses Propriétés, Sa Fabrication, et Ses Applications", that the tone of this bell was none too good and that it was quickly damped due to the shape of the bell. He regretted that he had cast this bell in the traditional form of all bronze bells, but evidently did no further experimenting. He commented briefly on the fact that a bar or ingot of aluminium when struck sharply rang with a much better tone than his bell.

Faraday seems to have experimented with a rotating bar of aluminium which he caused to ring by appropriate tapping. He noticed two tones, rather similar, following each other in rapid succession.

These historic items come to mind now because, on February 23, when Oberlin College celebrates the semi-centennial of the discovery by Charles Martin Hall of the modern process of preparing aluminium, a great aluminium bell, three feet in diameter and three-fourths of an inch thick, will be rung in honour of this Oberlin student who succeeded so brilliantly at twenty-two years of age. Young Hall was a talented pianist, so it is highly appropriate that the ceremonies begin with aluminium music from this bell and from an aluminium violin of fair quality.

This remarkable bell has just been especially cast in a new shape by the Aluminum Company of America. It is much flatter than the classic bells of the bronze type, and really resembles a huge gong in form. The tone is splendid, sonorous, and lasts a long time. This casting was really an experiment, and the Company expects to cast another to give into the permanent possession of the Department of Chemistry, Oberlin College.

Many readers in Europe may contest the appropriateness of a celebration in honour of Charles Martin Hall, feeling that the youthful Héroult had made the discovery in 1886. The two discoveries were almost simultaneous, but the United States Patent Office records show that Hall made his discovery on February 23, 1886, while Héroult applied for and was granted a French patent on April 23, 1886. Héroult's application for a patent in the United States was denied.

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