

## LETTERS TO THE EDITOR

*Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twenty-eighth of the preceding month; for the second issue, the thirteenth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.*

## OH Bands and the Ultraviolet Line Spectrum of the Wehnelt Interrupter

With an improved form of Wehnelt interrupter, equipped with a cooling coil and an electrolyte circulator, the spectrum of the discharge at the positive platinum point electrode has been investigated in the region  $\lambda 4000$  to  $\lambda 2230$ . Solutions of hydrochloric, sulphuric, and nitric acid were used.

The OH bands were particularly prominent. A continuous banding from head to head was present. The new lines observed have been analysed and rotational assignments made. Twenty-four new lines have been added to the analysis by Jack (Proc. Roy. Soc. A115, 373 (1927)) of the band  $\lambda 2608$ , and 120 lines to the analysis by Watson (Astrophys. J. 60, 145 (1924)) of the bands  $\lambda \lambda 2811$  and  $2875$ . A few rearrangements of previous assignments were made in the case of the latter bands—particularly in the R branch of  $\lambda 2875$ . Seventy three new assignments were made in the

analysis by Fortrat (J. de Physique 5, 20 (1924)) of the bands  $\lambda \lambda 3064$  and  $3122$ . A preliminary comparison of wave-lengths of the new lines observed in these bands with values given in Rowland's table of solar lines showed good agreement with lines of unknown origin.

The band  $\lambda 3428$  is present on the plates but seems to present no new features.

A new band in the region  $\lambda 3525$  is being investigated in view of its possible relationship to the OH system.

Up to the present only lines arising from the platinum anode have been observed between  $\lambda \lambda 2608$  and  $2230$ .

R. WILLIAM SHAW

Department of Physics,  
Cornell University.

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## An Infrared Band System of Iodine Bromide

During an investigation of the absorption of iodine bromide in the visible, the writers recently observed an infrared band system due to this substance which, so far as they are aware, has not previously been reported. When an absorption cell 3 ft. in length was used, containing IBr at about 90 mm pressure at  $50^\circ$ , five band progressions of moderate intensity were observed in the region  $\lambda \lambda 6850$ – $8060$ . Due to the fact that there is a rather sudden change in the slope of the  $\omega_v v$  curve for the upper state at  $v'=12$  it is not possible to represent the entire system satisfactorily by one simple formula. However, those bands for which  $v'$  is less than 12 are well represented by the equation:

$$\nu(\text{cm}^{-1}) = 13,251 + (105.9 v' - 2.42 v'^2) - (266.5 v'' - 0.81 v''^2).$$

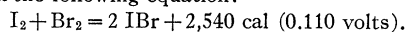
The absolute numbering of the vibrational levels of the upper electronic state is still in some doubt as it has not as yet been possible to make use of the isotope effect which is not very readily measurable.

The upper electronic level of the infrared system is a state which yields normal atoms on dissociation. By means of a graphical extrapolation the energy of dissociation of the normal IBr molecule into normal atoms has been estimated to be  $1.801 \pm 0.007$  volts ( $41,520 \pm 150$  cal). The good agreement with the value 1.84 volts estimated by Cordes and Spomer<sup>1</sup> from fluorescence data of Loomis

<sup>1</sup> H. Cordes and H. Spomer, Zeits. f. Physik 63, 334 (1930).

is possibly due to a compensation of errors in the latter case.

Recent studies in this laboratory<sup>2</sup> on the effect of temperature on the equilibrium between iodine, bromine, and iodine bromide have given an accurate value for the heat of formation of iodine bromide ( $H_{298}^\circ$ ) given in the following equation:



Since the heat of this reaction is practically independent of temperature it may be compared directly with the energy change at the absolute zero, for the reaction, calculated from the spectroscopic determinations of the dissociation energies of iodine,<sup>3</sup> bromine, and iodine bromide. This spectroscopic value is 2,440 cal (0.106 volts), which checks with the

thermal value well within the probable experimental error. This agreement is good evidence for the self consistency of the spectroscopic values of the dissociation energies of the three molecules in question.

RICHARD M. BADGER  
DON M. YOST

Gates Chemical Laboratory,  
California Institute of Technology,  
May 7, 1931.

<sup>2</sup> D. M. Yost and J. McMorris, to appear shortly in the *Journ. Am. Chem. Soc.*

<sup>3</sup> We have used for the dissociation energy of iodine a value 1.535 volts received in a personal communication from Mr. W. G. Brown, at Berkeley, California.

#### Thermionic Emission in Caesium-Oxide Photo-cells at Room Temperatures

During an investigation of the suitability of some caesium oxide on silver photoelectric cells for astronomical photometric work at low intensities it was noticed that in some cases there was, in total darkness, a large, unidirectional leakage which increased rapidly as the cell was warmed and which could be decreased considerably by the application of a magnetic field. These facts indicated conclusively that the leakage was of thermionic origin. Subsequently more careful temperature measurements were made both above and below room temperatures which showed that the emissions were following the ordinary  $T^2$  equation with thermionic work functions in different cells varying from about 0.40 to 0.80 volt.

The largest thermionic current which we have observed at 20°C and 22.5 volts is  $8 \times 10^{-9}$  amperes in a cell of about 88 cm<sup>2</sup> cathode area, which is approximately the current given photoelectrically by exposing the cell to an illumination of  $3 \times 10^{-4}$  lumens from tungsten light at 2848°K color temperature. Observations were made on this cell as low as -5°C and could undoubtedly have been continued lower if we had shifted from our high sensitivity galvanometer to the electrometer. The thermionic constants determined from a plot were  $A = 5 \times 10^{-3}$ ;  $b_0 = 8550$ . At 20°C an increase of one degree increases the thermionic current about 11.2 percent so that when such a cell is used for photoelectric measurements it might well be necessary to control its temperature. The value of  $b_0$  for this particular cell is very close to that

found by Koller (*Phys. Rev.* **33**, 1082 (1929)) for some caesium oxide on silver cells from 100° up to 170°C.

Another cell of somewhat lower photoelectric sensitivity gave the values,  $A = 3.7 \times 10^{-10}$ ;  $b_0 = 4290$ , the lowest that we have yet obtained. The cathode area of this cell was 19.4 cm<sup>2</sup>, and the total current at 20°C was about  $2.7 \times 10^{-10}$  amperes, with only a 5.8 percent increase in a temperature rise of one degree. The largest thermionic current at room temperature was therefore not obtained with the cell of lowest work function due to the very great decrease in the value of  $A$ . The measurements made so far on different cells do not indicate any precise relation between  $\log A$  and  $b_0$  which would enable one to predict definitely the emission at room temperature from the thermionic work function. If there is a large decrease in  $b_0$  as shown above, it is of course reasonable to expect a decrease in  $A$  otherwise the emission would increase enormously.

Measurements on some of the cells at constant illumination to tungsten light showed a decided drop in the photo current with considerable increase of temperature while on the other hand the effect of cooling did not seem to be nearly as great in producing an increase. This is opposite to what Koller found with cathodes much less sensitive photoelectrically than our own.

We have purposely selected for this work cells with clean walls and stems which gave negligible ohmic leakage. The two kinds of leakage are present in many cells and it is difficult to separate them with certainty. If