

charge of the electron, and  $z$  the factor for nuclear charge. Thus, the Balmer formula is derivable as a property of Planck's law, and the ambivalent measurement of energy, without any assumption as to the planetary structure of the atom. In addition, we get the fine-structure terms without further trouble. On the other hand, an assumption of some sort will have to be made about atomic structure or its field of probabilities, in order to derive the intensities.

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### STRUCTURE OF THE SECOND SPARK SPECTRUM OF BROMINE—BR III

QUARTET and Doublet terms of Br III were reported in a previous communication.<sup>1</sup> A further investigation of the spectrum has led to the identification of many intercombination lines in the ordinary optical and vacuum grating region. The interval between the deep terms  $4p\ ^4S_{3/2}$  and  $4p\ ^2D_{3/2}$  is found to be 15042 units and that between  $4p\ ^2D_{5/2}$  and  $4p\ ^2P_{1/2}$  is 10613. The ratio between the intervals is in agreement with the theoretical value. A full report of the extension of the scheme of terms will be published elsewhere.

Andhra University,  
Guntur,  
February 18, 1944.

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1. Rao and Krishnamurty, *Proc. Roy. Soc. (Lond.)*, 1937, **161**, 38.

### THERMAL REPULSION

DURING the last few years numerous contributions,<sup>1,2,3,4,5</sup> have been made to this subject from the laboratories of the Meteorological Office at Poona. It was shown<sup>4,5</sup> that, under the ideal conditions when convective movements are eliminated in an air-cell by bringing the plane hot surface sufficiently close to the plane cold surface, the thermal repulsion of objects like dust particles, oil droplets or a mica vane (suspended vertically by quartz fibre and at right angles to the temperature gradient) may be observed as a simple force acting in the direction of the thermal gradient towards the cold surface. Under the above circumstances, the thermal force is not affected by the disturbing influence of convection. A reference to the figures in Plate XI of Paranjape's paper<sup>4</sup> will show the simplicity of the phenomenon when convection is eliminated.

Fig. 1 shows the apparatus devised by Ramdas and Joglekar<sup>5</sup> for measuring the force due to thermal repulsion. A temperature gradient is maintained between the faces GH and KL of the vessels A and B which are kept at the desired temperature by circulating hot and cold water respectively through the tubes  $C_1$ ,  $C_2$  and  $C_3$ ,  $C_4$ .  $T_1$  and  $T_2$  are thermometers. The vessels A and B slide in the outer piece CEFD so that the distance between GH and KL may be adjusted as desired. The joints at C, D, E and F can be made air-tight by means of a

mixture of bees-wax and rosin. The mica piece M is suspended by means of a fine

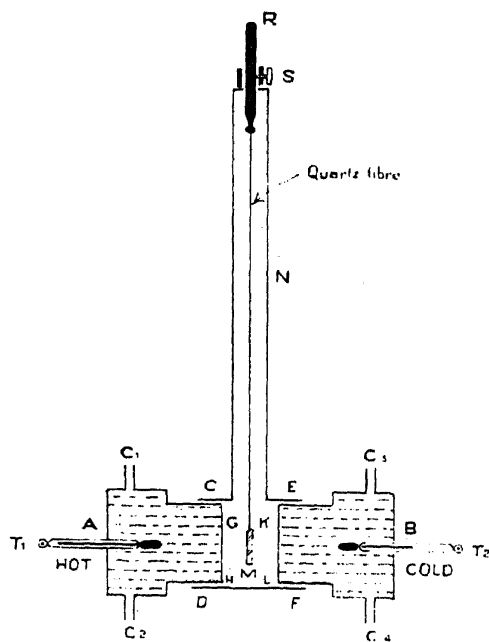


FIG. 1.

quartz fibre as shown. As soon as the face GH becomes warmer than KL, M is deflected to the right, the deflection being proportional to the thermal gradient. The deflections are measured by means of a microscope focussed on the lower end of the quartz fibre and having a suitable graticule in the eye-piece.

At the suggestion of Dr. Ramdas, the present writer undertook the investigation of the effect of the pressure of the gas on thermal repulsion. The range of pressure was from 1 atmosphere down to the lowest pressure which it was possible to obtain with a high-vac pump in series with a pair of Waran's mercury diffusion pumps, with the necessary traps to eliminate water vapour. The low pressures were measured by a Mac-Leod gauge and the higher pressures directly with the aid of a travelling microscope and a mercury manometer.

It is found that the thermal repulsion pressure  $F$  ( $F = mg\theta$  where  $m$  is the mass per unit area of M the mica-piece,  $\theta$  is the angular displacement from the vertical in radian measure and  $g$  is the acceleration due to gravity) is found to increase only slightly on reducing the pressure in the apparatus from 71 cm. to 1 cm. of Hg. The most interesting variations occur as the pressure is reduced below 1 cm. There is at first a gradual and later a very rapid increase in the thermal force. For an air gap of 2.5 mm. and a temperature difference of 2.5° C. between the walls (under the ideal conditions referred to at the beginning of this note, relatively small temperature gradients are indeed sufficient to produce sensible effects) the thermal force for a temperature difference of 1° C. attains a maximum value of the order of 0.027 dyne per sq. cm., when the pressure is about 10<sup>-2</sup> cm. of Hg. As the pressure is reduced further the thermal force decreases rapidly. Fig. 2 shows the general nature of the results obtained. It may be pointed out that the portion BC of the curve

represents conditions corresponding to the "Knudsen manometer action" which is utilised for low pressure measurements (Pirani

for permission to work in the laboratories of the Meteorological Office at Poona.

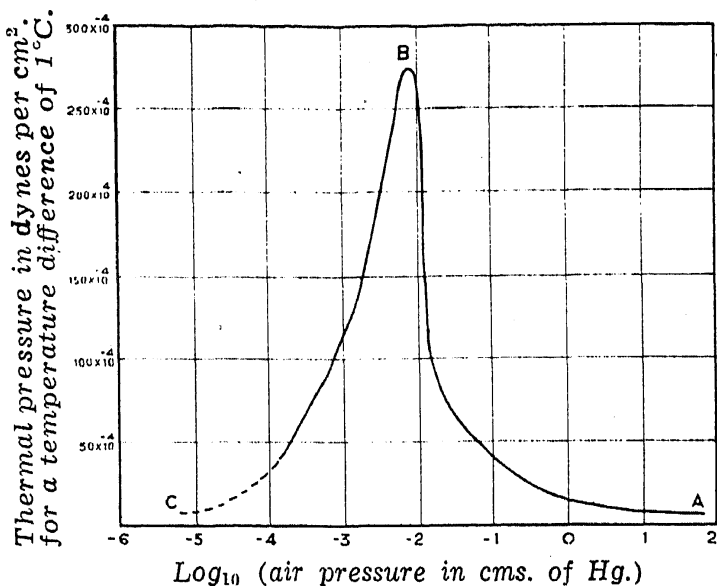


FIG. 2

Gauge\*). Curves somewhat resembling Fig. 2 were obtained by G. D. West<sup>6</sup> but his experimental arrangements and results were complicated by the use of rather large-sized air-cells and of radiation as the source of heating.

The whole subject is now under active investigation for different air-gaps, temperature gradients and gases. A full discussion of the results, both experimental and theoretical, will be presented in a forthcoming paper.

The writer is grateful to Dr. L. A. Ramdas, Agricultural Meteorologist, for suggesting the problem and for guidance. Thanks are also due to the Director-General of Observatories

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1. Ramdas, L. A., and Malurkar, S. L., *Ind. Journal of Physics*, 1932, 1, 1. 2. —, *Nature*, February, 1932, 6, 201. 3. Ramdas, L. A., *The Journal of the University of Bombay*, Sept. 1937, 6, Pt. II, 18. 4. Paranjape, M. K., *Proc. of the Ind. Academy of Sciences*, 1936, 4A, 4, 423. 5. Ramdas, L. A., and Joglekar, S. Y., *Ibid.*, 1941, 13, No. 5, Sec. A. 6. West, G. D., *Proc. Phys. Soc.*, London, 1920-21, 33, 266.

\* See also a paper by Lockenvitz; *Review of Scientific Instruments*, 1938, 9.

### HUMID FATIGUE OF HYGROMETERS

Now, while finding the time lag of Mahajan's optical hygrometer,\* it is observed that this hygrometer when treated for a number of times with moist and dry currents of air alternately (without any break in the cycle of observations) has less time lag than otherwise. The hygrometer which has been so treated comes to rest and gives a constant value in a shorter time than otherwise. Thus the time lag of hygrometer depends upon its immediate past history, besides other factors.

The effect of the immediate past history is found in other types of hygrometers also. This phenomenon may be called the Humid Fatigue of hygrometers.

A set of observations recorded for some of the hygrometers is given in Table I below.

TABLE I

| Kind of hygrometer           | No. of observations | I cycle              |                      | II cycle             |                      | Remarks                                  |
|------------------------------|---------------------|----------------------|----------------------|----------------------|----------------------|--|
|                              |                     | Increase of humidity | Decrease of humidity | Increase of humidity | Decrease of humidity |  |
| 1                            | 2                   | 3                    | 4                    | 5                    | 6                    | 7  |
| Mahajan's Optical Hygrometer | 1st set             | 22 min.              | 37 min.              | 21 min.              | 34 min.              | All sets taken on different days & times |
|                              | 2nd "               | 20 "                 | 38 "                 | 15 "                 | 30 "                 |  |
|                              | 3rd "               | 18 "                 | 34 "                 | 11 "                 | 23 "                 |  |
|                              | Mean                | 20 "                 | 36 "                 | 16 "                 | 29 "                 |  |
| Hair Hygrometer              | 1st set             | 20 min.              | 40 min.              | 17 min.              | 29 min.              | do.                                      |
|                              | 2nd "               | 17 "                 | 39 "                 | 16 "                 | 27 "                 | "  |
|                              | 3rd "               | 18 "                 | 38 "                 | 15 "                 | 25 "                 | "  |
|                              | Mean                | 18 "                 | 39 "                 | 16 "                 | 27 "                 |  |
| Paper Hygrometer             | 1st set             | 35 min.*             | 45 min.              | 22 min.              | 32 min.              | do                                       |
|                              | 2nd "               | 29 "                 | 43 "                 | 25 "                 | 39 "                 | "  |
|                              | 3rd "               | 34 "                 | 48 "                 | 21 "                 | 35 "                 | "  |
|                              | Mean                | 33 "                 | 45 "                 | 23 "                 | 35 "                 |  |