

normal C atom and an excited ($1D$) S atom. Similarly he has determined from his own experimental results a heat of dissociation for SO of 148 kcal. and regards this as giving normal S and O atoms. Since the heat of dissociation of the oxygen molecule is only 118 kcal., the experimental value for SO is evidently too great. We have shown that the force constant for SO_2 is 9.6×10^5 dynes/cm., and for SO is 7.8×10^5 dynes/cm.; since the heat of dissociation of each SO_2 bond is 248/2, the corresponding quantity for SO should, from the above, be approximately $124 \times 7.8/9.6 = 101$ kcal., and hence the experimental value again represents dissociation into one normal and one excited atom, possibly in this case a ($1D$) O atom.

It was further observed that the force constants for the molecules CO, NO, OO were proportional to the heats of linking for these substances; the periodicity thus observed suggested the calculation from band spectra data of the heats of linking of a large number of non-polar compounds of the second and third

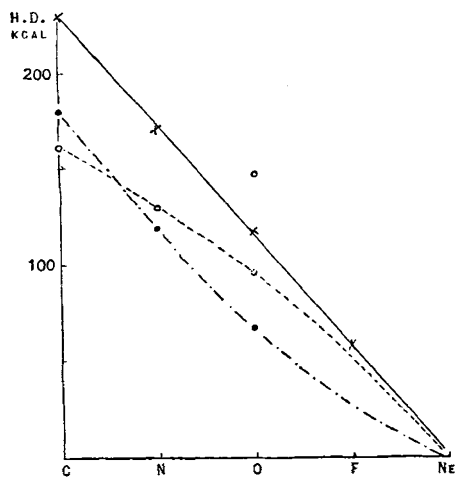


FIG. 1.—Heats of decomposition in second period. -x- oxide, -o- sulphide, -●- di-oxides/2.

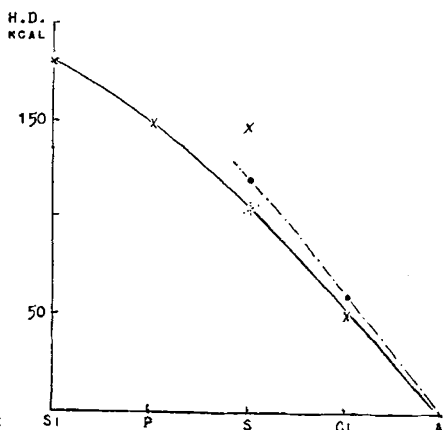


Fig. 2.—Heats of decomposition in third period. -x- oxides, -●- di-oxides/2.

periods of the table: many of these, such, for example, as NS, have become only very recently available. Some of the data are given in Figs. 1 and 2, and it will be seen that the values lie on regular curves which are very nearly straight lines, the heat of formation of the inactive gas compound being taken as zero. If SO is taken either as the sulphide of oxygen in the second period or as the oxide of sulphur in the third period, it will be seen that the previously accepted value lies high above the curve in each case, interpolation giving the calculated value of c. 100 kcal. The method has been extended to the diatomic molecules of the elements and the nitrogen and carbon compounds; the regular nature of the curve holds in all cases. A number of interesting consequences arise and will be expounded in a subsequent paper: it will suffice to mention two of them, taken from the nitrides of the second period: (1) the experimental value for CN lies some 1.6 volts below the curve, suggesting decomposition into normal N and C atoms, C (3P) being below C (5S) by this amount; and (2) half the heat of formation of N_2O lies midway between NN and ON, confirming the structure NNO and not NON for this substance.

C. R. BAILEY.

The Sir William Ramsay Laboratories of
Inorganic and Physical Chemistry,
University College, London,
July 1.

¹ *Proc. Roy. Soc., A*, 132, 236; 1931.

Micro-Analysis of Gases

KROGH's micro-analysis method as originally described,¹ for small bubbles of from 50 to 100 cubic millimetres and containing oxygen, carbon dioxide, and nitrogen, is limited to bubbles which have been in contact with a fluid, because the lower cup of the micro-apparatus must be filled with some of the same fluid with which the gas bubble has been in equilibrium otherwise the gas bubble will lose some gas, particularly carbon dioxide, which is so soluble in most fluids.

I have been attempting to modify this method so that gas tensions in any small bubble from an animal's tissues may be estimated, that is, also in bubbles which have not been in contact with excess of fluid. The problem was investigated using a freshly prepared solution of 80 per cent glycerol and 20 per cent distilled water to fill the cup, capillary, etc., of the micro-apparatus. The coefficient of solubility of

nitrogen in glycerol is too low for measurement, and those for oxygen and carbon dioxide are too low to cause any appreciable absorption under the present conditions. The addition of the small amount of water to the glycerol enables the bubble to be moved up and down easily in the graduated capillary of the apparatus without breaking up.

A small gas bubble is injected anywhere in the body cavities, tubes, or tissues and after some hours' interval it is withdrawn by means of a standard 1 c.c. syringe fitted with a very fine needle, the dead-space of which is filled with the above glycerol solution. The bubble is then care-

fully transferred to the cup of the apparatus, which has been previously filled with the same solution. The remainder of the technique for analysis of carbon dioxide and oxygen is as described by Krogh. I have been able to analyse mixtures, of from 0 to 15 per cent carbon dioxide and from 0 to 20 per cent oxygen with the remainder nitrogen, in gas bubbles (50-100 c.mm.) using the micro-apparatus in this way; the gas tensions obtained agree, within 2-3 mm. Hg, with those obtained from analyses of 10 c.c. of gas in the ordinary Haldane analyser. Carbon dioxide and oxygen tensions in the bladder and uterus have been estimated with the above accuracy using this modification of the micro-method.

I have diminished the risk of entry of small bubbles of outside air into the lower cup during the manipulations by attaching a glass tube 8 cm. in length to its lower end by means of a short piece of rubber tubing. The lower end of the glass tube is bent slightly, and its opening is so cut that the under edge projects beyond the upper; the whole tube is kept filled with the same fluids as used for the lower cup.

J. ARGYLL CAMPBELL.

National Institute for Medical Research,
Hampstead, N.W.3,
July 15.

¹ *Skand. Arch. f. Physiol.*, 20, 279; 1908.