required than may be found in the enzymic activity during the hydrolysis of starch and sugar.

The weight of copper deposit enables the weak electric currents to be accurately determined.

M. C. POTTER.

Corley Croft, New Milton, Hants,
Mar. 10.

Molecular Spectra of Mercury, Zinc, Cadmium, Magnesium, and Thallium.

To obtain a general conception of the energy states of a loosely bound molecule, we have investigated the molecular spectra of mercury, zinc, cadmium, calcium, magnesium, and thallium in emission with an apparatus capable of concentrating excited molecules in a suitable quantity. The photometric measurement of the photographic records obtained is summarised in Fig. 1, in which the intensity of a continuous spectrum is denoted by a full line, and that of the region with some structure by a dotted line.

From the results obtained, it may be generally stated that a ' band system ' emitted from diatomic molecules of mercury, cadmium, zinc, and magnesium
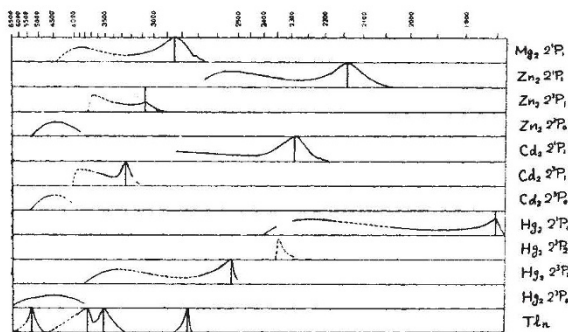

FIG. 1.

vapours has two broad maxima and one flat minimum of intensity. One of these maxima always coincides with the resonance line $1\,^1S_0 - 2\,^1P_1$ or $1\,^1S_0 - 2\,^3P_{0,\,1,\,2}$, and the other lies at the region of longer wave-length than this resonance line. The intensity of the shorter wave-length side from the resonance line gradually decreases and terminates rather suddenly at a certain position, while that of the longer wave-length side from the second maximum decreases also gradually to a certain point where the band system suddenly breaks off or melts into the continuous spectrum of wide or narrow breadth. In the region about this second maximum, there was found a generally coarse structure ; the fluted bands occasionally consist of finer bands, while no bands were observed in the region near the resonance line. The frequency of convergence of the coarser bands falls somewhere between the frequency of the resonance line and this frequency, plus the energy of dissociation in frequency unit.

These experimental results and other details can be explained in the light of recent theoretical considerations put forward by Born, Franck, Condon, Winans, and Kuhn, if we assume that the intensity maximum about the resonance line corresponds to that emitted by excited quasi-molecules and the maximum on the longer wave-length side to that emitted by excited stable (quantised) molecules.

The energy of dissociation of a molecule in the normal or the excited states can be calculated approximately, as given in the accompanying table, from the difference of energies corresponding to the frequency of the resonance line and that of the shortest

or the longest wave-length limit of the band system. These values for normal molecules evaluated in this manner are always a little greater than those already obtained by other observers. For example, those for the molecules Zn_2, Cd_2, and Hg_2 are $0\cdot29$, $0\cdot24$, and $\geq 0\cdot07$ volt respectively, while Winans calculated them to be $0\cdot25$ and $0\cdot20$ volt for Zn_2 and Cd_2 from the limits of the absorption spectra, and Franck, Grotrian, and Koernicke as $0\cdot04$–$0\cdot06$ volt for Hg_2. These discrepancies can be explained by taking into account the effect of the kinetic energies of colliding atoms at the temperatures of this experiment.

	$1\,^1S_0$	$2\,^3P_0$	$2\,^3P_1$	$2\,^3P_2$	$2\,^1P_1$
Mg_2 .	$0\cdot30$	..	..	..	$\sim 1\cdot5$
Ca_2 .	$> 0\cdot18$	..	..	..	?
Zn_2 .	$0\cdot29$	$< 1\cdot7$	$\sim 0\cdot7$	..	$< \sim 1\cdot2$
Cd_2 .	$0\cdot24$	$< 1\cdot4 \brace > 0\cdot9$	$\sim 0\cdot7$	..	?
Hg_2 .	$\geq 0\cdot07$	$< 2\cdot8$	$< 1\cdot6 \brace > 1\cdot1$	$\sim 0\cdot2$	$< 1\cdot5$

In the case of quasi-molecules, the continuous spectrum accompanying forbidden lines $1\,^1S_0 - 2\,^3P_0$ and $1\,^1S_0 - 2\,^3P_2$ is lacking or very weak, while that with the line $1\,^1S_0 - 2\,^3P_1$ is excited, and the greater the intensity the greater is the triplet separation in the atomic spectrum. The continuous band due to the transition $1\,^1S_0 - 2\,^1P_1$ is emitted intensely in the case of all the metals. From these results, it seems that the intensity rule for the atomic line holds good in the case of the continuous spectrum emitted by quasi-molecules, but similar reasoning does not hold good for the stable molecules.

Symmetrical and asymmetrical ' bands ' accompanying the lines in the spectrum of thallium are probably due to thallium molecules, but nothing could be deduced as to whether the molecule is diatomic or not. At any rate, the structure of the band systems at 3776 A. and 5350 A. differs from that of the diatomic one. The continuous branch extending on the shorter wave-length side from edges at $3770\cdot7$ A. or $2766\cdot3$ A. in the 3776 A. band or 2768 A. band may be explained as the excess of energy due to the kinetic energies of the colliding atoms.

A detailed statement of the investigation will be published elsewhere.   H. HAMADA.

Physical Laboratory,
  Sendai, Japan,
    Feb. 17.

Relation between Electrical Resistance and Energy of Magnetisation.

IN a recent paper,[1] Gerlach and Schneiderhan have described some experiments on the electrical resistance of nickel as a function of the temperature and as a function of a longitudinal external magnetic field. They have shown that in the absence of an external magnetic field there is, in addition to the normal linear change of resistance with temperature, a term which is directly proportional to the energy of spontaneous magnetisation. The accuracy with which this relation holds good for all temperatures up to the Curie point is very striking.

Gerlach and Schneiderhan have also examined the change of resistance as a function of an external longitudinal field at constant temperature, for a range of temperature around the Curie point. The change is shown to be a maximum at the Curie point and to fall off quite rapidly both above and below this temperature. Considered as a function of temperature, the change of resistance in a given field varies in a manner strikingly like the variation of the magneto-caloric effect with temperature.[2] One is therefore again led to consider this change of resistance as being