

surrounding the discharge tube, making the total cooling path about three yards in length, had little effect on the results. A high gas pressure and low temperature activation, therefore, are unfavourable to the occurrence of the Rayleigh quenching.

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- <sup>1</sup> Joshi and Purshotham, *Proc. Ind. Acad. Sci.*, **19**, No. 4 (1944).  
<sup>2</sup> Strutt, R. J., *Proc. Phys. Soc.*, **23**, 66 (1910) ; *Proc. Roy. Soc.*, A, **85**, 219 (1911). Trowbridge, *Phys. Rev.*, **23**, 279 (1906).

### Constitution of some Binary Oxide Systems

THE constitution of the oxide systems FeO-MnO, FeO-MgO, CaO-MnO and MgO-MnO have been studied by the X-ray diffraction method. Preparation of the powder samples was carried out *in vacuo* at temperatures up to 1350° C., followed by slow cooling to 1150° C., from which temperature the samples were rapidly cooled.

The X-ray patterns showed that the four systems are single phase. It was possible to make accurate lattice dimension measurements for all samples. The result on the FeO-MnO system is in agreement with that of Andrew, Maddocks and Howat<sup>1</sup> and of McCaughey<sup>2</sup>, but in contradiction to that of Benedicks and Löfquist<sup>3</sup> and Hay, Howat and White<sup>4</sup>. The FeO-MgO system has been reported to be a single phase system by Bowen and Schairer<sup>5</sup>, following the use of thermal and optical methods. References have not been found to any previous work on the CaO-MnO and MgO-MnO systems.

Full details of the work will be published later.

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- <sup>1</sup> Andrew, Maddocks and Howat, *J. Iron and Steel Inst.*, **2**, 283 (1931).  
<sup>2</sup> McCaughey, *Amer. Open-Hearth Proc.* 1938, Discussion, p. 169.  
<sup>3</sup> Benedicks and Löfquist, "Non-Metallic Inclusions in Iron and Steel" (1930).  
<sup>4</sup> Hay, Howat and White, *J. West Scot. Iron and Steel Inst.*, **41**, 97 (1933-34).  
<sup>5</sup> Bowen and Schairer, *Amer. J. Sci.*, **29**, 151 (1935).

### A Molecule-building Principle

It has long been realized in the field of molecular spectra that there is need of some form of molecule-building principle equivalent to the *Atombau* principle of Bohr. This would enable the electron configuration and term type of at least the ground-state of any molecule to be predicted from its position in the Periodic Table. Mulliken<sup>1</sup> attempted to trace the change in electron configuration from molecule to molecule for the lighter members of the Table, but his pioneering work was hampered by the absence of many necessary spectrum data, and no progress has since been made. In particular, very little knowledge has been obtained on the configuration of the heavier diatomic molecules.

I have been studying for some time the spectra of the heavy fluorides of the series, AuF, HgF, TlF, PbF and BiF, and it is now possible to describe

their ground-states in terms of electron configurations. These are shown in Table 1, along with the corresponding iso-electronic oxides and their probable configurations.

TABLE 1.

Molecule	AuF	HgF	TlF	PbF	BiF
Type	<sup>1</sup> Σ	<sup>2</sup> Σ	<sup>1</sup> Σ	<sup>2</sup> Π	<sup>2</sup> Σ
Config.	π <sup>4</sup>	π <sup>4</sup> σ	π <sup>4</sup> σ <sup>2</sup>	π <sup>4</sup> σ <sup>2</sup> π	π <sup>4</sup> σ <sup>2</sup> π <sup>2</sup>
Molecule	AuO	HgO	TlO	PbO	BiO
Type	<sup>2</sup> Π <sub>g</sub> (?)	<sup>1</sup> Σ	<sup>1</sup> Σ	<sup>1</sup> Σ	<sup>2</sup> Π
Config.	π <sup>3</sup>	π <sup>4</sup>	π <sup>4</sup> σ	π <sup>4</sup> σ <sup>2</sup>	π <sup>4</sup> σ <sup>2</sup> π

Iso-electronic molecules connected by dotted line.

It is evident that a building principle is operating in which the configuration of a given molecule retains the structure of the preceding with the addition of an electron to the lowest available orbital.

It is of interest to note the probable configuration and term type of the molecules AuO (AgO and CuO) and BiO, the spectra of which are still in a state of confusion. More information can be derived for the <sup>2</sup>Π BiO state by examining the doublet separations of the <sup>2</sup>Π states arising from π<sup>4</sup>σ<sup>2</sup>π, given in Table 2.

TABLE 2.

CF	NO	SiF	PO	GeF	AsO	SnF	SbO	PbF	BiO
(60)	121	161	221	(920)	1027	2317	2272	8260	

Bracketed values are predicted in forthcoming publication.

This suggests that an electronic interval of the order of 8,000 cm.<sup>-1</sup> should be sought for among the many bands of this molecule.

A fuller report of this work will be published elsewhere.

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- <sup>1</sup> *Rev. Mod. Phys.*, **4**, 1 (1932).

### Torulopsis utilis and the Citric Acid Cycle

THE ordinary strain of *Torulopsis utilis* (Henneberg) deriving from Haehn<sup>1</sup> can easily grow on a great many substrates under aerobic conditions (cf. Fink<sup>2</sup>). Nevertheless, there are still many substrates to which the *Torulopsis* yeast can be accustomed. Among others, I have studied some of the acids belonging to the so-called citric acid cycle of Krebs<sup>3</sup>.

In my experiments the standard *Torulopsis* yeast was cultivated on ethyl alcohol, ammonia and salts, including the sulphates and phosphates of potassium, magnesium and calcium. These salts being of technical quality, it is probable that they contained other elements necessary for the growth of the yeast, for example, iron.

Cultivations were carried out under vigorous aeration. The substrate, except in the earliest stages of adaptation to a new substrate, was added in small portions, using a time schedule, so that the concentration of substrate might be as small as possible.