

the ground-level of BeO involves an excited Be atom and this is corroborated by the spectrum of BeF. This correlation has been used already for about a dozen of molecules of these two types and cannot be taken to be fortuitous. Here clearly exist two electronic configurations, which both should produce stable terms of the molecule according to the single electron bond interpretation of the method of molecular orbitals, but instable terms according to the pair bond theory of valency—and the experiment shows definitely, that these stable terms do not exist. The conclusion, that not the promoted but the odd electron weakens the chemical bond is again at once confirmed by the spectra of all the molecules of NO type, *i.e.*, NO, PO, AsO and SbO.

Furthermore, new spectra are again entirely consonant with this view. Molecules like AlO and GaO behave similar to BeO and MgO. In its unexcited configuration  $s^2p$  the metal atom forms only a single link with oxygen and the double bond comes into existence only after the original  $s^2$  group of the metal atom has been broken up. Those excited terms, which possess a higher energy of dissociation than the ground-level on account of the double bond, therefore dissociate into oxygen and an excited metal atom in the configuration  $sp^2$ . Again SiF and SnCl

behave like BeF, MgF, or NO; they are odd numbered and increase their energy of dissociation by the partial removal of the odd electron, which does not take part in the linkage<sup>6</sup>.

If we do not take into consideration hydrides, which approach the "united atom", but ordinary diatomic molecules, then we must say, that the interpretation of band spectra during the last few years has changed the whole basis for the interpretation of the method of molecular orbitals as a theory of valency. There is ample experimental proof for the conclusion, that not non-promoted electrons, but electrons, which join in the same orbital with other ones of the second atom confer stability to a molecule and that not promoted electrons disturb the linkage but the unpaired ones. These new results, obtained from new correlations and new spectra are so uniform and follow so closely the predictions of the pair bond theory, that there seems to be little or no doubt for the experimentalist. How far they may serve as the basis of the theory of valency will be seen from a more general survey.

<sup>6</sup> For molecules of the type GaO and SiF, *cf.*, forthcoming papers of R. K. Asundi and R. Samuel, *Proc. Ind. Ac. Sci.* (Bangalore), in press.

(To be Continued.)

## Recent Advances in Sanitary Science.

THE following is the extract of an address delivered by Dr. Gilbert J. Fowler, before the Joint Session of the Association of Economic Biologists, Coimbatore, the Indian Academy of Sciences, the Indian Chemical Society (Madras Branch), the Institute of Chemistry of Great Britain and Ireland (Indian Branch), the Society of Biological Chemists, India, and the South Indian Science Association, Bangalore, held at Bangalore on 10th April 1936.

Dr. Fowler dealt with the recent researches on water purification, with particular reference to Madras, the study of sewage-sick soils and the sewage problems of Madras and Ahmedabad. Finally he spoke of recent researches and discussions on the manufacture of compost from waste materials.

Introducing the subject he thanked the President (Dewan Bahadur N. N. Iyengar) for his kind reference to the work which had been done in connection with the provision of compost for the villagers. It was a great encouragement to him that his objective towards which he had devoted a good many years of work seemed now within sight of fulfilment. He referred to a recent address by Sir George Schuster to the Royal Society of Arts in London, where Sir George had quoted Lord Bacon to the effect that money was like muck, it was no good unless it was spread. The scientific utilisation of waste materials for the use of agriculture was a true spreading of wealth. We heard that nowadays in England the distribution by Government of free milk to necessitous school children was an accomplished fact. Such a policy would have been hardly conceivable not so many years ago, yet now it was realised that the safeguarding

of the health and well-being of the future generation was the best possible investment a country could make. There was in England at the present time a movement with the object of converting the sewage works of the country into Fertiliser Factories. The economics of this question had awakened vigorous discussion. One school, supported mainly by engineers, was in favour, *e.g.*, of discharging all the sewage of London through a long tunnel into the sea. Another school, representing Biochemistry and Agriculture, was averse even to the water carriage system on account of its waste of fertilising material. In view of the large expenditure of capital on works of sanitation it was of the highest importance that the scientific foundations of the subject should be thoroughly investigated. In his (Dr. Fowler's) opinion, the true solution of the problem would only be found in a close adherence to Nature's cycle. Recent research by McCarrison, Howard and others had shown the immense importance of certain factors which must be present in the food of plants and consequently of animals if the processes of life were to function satisfactorily. It was the little extra something, be it vitamin or hormone, protein cleavage product or whatever it might be named which was characteristic of living process, which determined the health and well-being of the plant and the animal which fed thereon.

Having these considerations in mind, it was interesting to note that the largest modern sewage works, *viz.*, at Mogden (West Middlesex, England) involved a capital cost of approximately £1,700,000 which was almost the same as the capital value of the Kolar Gold Fields. The question arose, which was the more valuable, Nitrogen or Gold?