LETTERS TO THE EDITOR.

Diamagnetism of Mercury.

MERCURY occupies a unique position among the metals. It forms several amalgams with various elements. Some magnetic work on the copper amalgams has been referred to from this laboratory (Physical Principles of Magneto-Chemistry by Bhatnagar and K. N. Mathur). From the results it would appear that the mixture law is valid as long as the amalgam is very dilute and remains liquid. On solidification due to the higher concentration of copper its diamagnetism decreases and the mixture law is no more applicable. This has recently been confirmed by Bates and Tai.[1] However, it was not then found desirable to give particular attention to the specific diamagnetic value of mercury as the results concerned were only of a comparative nature. The specific diamagnetic values of mercury obtained by various authors are not consistent. In 1910, Honda and Owen[2] gave a value 0·19 for $-\chi \cdot 10^6$ which was further corrected to 0·184 by Owen[3] in 1912 from Kahlbaum's sample of 0·0002% impurity of iron. From the examination of some mercury amalgams, Davis and Keeping[4] got the specific diamagnetic value 0·189 for mercury. In an investigation of dia- and para-magnetism in series of metallic mixed crystals, E. Vogt[5] has found the diamagnetic susceptibility of mercury to be $-0{\cdot}168 \times 10^{-6}$. He has, however, made no mention of the purity of mercury employed by him. In a recent publication Bates and Tai[6] have reported that mercury has a diamagnetic susceptibility $-0{\cdot}1676 \times 10^{-6}$ and this value is in substantial agreement with that of Vogt.

J. S. Shur[7] has recently given the specific diamagnetic value 0·389 for mercury in the vapour state. The value 0·389 obtained by him approximately corresponds to 0·419 calculated theoretically by Slater's method, while all the values in the liquid state are decidedly low. It has been deduced from an examination of the various physical properties of mercury that it is monoatomic in the vapour state and polyatomic in the liquid state. The fact that the diamagnetic susceptibility in the vapour state is quite different from that in the liquid state clearly establishes the above statement from the magnetic point of view. Further, there is so great a discord between the different diamagnetic specific values of mercury that it was found desirable to investigate mercury that can be obtained in the utmost purified condition. The inconsistency in the various values may be attributed to the different impurities such as iron and zinc which can only be removed with great difficulty. Special care must therefore be taken to purify mercury. It is always better to get it from one of its chemical compounds which can be obtained in a higher state of purity. In the present investigation mercury was obtained from Kahlbaum's extra pure compounds of mercury. All the necessary precautions were taken to get it in as pure a condition as possible.

Specific and Atomic Susceptibilities of Mercury. Experimental Values.

Authors	Specific susceptibility $-\chi \cdot 10^6$	Atomic susceptibility $-\chi_{at} \cdot 10^5$
Honda and Owen ..	0·19	38·1
Owen	0·184	36·9
Davis and Keeping ..	0·189	37·9
E. Vogt	0·168	33·7
Bates and Tai ..	0·1676	33·6
Present Authors' Observation.		
1. Purified and distilled ..	0·157	31·5
2. Obtained from extra pure oxide of mercury ..	0·1716	34·4
3. Obtained from extra pure mercuric nitrate ..	0·1729	34·7
4. Obtained from extra pure mercuric benzoate ..	0·172	34·5
J. S. Shur ..	0·389	78·0 vapour
Theoretical Value.		
Calculated according to Slater's method..	0·42	84·6

The specific and atomic susceptibilities of purified and distilled mercury are rather low when compared with other experimental values. The values obtained from Kahlbaum's extra pure compounds are, however, almost the same as obtained by E. Vogt, Bates and Tai. The higher specific and atomic susceptibilities obtained by Shur in the vapour state and their close resemblance with the theoretically calculated values by Slater's method, show that mercury is monoatomic in the vapour state. The lower diamagnetic values of mercury in the liquid state may be attributed to the polyatomic molecule of mercury. This can further be explained on the assumption that the free electrons in the outer orbit of mercury may be interchanging between the component atoms to form an aggregate of complex or polyatomic mercury. It is rather curious to note that the atomic diamagnetic values in the liquid state closely correspond to the susceptibility constants of mercury in the divalent and extremely covalent state. Considering the interesting work so far accomplished and the fact that many important conclusions are derived from it, it appears desirable to investigate mercury in a spectroscopically pure state also. Further work will be reported on this subject shortly.

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1 Bates and Tai, *Proc. Phys. Soc.*, 1936, **48**, 795.
2 Honda and Owen, *Ann. Phys. Lpz.*, 1910, **32**, 1027.
3 Owen, *ibid.*, 1912, **37**, 657.
4 Davis and Keeping, *Phil. Mag.*, 1929, **7**, 145.
5 E. Vogt, *Ann. Phys. Lpz.*, 1932, **1**, 14.
6 Bates and Tai, *loc. cit.* under 1.
7 J. S. Shur, *Nature*, May 8, 1937.