

three observations > 1 included in (1), (2) and (3) of A is

$${}_n C_3, \frac{n(n-1)(n-2)}{1!2!} \text{ and } \frac{n(n-1)(n-2)}{2!}$$

respectively. Adding them with the proper signs it will be seen that ${}_n C_3$ samples with three observations in each > 1 are to be subtracted from (E) and the final distribution of x for the interval $\frac{3}{n}$ to $\frac{4}{n}$ becomes

$$I_n^n \left[x^{n-1} \left\{ {}_n C_1 \left(x - \frac{1}{n} \right)^{n-1} + {}_n C_2 \left(x - \frac{2}{n} \right)^{n-1} + {}_n C_3 \left(x - \frac{3}{n} \right)^{n-1} \right\} \right] dx \quad (F)$$

As in the previous cases (F) can be shown to be equal to

$${}_n C_3 \cdot (4) + {}_n C_2 \cdot n \cdot (3) + {}_n C_1 \cdot n \cdot {}_n C_2 \cdot (2) + {}_n C_0 \cdot n \cdot {}_n C_3 \cdot (1),$$

where (4), (3), (2) and (1) refer to (B).

The above argument can be extended to the case of x lying in the interval $\frac{p}{n}$ and $\frac{p+1}{n}$, p being $> n$. The number of combinations having p observations > 1 to be subtracted from the distribution for the interval $\frac{p-1}{n}$ and $\frac{p}{n}$ is

$${}_n C_p - {}_n C_1 \cdot n \cdot {}_n C_{p-1} + {}_n C_2 \cdot n \cdot n \cdot {}_n C_{p-2} + \dots + (n-1) \cdot {}_n C_{p-1} \cdot (n-p).$$

This is equal to $(-1)^p$ or $-{}_n C_p$ according as p is odd or even. Hence the distribution for the interval $\frac{p}{n}$ and $\frac{p+1}{n}$ is obtained by subtracting $(-1)^{p+1} {}_n C_p$ times the distribution of x modes having p observations > 1 from the distribution for the preceding interval.

In general the distribution of x for the interval $\frac{p}{n}$ to $\frac{p+1}{n}$ is also given by

$${}_n C_p \cdot (p+1) - {}_n C_{p-1} \cdot n \cdot {}_n C_1 \cdot (p) + {}_n C_{p-2} \cdot n \cdot n \cdot {}_n C_2 \cdot (p-1) + \dots + (-1)^p \cdot {}_n C_{p-1} \cdot n \cdot {}_n C_p \cdot (1),$$

where $(p+1)$, (p) , \dots , (1) refer to the integrals given in (B).

The above method of approach will lead to the distribution of the means of Type II and I curves which will be useful in getting the distribution of the mean of $Y = \left(1 + \frac{T^2}{N-1} \right)$, where T^2 refers to Hotelling's² T^2 . As the actual expressions for the distribution of y are complicated they will be dealt with in another communication.

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1. Irwin, J. O., *Biometrika*, 1927, 19, 223. 2. Hotelling, H., *Annals of Math. Stat.*, 1931, 2, 360.

NEW BANDS OF THE Hg Br MOLECULE

In the course of a reinvestigation of the band systems of the HgBr molecule, in order to bring them into conformity with those of HgCl, the authors have obtained a new band system in the region $\lambda 2470$ - $\lambda 2430$, consisting of diffuse and headless bands. About thirty

bands could be measured and assigned to the three sequences (0,1), (0,0) and (1,0). The intensity distribution gives a narrow Condon Parabola. The following vibrational constants have been determined:

$$r_e = 40720 \quad w_e' = 166.0 \quad w_e'' = 183.0 \\ x_e' w_e' = 1.1 \quad x_e'' w_e'' = 2.0$$

The final state of this system appears to be the same as the final state of the class I system of the HgBr bands, studied previously by Wieland¹ and by Sastry.² Full details will be published shortly.

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1. Wieland *Helv. Acta. Phys.*, 1929, 2, 46 and 77.
2. Sastry, *Nat. Inst. Sci. Int. Proc.*, 1941, 7, 353.

MAGNETISM OF GERMANIUM

From several points of view, germanium is an interesting element. It crystallizes in the diamond structure. But in electrical properties, it behaves like a semiconductor. Unlike diamond, germanium is soft and has a metallic lustre. One would expect these properties to be reflected in the magnetic behaviour of germanium.

This element has been studied by Owen (1912) who obtained $\chi = 0.12^p$ as its specific susceptibility. A redetermination of the susceptibility seemed desirable since a sample of Hilger's spectroscopic brand was available. Curie's method was adopted, using water as the standard. The element showed a trace of ferromagnetic impurity, for which due correction was made. The average specific susceptibility obtained with two pieces was found to be $\chi = 0.147$. This gives for the atomic susceptibility the value $\chi = 10.7$.

Diamond, silicon, germanium and grey tin belong to the same class of elements from the point of view of crystal chemistry. It is obvious, however, that germanium stands unique on account of some of its properties being absent in the other cases.

A calculation of the atomic susceptibility of germanium on the basis of Slater's method, as modified by Angus (1932) gives $\chi = 40.9$. On the same basis, the ionic susceptibility of Ge^{4+} (which is in 1S_0 state) works to $\chi = 16.8$ while the experimental value for the metal is $\chi = 10.7$. These results suggest that the metal contains Ge^{4+} ions, with the two $4p$ electrons showing evidence of both valence characteristics and metallic bond. That the valence characteristics are predominant and the metallic bond subdued are apparent from the following facts.

Owen (1912) found that when the element is melted, there is a large rise in the diamagnetic susceptibility. In the case of covalent or hemipolar combination, the increase of diamagnetism is accompanied by a link depression. On melting, this depression should partly vanish and the valence electrons would evince a larger diamagnetism.