The writer has found no previous determinations for comparison. The activity coefficients for potassium chlorate determined in this Laboratory[3] are entered in Table II for comparison.

[3] Jones and Froning, THIS JOURNAL, **66**, 1672 (1944).

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Tetrahedral Interactions and Diamagnetic Susceptibilities

BY JOHN R. LACHER

Recently French and Trew[1] have summarized the molar susceptibilities of the polyhalogen derivatives of methane. These compounds are anomalous in the sense that they deviate seriously from Pascal's additivity rule. It is desired here to show that the data can be interpreted empirically by assuming that the molar susceptibility is the sum of the atomic susceptibilities and six interaction terms directed along the edges of a tetrahedron. The geometry of a tetrahedron is useful in the interpretation of diamagnetic susceptibilities as well as the heats of disproportionation reactions.[2] The compounds under consideration together with the experimental molar susceptibilities[1] are given in Table I columns one and two. The susceptibilities calculated by summing Pascal's atomic susceptibilities are in column three. The necessary data are from the "International Critical Tables"[3] and the constitutive correction factor for a single halogen bonded to carbon was not used. These calculated values are all higher than the experimental ones and the deviations increase with increasing number of halogens on the same carbon. In case of tetrahalogen compounds, the difference is close to 30%.

TABLE I

EXPERIMENTAL AND CALCULATED DIAMAGNETIC SUSCEPTIBILITIES

Compound	χ_M exp × 10^6	χ_A Pascal × 10^6	χ_M calcd. × 10^6
CH_4	16	17.7	17.7
CH_3Cl	32.0	34.9	33.3
CH_2Cl_2	46.6	51.2	46.3
$CHCl_3$	58.6	69.2	56.6
CCl_4	66.8	86.4	64.8
CH_3Br	42.8	45.4	44.3
CH_2Br_2	65.9	73.1	65.8
$CHBr_3$	82.2	100.7	82.1
CBr_4	93.7	128.4	93.4
CH_3I	57.2	59.4	58.5
CH_2I_2	93.5	101.1	91.7
CHI_3	117.3	142.7	117.2
CI_4	135.6	184.4	135.2

The molar susceptibilities listed in the last column of the table were calculated on the assumption that they could be represented as the sum of atomic susceptibilities plus six appropriate interaction terms. The equations used are

$$CH_4\text{: } \chi_M = \chi_C + 4\chi_H$$
$$CH_3X\text{: } \chi_M = \chi_C + 3\chi_H + (\chi_X + 3H{\cdot}X)$$
$$CH_2X_2\text{: } \chi_M = \chi_C + 2\chi_H + 2(\chi_X + 3H{\cdot}X) - (2H{\cdot}X - X{\cdot}X)$$
$$CHX_3\text{: } \chi_M = \chi_C + \chi_H + 3(\chi_X + 3H{\cdot}X - 3(2H{\cdot}X - X{\cdot}X)$$
$$CX_4\text{: } \chi_M = \chi_C + 4(\chi_X + 3H{\cdot}X) - 6(2H{\cdot}X - X{\cdot}X)$$

The atomic susceptibilities for carbon and hydrogen, χ_C and χ_H, are from Pascal.[3] The constitutive correction due to a hydrogen–hydrogen interaction, H·H, was arbitrarily placed equal to zero. The susceptibility due to a halogen and three hydrogen–halogen interactions, $\chi_X + 3H{\cdot}X$, was calculated to give the best fit for the data of French and Trew.[1] The difference between two hydrogen–halogen and a halogen–halogen interaction, 2 H·X − X·X, was also calculated from the experimental data. The numerical values of all these quantities are summarized in Table II. The susceptibilities due to X + 3H·X are close to the values of Pascal's constants for chlorine, bromine and iodine. The latter are 20.1, 30.6 and 44.6, respectively.

TABLE II

ATOMIC AND CONSTITUTIVE SUSCEPTIBILITIES

Element or interaction	χ × 10^{+6}	Element or interaction	χ × 10^{+6}
C	6.0	Br + 3H·Br	29.5
H	2.93	I + 3H·I	43.7
H·H	0.0	2H·Cl–Cl·Cl	2.6
Cl + 3H·Cl	18.5	2H·Br–Br·Br	5.1
		2H·I–I·I	7.6

The molar susceptibilities calculated from the above equations and the data in Table II are given in the fourth column of Table I. The agreement between the experimental ones and those calculated in this way is quite satisfactory. Experimental studies on mixed halogen derivatives of methane would be interesting.

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[1] French and Trew, *Trans. Faraday Soc.*, **41**, 439 (1945).

[2] J. R. Lacher, THIS JOURNAL, **68**, 526 (1946).

[3] "International Critical Tables," Vol. VI, p. 349.

Halogenated Sulfonanilides

BY A. MOORADIAN AND G. W. LEUBNER

In a previous contribution[1] from these laboratories, there was described a series of N^1-phenyl sulfanilamides in which the N^1-phenyl group was variously substituted with chlorine and bromine atoms. Since substituents in the 3,5-positions were found most effective as far as antibacterial activity is concerned, more compounds of this general type have now been prepared for study. Not only have chlorinated and brominated compounds been prepared and studied further, but also the iodinated and trifluoromethylated deriva-

[1] Kaplan and Leubner, THIS JOURNAL, **67**, 1076 (1945).