A series of decaborane derivatives of the type $\text{B}_{10}\text{H}_{12}L_2$ is well known, in which $L$ is a Lewis base, combining with a borohydride nido-cluster $[\text{B}_{10}\text{H}_{12}]$. These compounds are synthesized by interaction of $L$ with $\text{B}_{10}\text{H}_{14}$ in a liquid hydrocarbon medium on heating [1]. A method of their synthesis by the reaction [1-3]

$$\text{B}_{10}\text{H}_{12}L_2 + 2L' = \text{B}_{10}\text{H}_{12}L'_2 + 2L$$

(1)
is also known, and in this case the basicities of the substituents must satisfy the condition $L' > L$ [2-4]. The nature of the bond of $L$ with $\text{B}_{10}\text{H}_{12}$ can be rather complex. In the literature three variations of bonding are discussed [2].

In the first variation $L$ does not contain $p_\pi$ or $d_\pi$ orbitals and a simple $\sigma$ bond is accomplished, as, for example, in $\text{B}_{10}\text{H}_{12}[\text{N(C}=\text{H}_5)]_2$. In the second variation $L$ contains vacant $d_\pi$ orbitals of corresponding symmetry, capable of accepting electron density from $[\text{B}_{10}\text{H}_{12}]$. As examples of $\text{B}_{10}\text{H}_{12}[\text{S(CH}_3)_2]_2$ and $\text{B}_{10}\text{H}_{12}[\text{PC}_6\text{H}_5]_2$ are given, in which the $d_\pi$ orbitals of $S$ and $P$ participate in bonding. Finally, in the third variation $L$ can have filled $\pi$ orbitals, which overlap with the $[\text{B}_{10}\text{H}_{12}]$ electronic system, making a contribution to bonding [2, 3], for example, in $\text{B}_{10}\text{H}_{12}[\text{NC}_6\text{H}_5]_2$ and $\text{B}_{10}\text{H}_{12}(\text{CNCH}_3)_2$. In the case of a pyridine derivative $L$ has aromatic character and conjugation of the two aromatic systems occurs — the planar cyclic pyridine and the spatial system in the $[\text{B}_{10}\text{H}_{12}]$ cluster. In [3] such a combination is compared with the diamagnetism of $\text{B}_{10}\text{H}_{12}(\text{NC}_6\text{H}_5)_2$, but experimental data are not given.

For boron hydride clusters and several of their derivatives delocalization of the electrons is characteristic, giving these systems aromatic character [5], which is reflected in the values of the atomic increments of the diamagnetic susceptibility of the boron atom $\chi_B$ [6]. In [6] a method is proposed of calculating the values of the molar susceptibility $\chi_M$ of borane derivatives using $\chi_B$ determined experimentally for $B$ with coordination numbers ($n$) 5 and 6, characteristic for the chemistry of the higher boron hydrides. For $n = 5$ $\chi_B = 9.1$ and for $n = 6$ $\chi_B = 10.7$ (in the dimensions $10^{-6}$ cm$^3$ mole$^{-1}$, which below are omitted from the text). Here $\chi_B$ are separated from the experimental values of $\chi_M$ of the clauso-anions $\text{B}_{10}\text{H}_{12}^{2-}$ and $\text{B}_{12}\text{H}_{12}^{2-}$ (see Figs. 1 (a) and (b)). It was shown that the proposed system of calculating $\chi_M$ gives rather good results for ionic clauso-compounds [6, 7]. For nonionic derivatives a systematic investigation has not been performed. For individual compounds with covalent bonds, in particular $\text{Cu}_2\text{B}_{10}\text{H}_{10}$, $\text{B}_{10}\text{H}_{12}(\text{NH}_3)_2$, (1,2-$\text{B}_2\text{C}_6\text{H}_{11-}\pi$),$\text{NH}_3$, substantial divergences of the experimental and theoretical values of $\chi_M$ are detected ($\approx$6-14%). The purpose of this paper is to obtain experimental values of $\chi_M$ for a series of typically nonionic compounds $\text{B}_{10}\text{H}_{12}L_2$ with different types of bonding of $L$ with $[\text{B}_{10}\text{H}_{12}]$. In Fig. 1 their structures and topological schemes for $L = \text{NH}_3$ and $\text{C}_6\text{H}_5\text{N}$ are given, using structural data and the means of depiction from [8, 9]. They are necessary to determine $n$ in calculations of $\chi_M$ using $\chi_B$, the results of which will be compared with experiment.

**EXPERIMENT**

$\text{B}_{10}\text{H}_{12}L_2$ compounds, the formulas of which are given in Table 1, were synthesized by direct interaction of $L$ with $\text{B}_{10}\text{H}_{14}$, for example, $\text{B}_{10}\text{H}_{14}(\text{NH}_3)_2$ and $\text{B}_{10}\text{H}_{14}[\text{S(CH}_3)_2]_2$, and also by reaction (1) with the dimethyl sulfide derivative [1-3]. By the second method purer substances can be obtained, since it is not complicated by side processes. The $\text{B}_{10}\text{H}_{12}L_2$ compounds obtained were purified by recrystallization from organic solvents and were checked using IR and $^{11}$B NMR spectra using the data of [1, 9], and also analytically.

The measurements of $\chi_M$ were performed by the Faraday method at 20°C analogously to [6, 7]. The setup was calibrated using Hg[Co(CNS)$_4$] and H$_2$O [10]. The results of calibration by
these two references are practically identical. The absolute error of the measurements of $\chi_M$ comprised 2%, which is characteristic for the given method [10]. The measurements of $\chi_M$ were performed on two to three samples of each compound. The discrepancies between the parallel measurements were not more than ±2%. In the calculations $\chi_M$ for L and the atomic increments $\chi_A$ from [10, 11] were used.

The experimental values of $\chi_M$ for $\text{B}_{10}\text{H}_{12}\text{L}_2$ and the $\chi_M$ calculated from them for $|\text{B}_{10}\text{H}_{12}|$ are given in Table 1. From the tabular data it follows that $\chi_M$ of $|\text{B}_{10}\text{H}_{12}|$ of the series of compounds studied lie within the limits 116-131 at an average value of $\chi_M = 125 \pm 3.3$ (±2.6%).