Magnetic susceptibilities, indices of refraction and densities of diamagnetic substances of the 1st and Vth principal subgroups are determined. From them, by means of the Kirkwood's formula, the temperature independent Van Vleck's polarization-paramagnetism was calculated. Its dependence on the electric polarizability, or on the number of electrons of the molecule, is a decreasing function for the carbonates of elements of the 1st principal subgroup. Its analysis shows that the substances Li$_2$CO$_3$, Na$_2$CO$_3$, K$_2$CO$_3$ have an ionic bond with a certain portion of covalency.

The polarization-paramagnetism of perchlorates of the 1st principal subgroup has the character of a rising function of the polarizability and of the number of electrons. This is in connection with the fixation of the electron cloud of the [ClO$_4$]$^-\,$ anion and, probably, also with the fact that for ions of these substances the energy difference of the normal and excited states in zero field decreases progressively with increasing number of electrons in a molecule.

The measurements show a considerable value of the polarization-paramagnetism of oxides of the Vth principal subgroup of elements, increasing with the number of electrons in a molecule. This phenomenon is also interpreted.

**INTRODUCTION**

Many measurements of magnetic susceptibilities gave, in the past, results very different from the suggestions of the classical theory of weakly magnetic substances. An alarming fact was that the experimental results of Freed and Thode [1] in 1935 for molar susceptibility of LiH was $(-4.60 \pm 0.09) \times 10^{-6}$ CGSM $u_\text{m}$, which is a value 90 to 130\% higher than the calculated values of other authors. Similar anomalies appeared frequently. A way out was found after elaborating the complete quantum-mechanical theory of the weakly-magnetic substances by Van Vleck [2]; he has demonstrated that one of the components of the magnetic susceptibility is the temperature independent polarization-paramagnetism $\chi_p$. Later many anomalies were explained and, in addition to it, the calculation of $\chi_p$ appeared as one of the methods of interpreting the properties of substances. A particularly important contribution is due to Dorfman [3,4]. In our laboratory we have studied the problem of the Van Vleck's paramagnetism, particularly in the papers on the magnetic properties of solid solutions of the ionic compounds [5], on the influence of the crystallising water on the magnetic susceptibility [6], on the aqueous solutions of HCl [7] and on the magnetic properties of several hydrides of the 1st and IIa\textit{d} subgroups [9].

Carbonates and perchlorates of the 1st principal subgroup and oxides of the Vth principal subgroup are diamagnetic substances, that have not been studied up-to-now
from this point of view. The object of this paper is to determine the Van Vleck’s polarization-paramagnetism, its dependence on the number of electrons and on the electric polarizability and the interpretation of the results with respect to the properties of those substances.

EXPERIMENTS AND RESULTS

For measuring the magnetic susceptibility, chemically purified substances with negligible amount of paramagnetic impurities (less than 0.002%) were used. The Curie-Chéneveau torsion balance, according to [20] was employed for the magnetic susceptibility measurements at room temperature, using the distilled water of susceptibility of $-0.72 \times 10^{-6}$ CGSM u. as a standard. The inaccuracy of measurement on the balance of our construction was always less than 1%. The measured susceptibility $\chi$ was evaluated from the relation

$$\chi = \frac{d - d_0}{d' - d_0} \frac{m'}{m} \chi'$$

where $\chi$, $d$, $m$ are the specific susceptibility, deviation of the balance and the mass of the measured substance, respectively, $\chi'$, $d'$, $m'$ are the same quantities for the standard, and $d_0$ the deviation of the balance for the empty thin-walled tube of 6 mm diameter and 6 cm length. With respect to a certain scatter of values following from the method of filling the tube, each measurement was repeated many times and the arithmetic mean value was determined. The molar susceptibility is then $\chi_M = \chi \cdot M$ where $M$ is the molecular weight of the substance. The measured values represent the mean value of three principal susceptibilities $\chi = (\chi_1 + \chi_2 + \chi_3)/3$ since the substances were measured in a powdered form.

In order to calculate the electric polarizability $\alpha$, we need to determine the mean value of refraction from the refraction indices of their aqueous solutions, according to the relation [10]

$$R = R_1 \frac{100}{c} - R_2 \frac{100 - c}{c}$$

where $R$ is the measured refraction of the investigated substance, $c$ its percent content in the solution, $R_1$, $R_2$ are the specific refractions of the solution and of the pure solvent. By means of the Mosotti-Clausius and the Lorez-Lorentz relations [11] equation (2) gets the form

$$R = \frac{n_1^2 - 1}{n_1^2 + 2 \varrho_1} \frac{100}{c} - \frac{n_2^2 - 1}{n_2^2 + 2 \varrho_2} \frac{100 - c}{c}$$

where $n_1$, $\varrho_1$ are the index of refraction and the density of the solution, respectively, $n_2$, $\varrho_2$ are the same quantities for the pure solvent. Then the polarizability can be obtai-