ent with several previous investigations and formulations, such as those of Levine, Denenberg, and Harlow (*6*). These workers were concerned with the effects of a variety of early treatments and methods of handling, and demonstrated their importance by showing fairly reliable and consistent behavioral changes in the adult. The results of this study also indicate that (i) psychopharmacological intervention during significant periods of developmental and environmental interaction can produce long-lasting changes in the later behavior of the animal; and (ii) it is possible to use psychopharmacological techniques for studying the early development of certain classes of behavior and for investigating the biological basis for their development.

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Equilibrium of Talc with Enstatite and Quartz

Abstract. *A thermodynamic calculation of the vapor pressure of H_2O in equilibrium with talc gives p_{H_2O} of one atmosphere at 718° ± 15°K in contradiction to the results of Mueller.*

A report by Mueller on the chemistry and petrology of the planet Venus (*1*) makes use of certain calculations and data contained in an unpublished thesis by Robie (*2*). Unfortunately, Mueller apparently misunderstood the results of Robie for the equilibrium

$$Mg_3Si_4O_{10}(OH)_2 \leftrightharpoons 3MgSiO_3 + SiO_2 + H_2O$$

Table 1. Calculated decomposition curve of talc.

Temperature (°K)	$\frac{\Delta(F^\circ_T - H^\circ_{298})}{T}$ (cal deg⁻¹)	ΔF°_T (cal)	$\frac{(P-1)\Delta V^\circ}{41.2929}$ (cal)	p_{H_2O} (atm)
600	−41.00	+4,740	0	.02
700	−40.80	+780	0	.57
800	−40.56	−3,108	−3	7.1
900	−40.29	−6,921	−23	50
1000	−39.99	−10,650	−113	242
1100	−39.66	−14,286	−471	994
1200	−39.32	−17,844	−1613	(3400)

The value of 2200 atmospheres for the vapor pressure of water in equilibrium with talc at 700°K which Mueller gives as "extrapolation from data obtained by Robie," is apparently taken from the last entry of Table 18, page 91 of the thesis. This table was a calculation of the decomposition equilibrium based on the heat of formation of talc given by Bennington (*3*), − 35,530 ± 350 calories, and the third law entropy reported in the thesis (*2, 4*). This calculation was made, however, for the sole purpose of pointing out the discrepancy between the equilibrium data of Bowen and Tuttle (*5*) and Bennington's heat of formation of talc. In the same section of the thesis an approximately correct value for the heat of formation was derived, − 43,600 ± 1500 calories at 298.15°K. Values for the vapor pressure of H_2O in equilibrium with $Mg_3Si_4O_{10}(OH)_2$ calculated from this heat of formation gave p_{H_2O} of 0.7 atmosphere at 700°K, several orders of magnitude less than the value of 2200 atmospheres that Mueller attributes to Robie's data. On page 92 of the unpublished thesis is a log p_{H_2O} versus 1/T(°Kelvin) plot of the equilibrium curves for the talc decomposition reaction calculated from these two different heats of formation and including the experimental points of Bowen and Tuttle. The equilibrium curve based on the heat of formation of talc, − 43,600 calories, is in agreement with the available equilibrium data. The curve calculated from the value, − 35,530 calories, differs from the equilibrium data at 700°K by roughly 2000 atmospheres of H_2O pressure. Barany (*6*) has recently redetermined the heat of formation of talc by hydrogen fluoride–solution calorimetry. His value, − 44,890 ± 350 calories, confirms the calculations of Robie and greatly reduces the uncertainty.

It follows that the deductions of Mueller concerning the instability of $Mg_3Si_4O_{10}(OH)_2$ on Venus are unfounded and that any conclusions drawn from them must be severely modified.

The equilibrium curve calculated from the calorimetrically determined entropy (*4*), the heat of formation (*6*), and the approximate high temperature heat capacity equation for talc (*4*)

$$C_p = 84.58 + 41.68 \times 10^{-3}\,T - 17.96 \times 10^5\,T^{-2}\ (298 - 1100°K)$$

is given in Table 1. The data for $MgSiO_3$ and SiO_2 were taken from Kelley (*7*).

The molar volumes of the solid phases and the fugacities of H_2O were those given by Robie (*8*).

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