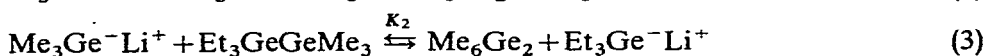
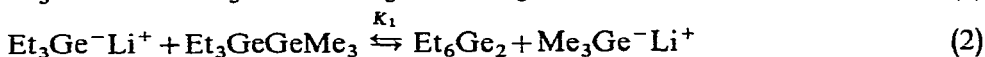


## PRELIMINARY COMMUNICATION

### Investigations on organogermanium compounds

#### VIII\*. Base-catalyzed disproportionation of compounds containing a germanium-germanium bond

Mixed alkylsubstitute digermanes of the type  $R_3GeGeR'_3$  can be readily obtained<sup>1</sup> by reacting trialkylhalogermanes  $R_3GeX$  with trialkylgermyl alkali metal derivatives  $R'_3GeM$  (prepared<sup>2</sup> by alkali metal cleavage of hexaalkyldigermanes in hexamethylphosphoric triamide, HMPT<sup>3</sup>). This coupling reaction is always accompanied by the formation of varying amounts of the symmetrical compounds  $R_6Ge_2$  and  $R'_6Ge_2$ . Previous studies<sup>1</sup> suggested that nucleophilic attack of the germyl alkali metal compound on the metal-metal bond of the mixed coupling product (reactions 2 and 3) rather than halogen-metal exchange (*i.e.* nucleophilic attack on halogen) is involved in the formation of these symmetrically substituted digermanes:



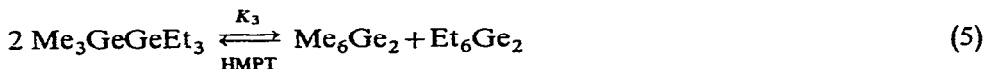
A closer study of equilibria (2) and (3), which were approached from both sides using various ratios of the reactants, has now revealed (*cf.* ref. 1) that these equilibria are reached instantaneously on mixing the reactants in HMPT.

The equilibrium constants  $K_1$  and  $K_2$  have been determined\*\*:

$$K_1 = \frac{[Me_3GeLi][Et_6Ge_2]}{[Et_3GeLi][Et_3GeGeMe_3]} = 0.59 \pm 0.01$$

$$K_2 = \frac{[Et_3GeLi][Me_6Ge_2]}{[Me_3GeLi][Et_3GeGeMe_3]} = 0.20 \pm 0.01$$

Summation of equations (2) and (3) gives



with an equilibrium constant

$$K_3 = \frac{[Me_6Ge_2][Et_6Ge_2]}{[Me_3GeGeEt_3]^2} = K_1 \times K_2 = 0.12 \pm 0.02$$

\* For part VII see ref. 1.

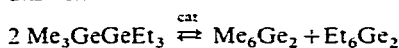
\*\* The equilibrated reaction mixtures were decomposed and the amounts of hydrides and digermanes present were determined gaschromatographically using a silicone oil column (15 % silicone oil "Embaphase" on 60-80 mesh Diatoport S).

Since pure  $\text{Me}_3\text{GeGeEt}_3$  was shown to be perfectly stable towards disproportionation in HMPT solution the approach to equilibrium (5) must be kinetically controlled.

It was found that (5) is catalyzed by trialkylgermyl alkali metal derivatives or in general by nucleophilic species. Equilibrium (5) is reached instantaneously at room temperature (in HMPT) in the presence of 5–10 mole % of catalyst (see Table 1).

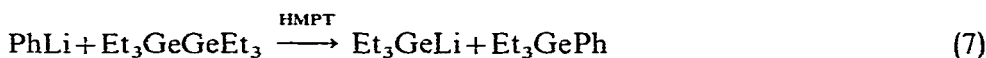
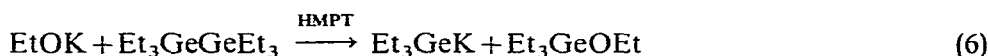
TABLE 1

BASE-CATALYZED DISPROPORTIONATION OF 1,1,1-TRIMETHYL-2,2,2-TRIETHYLDIGERMANE



Catalyst	Solvent	$K_3$
$\text{Et}_3\text{GeLi}$	HMPT	0.12
$\text{Et}_3\text{GeLi}$	THF/HMPT ~ 7	0.12
$\text{EtOK}$	HMPT	0.13
$\text{PhLi}$	HMPT	0.13
$\text{PhLi}$	THF	0

In accordance with the above it was found that hexaalkyldigermanes react instantaneously with potassium ethoxide or phenyllithium in HMPT at room-temperature:



Reaction (7) fails to take place in dimethylformamide or tetrahydrofuran at room temperature or in tetrahydrofuran after several hours at 50°.

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