d) Diphenyl and ditolyl were found among the reaction products.

e) It was established that under the conditions of reaction dibenzyl underwent very considerable destructive hydrogenation.

It may be noted that earlier, in experiments on the thermal decomposition of toluene at 470°C under pressure 30), ditolyl was also found in the reaction products. Ref.31) describes an investigation of the initial period of thermal decomposition of toluene (up to 1%) on passing toluene vapour through a quartz tube at 738-864°C followed by rapid cooling of the reaction products. The gaseous reaction products consisted of 59-62% hydrogen and 38-41% methane. The liquid products were benzene and dibenzyl (1 mole of dibenzyl per mole of gas liberated). On the basis of these facts it was decided that the reaction proceeds by the following stages:

$$C_6H_5CH_3 \rightarrow C_6H_5CH_2 + H; \quad (1)$$

$$C_6H_5CH_3 + H \rightarrow C_6H_5CH_2 + H_2; \quad (2)$$

$$C_6H_5CH_3 + H \rightarrow C_6H_6 + CH_3 \quad (3')$$

or

$$C_6H_5CH_3 + H \rightarrow C_6H_5 + CH_4; \quad (3'')$$

$$CH_3 + C_6H_5CH_3 \rightarrow C_6H_5CH_2 + CH_4 \quad (4')$$

or

$$C_6H_5 + C_6H_5CH_3 \rightarrow C_6H_6 + C_6H_5CH_2; \quad (4'')$$

$$2C_6H_5CH_2 \rightarrow C_6H_5CH_2CH_2C_6H_5. \quad (5)$$

The assumption that the breaking of the carbon-carbon bond

$$C_6H_5CH_3 \rightarrow C_6H_5 + CH_3$$

is the first step in the reaction could not explain the high concentration of hydrogen in the reaction products, while the above-mentioned scheme satisfactorily explains the production of hydrogen and the amount of dibenzyl produced.

Reactions (3') and (3") represent an interesting type of radical reactions. Data obtained in recent years indicate the likelihood of such reactions taking place (see 32-34)). It is evident that the scheme for the thermal decomposition of toluene could be supplemented with an equation for the production of ditolyl:

$$\left.\begin{aligned} C_6H_5CH_3 + H &\rightarrow H_2 + C_6H_4CH_3, \\ 2C_6H_4CH_3 &\rightarrow CH_2C_6H_4.C_6H_4CH_3 \end{aligned}\right\} \quad (3''')$$

although the following reaction also cannot be entirely excluded:

$$C_6H_5CH_3 \rightarrow C_6H_4CH_3 + H. \quad (1')$$

If we accept the above-mentioned reaction scheme for the thermal decomposition of toluene, it follows that in the presence of hydrogen under pressure radicals formed by the thermal decomposition will react with molecular hydrogen (and also with molecules of toluene and of reaction products). Reaction with hydrogen molecules leads to the production of atomic hydrogen and also to the initiation of a reaction chain. Thus a probable scheme for the mechanism of the destructive hydrogenation of toluene may be written as follows: