CHEMISTRY LETTERS, pp. 229-230, 1974. Published by the Chemical Society of Japan

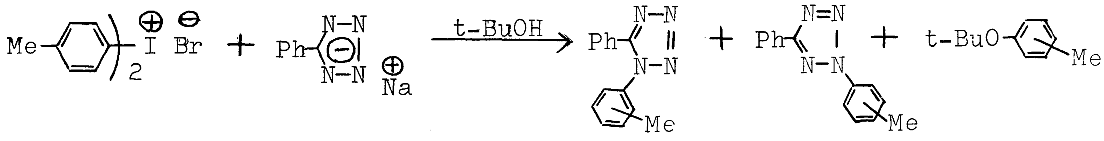
ARYLATION OF TETRAZOLIDE WITH DIARYLIODONIUM HALIDES: EVIDENCE FOR INTERMEDIACY OF BENZYNE

Tetsuo AKIYAMA, Yoshio IMASAKI, and Mituyosi KAWANISI
Department of Industrial Chemistry, Faculty of Engineering
Kyoto University, Sakyo-ku, Kyoto 606

By the reaction with sodium 5-phenyltetrazolides (II) di-p-tolyliodonium bromide (I) afforded 1-m-tolyl-(III), 2-m-tolyl-5-phenyltetrazole (IV), t-butyl m-tolyl ether (V) together with corresponding p-isomers. This result infers the existence of the pathway through a benzyne.

As a continuation of our investigation on the chemistry of nitrogen heterocycles,1) we sought to arylate tetrazolides by means of iodonium halides. Numerous investigations have been undertaken on the reactions of diaryliodonium salts with a variety of nucleophiles.2a-c) As to the mechanism the reaction pathways via radical-pair2b) and $S_N1$2c) have been proposed. Without rigorous proof, however, Beringer and Forgione have inferred that the path through a benzyne-intermediate could not be completely ruled out.2b) In the present communication we would like to present a conclusive evidence for the possible pathway through a benzyne.

After heating sodium 5-phenyltetrazolide (II) with di-p-tolyliodonium bromide (I)2a) under reflux in t-BuOH for 24 hr, usual work-up gave compounds (III-V)(eq. 1). Detailed NMR spectroscopic studies revealed that each compound III-V was a mixture of m- and p-isomers in a ratio of ca. 1:1. The NMR-data for methyl protons of compound III-V are summarized in Table 1. These assignments were unequivocally confirmed by independent syntheses.3)



(1)

I　　II　　III 12.6%　　IV 16.6%　　V 7.3%

Table 1 The chemical shifts(δ) of methyl-protons.*

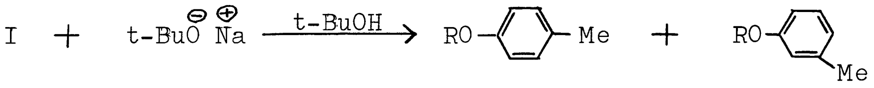
	m-Isomer	p-Isomer
III	2.40 (s)	2.43 (s)
IV	2.40 (s)	2.43 (s)
V**	1.27 (s)	1.30 (s)

* Varian EM-360, 60MHz, Solvent: $CDCl_3$.

** Methyl in t-butyl group.

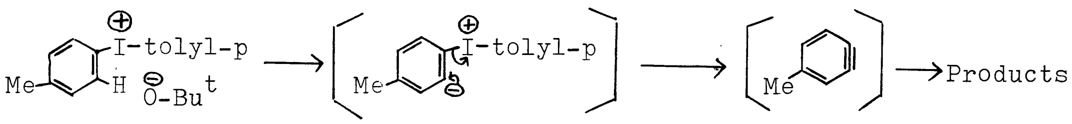
In order to gain further insights about the arylation by means of I, we have tried the reaction of I with sodium t-butoxide in t-BuOH (eq. 2), and the formation of p-tolyl-(VI) and m-tolyl t-butyl ethers (VII) in a ratio of ca. 1:1 (total yield 27.0 %) was confirmed as follows.4)5) The reaction mixture consisting of VI and VII was treated with boron tribromide6) converting into the corresponding cresols (VIII and IX) which were separated by high speed liquid chromatography7) clearly showing that the ratio of VIII : IX was ca. 1:1.

The conventional mechanistic considerations are explicable for the formation of p-cresol (VIII), but not appropriately for that of m-isomer (IX). A satisfactory rationale for these results can be formulated in terms of possible benzyne intermediate (X) as indicated in eq. 3.



(2)

R: t-Bu, VI VII
R: H , VIII IX



(3)

X

A complete understanding could, of course, blend aspects of hitherto-mentioned several mechanistic considerations. However, the present results would give powerful support to the notion that a route to benzyne intermediate at least in part can be an alternate candidate for the titled reaction. We are pressing related studies.

Acknowledgments are due to Drs. T.Isida and S. Kozima for their stimulating discussion and also to Dr. T. Imagawa for arrangement of liquid chromatography.

REFERENCES

1) T. Isida, T. Akiyama, K. Sisido, and S. Kozima, Bull. Chem. Soc. Japan, 46, 2176 (1973) and ref. cited therein.
2) a) For a review: Y. Yamada, J. Synth. Org. Chem., Jap., 29, 172 (1971).
   b) F. M. Beringer and P. S. Forgione, Tetrahedron, 19, 739 (1963).
   c) Y. Yamada and M. Okawara, Bull. Chem. Soc. Japan, 45, 1860 (1972).
3) R. M. Herbst, C. W. Roberts, H. T. F. Givens, and E. K. Harvill, J.Org. Chem. 17, 262 (1952).
4) Heating in t-BuOH without t-butoxide did not induce any change in I.
5) Since the yield of p-iodotoluene as determined by glc was nearly quantitative, the possibility that a benzyne may originate from this compound can be safely eliminated. We are indebted to a referee who has noticed us this point.
6) F. L. Benzon and T. E. Dillon, J. Amer. Chem. Soc., 64, 1128 (1942).
7) Column: Alumina; Solvent: n-hexane; Detector: UV (250 nm).

(Received December 20, 1973)