# NOTES

## *t*-Butyl Trichloroacetate

By Warner E. Scovill, Robert E. Burk and Herman P. Lankelma

Of the four butyl esters of trichloroacetic acid only the tertiary isomer has not been described. We find that it is readily prepared in 95% yield from trichloroacetyl chloride in the presence of pyridine, following the method used by Bryant and Smith[1] in the preparation of the corresponding acetate. No solvent was added, however, and heating was unnecessary. It was purified by distillation at 1 mm. pressure.

It may also be prepared from trichloroacetic acid and isobutylene, following the method used by Timofeev and Andreasov[2] for the preparation of the corresponding amyl ester. The isobutylene is rapidly absorbed in the trichloroacetic acid at 60°, the absorption being complete in three hours. The resulting brown, oily liquid crystallized on cooling with ice. It recrystallized well from both pentane and methanol at 0°, a yield of 80% being obtained from the former.

The following physical properties were determined: m. p. 25.5°; b. p. 37° at 1 mm. pressure; $d^{25}_4$ 1.2363; $n^{25}$ 1.4398.

*Anal.* Calcd. for $C_6H_9O_2Cl_3$: C, 32.83; H, 4.13; Cl, 48.46. Found: C, 32.50; H, 4.05; Cl, 48.65.

(1) Bryant and Smith, This Journal, **58**, 1014 (1936).

(2) Timofeev and Andreasov, *Chem. Zentr.*, **96**, II, 1652 (1925).

Morley Chemical Laboratory
Western Reserve University
Cleveland, Ohio Received March 8, 1944

## An Apparatus for the Manipulation of Sodium Triphenylmethide Reagent

By Erwin Baumgarten and Charles R. Hauser

Sodium triphenylmethide in ether solution is a useful reagent to bring about certain condensation reactions.[1] The present note describes a simple apparatus[2] for the manipulation of the reagent permitting the withdrawal of analyzed aliquots from a single large scale preparation of the reagent so that a series of relatively small scale experiments may be carried out conveniently.

The analyzed solution of sodium triphenylmethide, prepared[3] in a two-liter bottle from one mole of triphenylchloromethane,[4] is divided into desired aliquots by means of the buret assembly illustrated in Diagram I, the essential features of which are a mercury-filled pressure release and a three-way stopcock, connected as shown. The system is swept with nitrogen[5] before use. In operation, a constant pressure of nitrogen is maintained in the system sufficient to push the reagent from the storage bottle to the buret. Transfer of the reagent from the storage bottle to the buret is effected by adjusting stopcock A to position (a), applying a positive pressure on the storage bottle while the buret communicates with the atmosphere. Transfer is stopped by adjusting stopcock (A) to position (b), equalizing the pressure between the storage bottle and the buret. The buret may now be drained into the receiver, previously filled with nitrogen.

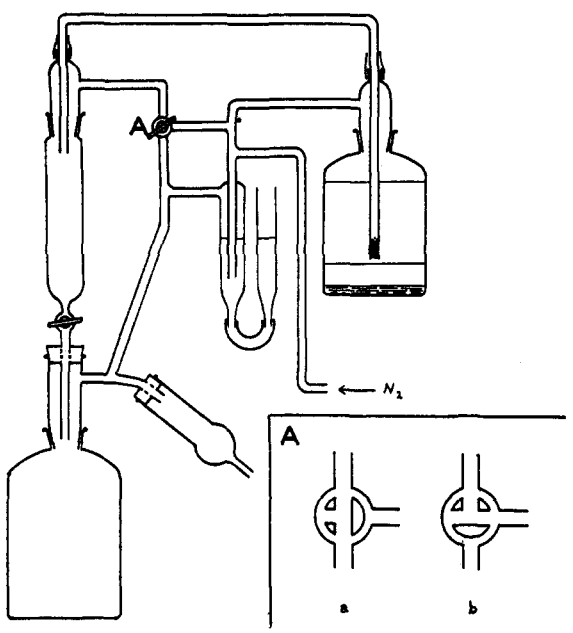


Fig. 1.

It should be noted that this apparatus maintains the reagent at all times under a small positive pressure of nitrogen preventing contact with moisture or oxygen.

(1) See especially, Hauser and Hudson, "Organic Reactions," John Wiley and Sons, New York, N. Y., 1942, Chapter 9.

(2) An apparatus for analytical purposes has been described by Corwin and Ellington, This Journal, **64**, 2098 (1942).

(3) Hauser and Hudson, "Organic Syntheses," John Wiley and Sons, New York, N. Y., 1943, Second Coll. Vol., 609 (Note 3).

(4) Hauser and Hudson, "Organic Syntheses," John Wiley and Sons, New York, N. Y., 1943, Vol. 23, p. 102.

(5) Commercial nitrogen was used without purification with the sodium triphenylmethide reagent; see Morton and Richardson, This Journal, **62**, 123 (1940).

Department of Chemistry
Duke University
Durham, North Carolina Received February 29, 1944

## Photochemical Destruction of Vitamin $B_2$ in Milk

By John A. Ziegler

The results of experiments carried out in March, 1944, on the destruction of riboflavin in

milk independently confirm those recently reported by Peterson, Haig and Shaw.[1] Preliminary experiments have also indicated that the destruction by radiation increases with temperature, as previously reported by Williams and Cheldelin.[2]

Samples of so-called "raw" milk (I), homogenized raw milk (II), pasteurized milk (III), homogenized pasteurized milk (IV), and irradiated vitamin D-containing milk (V), were freshly obtained. All samples were stored in the dark in the usual capped quart bottles and were refrigerated until the experiment was begun. Exposures were made within twenty-four hours of bottling to direct mid-morning spring sunshine in the open air for periods up to two hours during which the atmospheric temperature was 16.7 to 20.6°.

TABLE I

| Sample | Riboflavin concentration,[a] γ/ml. | Destruction of riboflavin after 1 hr. exposure,[a] % | 2 hr. exposure[a] % |
|---|---|---|---|
| I | 2.07 | 36 | 59 |
| II | 2.05 | 27 | 54 |
| III | 1.97 | 26 | 54 |
| IV | 1.86 | 39 | 68 |
| V | 1.89 | 32 | 66 |

[a] All riboflavin assays were made in triplicate and corrected for the values of the blank.

Riboflavin assays were made by the microbiological method of Snell and Strong[3] and frequent recovery experiments were made by adding known amounts of the pure crystalline vitamin to samples of milk to check the accuracy of the method. Recoveries amounted to 94–102%. In addition, samples of milk were withdrawn at the same time as those for assay, made alkaline to *p*H 10 with 1 *N* sodium hydroxide, and exposed to the light from a 750-watt bulb at 50 cm. for twenty-four hours in order to destroy all riboflavin present. The photolyzed milk was then neutralized to *p*H 6.8 and added separately to the basal medium in identical amount to the samples being assayed. The results of these blanks were subtracted from the values of the actual assays to give the riboflavin concentrations reported in Table I.

Since milk after delivery to the consumer frequently remains on an open porch in direct sunlight, it is apparent that during this period from one-third to two-thirds of the riboflavin may be destroyed.

DEPARTMENT OF PATHOLOGICAL CHEMISTRY
BANTING INSTITUTE
UNIVERSITY OF TORONTO
TORONTO, CANADA

RECEIVED APRIL 24, 1944

(1) W. J. Peterson, F. M. Haig and A. O. Shaw, THIS JOURNAL, **66**, 662 (1944).

(2) R. R. Williams and V. H. Cheldelin, *Science*, **96**, 22 (1942).

(3) E. E. Snell and F. M. Strong, *Ind. Eng. Chem., Anal. Ed.*, **11**, 346 (1939).

# COMMUNICATIONS TO THE EDITOR

## THE TOTAL SYNTHESIS OF 2,3,4,5-TETRADEHYDROBIOTIN

*Sir:*

Since the announcement of the structural elucidation of biotin [du Vigneaud, *et al.*, *J. Biol. Chem.*, **146**, 475, 487 (1942)], the quest for a practical synthesis of the vitamin in this Laboratory has led to the development of a seventeen-step synthesis of 2′-keto-3,4-imidazolido-2-thiophenevaleric acid, the aromatic analog of biotin. Experiments are now in progress on the nuclear reduction of this compound to biotin.

The starting materials were trimethylene chlorobromide and ethyl malonate, from which was obtained ethyl 3-chloropropylmalonate by the method of Fischer and Bergmann [*Ann.*, **398**, 120 (1913)]. Hydrolysis and decarboxylation followed by esterification gave ethyl 5-chlorovalerate, described by Mellor [*J. Chem. Soc.*, **79**, 132 (1901)]. This compound reacted with ethyl malonate to produce ethyl pentane-1,1,5-tricarboxylate (b. p. 165–170° (4 mm.), for $C_{14}H_{24}O_6$—Calcd.: C, 58.32; H, 8.37. Found: C, 58.49; H, 8.54). Hydrolysis yielded pentane-1,1,5-tricarboxylic acid (m. p. 82°, for $C_8H_{12}O_6$—Calcd.: C, 47.05; H, 5.92. Found: C, 47.11; H, 5.88). Treatment with sulfuryl chloride followed by decarboxylation gave 2-chloropimelic acid (m. p. 89–90°, for $C_7H_{11}O_4Cl$—Calcd.: C, 43.25; H, 5.70. Found: C, 43.27; H, 5.78) which after reaction with β-mercaptopropionic acid and esterification yielded 2-carbethoxyethyl 1,5-dicarbethoxyamyl sulfide (b. p. 210–213° (3 mm.), for $C_{16}H_{28}O_6S$—Calcd.: C, 55.14; H, 8.10. Found: C, 55.14; H, 8.15). Cyclization by the Dieckmann reaction gave ethyl 4-carbethoxy-3-keto-2-tetrahydrothiophenevalerate (for $C_{14}H_{22}O_5S$—Calcd.: C, 55.60; H, 7.33. Found: C, 55.53; H, 7.36). The oxime of this keto ester was converted to ethyl 3-amino-4-carbethoxy-2-thiophenevalerate (m. p. 43–44°) by means of dry hydrogen chloride followed by decomposition of the resulting amine hydrochloride with a suitable base. Selective hydrolysis produced 3-amino-4-carbethoxy-2-thiopheneval-