383. *Derivatives of Trishydroxymethylnitromethane.*

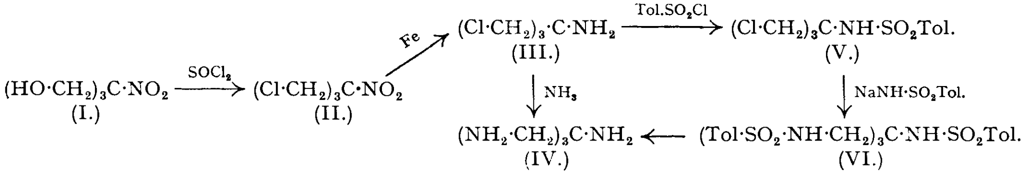
By Godfrey Fort and Andrew McLean.

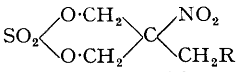
Trischloromethylaminomethane has been obtained in high yield from trishydroxymethylnitromethane and has been converted into the tetramine, $C(CH_2\cdot NH_2)_3\cdot NH_2$, by two methods. A compound resulting from the self-condensation of trischloromethylaminomethane in presence of alkaline catalysts has been tentatively formulated as 2 : 2 : 5 : 5-tetrakischloromethylpiperazine.

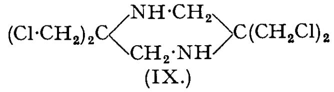
Attempts to prepare the nitroamines $C(CH_2\cdot NH\cdot NO_2)_3\cdot NH\cdot NO_2$ and $C(CH_2\cdot O\cdot NO_2)_3\cdot NH\cdot NO_2$ were unsuccessful.

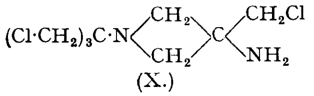
The main part of the present work was the preparation of the tetramine, trisaminomethylaminomethane (IV), for which the starting material was the trichloro-amine (III) previously prepared by Kleinfeller (*Ber.*, 1929, **62**, 1582) from trishydroxymethylnitromethane (I) by successive chlorination with phosphorus pentachloride and reduction with stannous chloride. The following scheme shows two routes employed to prepare the tetramine (IV). Of these, the first was analogous to that employed by Litherland and Mann (*J.*, 1938, 1591) for the preparation of tetrakisaminomethylmethane from tetrakisbromomethylmethane, and the second involved direct ammonolysis in aqueous alcohol. The approximate yield of distilled tetramine by the second method was 50% on trischloromethylaminomethane (28% on trishydroxymethylnitromethane), and by the first about half these values.

By modifying Kleinfeller's method of preparation, yields of trischloromethylaminomethane as high as 62% on the trishydroxymethylnitromethane were obtained. In the improved method excess of thionyl chloride and pyridine were used for the chlorination, and the trischloromethylnitromethane (II) was reduced by gradual addition of water to a stirred suspension of iron powder in its benzene solution (Hazlet and Dornfeld, *J. Amer. Chem. Soc.*, 1944, **66**, 1781). With smaller proportions of the chlorinating agents, trishydroxymethylnitromethane yielded, in addition to trischloromethylnitromethane, the cyclic sulphate (VII) previously prepared by Kleinfeller (*loc. cit.*) and also a substance, probably the corresponding *chloride* (VIII), which proved difficult to purify owing to solvation.


(Tol. = p-$CH_3 \cdot C_6H_4$.)


(VII, R = OH; VIII, R = Cl.)

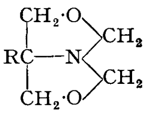

(IX.)

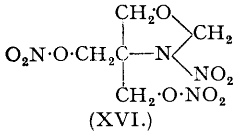

(X.)

[(p-Me·$C_6H_4 \cdot SO_2 \cdot NH)_3C_4H_6]_2NH$
(XI.)

$C(CH_2 \cdot NH \cdot NO_2)_3 \cdot NH \cdot NO_2$
(XII.)

$[(EtO_2C \cdot NH)_3C_4H_6 \cdot NH]_2CO$
(XIII.)


(XIV, R = $HO \cdot CH_2$.)
(XV, = $CH_3 \cdot CO_2 \cdot CH_2$.)


(XVI.)

Trischloromethylaminomethane was found to be a readily distillable and fairly stable liquid. Kleinfeller does not appear to have distilled it, but recorded that crystals were deposited on standing. This observation was confirmed, and the crystals shown to be trischloromethylaminomethane hydrochloride, indicating a self-condensation. In an isolated case a crystalline *compound* (Y) was deposited under similar conditions. (Y) was also obtained in small yield from the residue from the distillation of trischloromethylaminomethane, and also by prolonged heating of this substance alone or in presence of anhydrous sodium carbonate. (Y) had a composition suggesting that it was formed by intermolecular dehydrochlorination of the trichloro-amine, and it is therefore formulated as (IX). Structure (X) is rejected on account of the less likely four-membered ring. Trischloromethylaminomethane gave Schiff's bases readily with aromatic aldehydes, *e.g.*, *m*-nitro- and *p*-chloro-benzaldehydes.

Initial experiments showed that application of the sodio-toluene-*p*-sulphonamide reaction to trischloromethylnitromethane failed, as had been expected, on account of the lack of reactivity of the chlorine atoms, and that trischloromethylaminomethane reacted violently with decomposition. The *toluene*-p-*sulphonamide* (V), however, reacted smoothly without solvent at 140°, a temperature considerably lower than that required for the highly symmetrical compound $C(CH_2Br)_4$ employed by Litherland and Mann (*loc. cit.*), and gave a 64% yield of the pure *tetratoluene*-p-*sulphonamide* (VI). Hydrolysis with 80% sulphuric acid gave a high yield of the tetramine disulphate from which the free base was liberated. Sodiotoluene-*p*-sulphonmethylamide was also shown to react with the toluene-*p*-sulphonate (V) of trischloromethylaminomethane to give *tris(toluene*-p-*sulphonmethylamidomethyl)toluene*-p-*sulphonamidomethane.* The tetramine (IV) was more conveniently prepared by heating trischloromethylaminomethane with a large excess of ammonia in aqueous alcohol. It gave a *tetrapicrate* which was difficult to purify and gave rather poor analyses. The residue from the distillation of the crude tetramine gave a crystalline toluene-*p*-sulphonyl compound with the composition of the *hexatoluene*-p-*sulphonyl* derivative (XI) of a secondary amine derived from the tetramine by elimination of ammonia.

The preparation of the tetranitroamine (XII) was attempted by nitration of the *tetraurethane*, a crystalline derivative obtained along with smaller amounts of a higher-melting by-product (probably XIII) by reaction of the tetramine with ethyl chloroformate. The product of nitration under various conditions was a gum which on decarbethoxylation with ammonia gave a hard, colourless glass which could not be purified, and possessed a lower nitrogen value than that for (XII).

A related objective was the preparation of trisnitroxymethylnitroaminomethane. Unpublished work carried out in this laboratory had shown that direct nitration of trishydroxymethylaminomethane did not introduce an *N*-nitro-group but yielded only trisnitroxymethylaminomethane. Activation of the amino-group by carbethoxylation might provide a solution to this problem but was not attempted. Attention was restricted to attempts to nitrate the bicyclic compound (XIV), which by analogy with the production of *cyclo*trimethylenetrinitroamine from hexamine, might have yielded the desired product by fission of both rings and elimination of the methylene groups. Bicyclic compounds of this type have been shown to be formed by a general reaction of 2-nitro-1 : 3-diols with aldehydes (B.P. 564,506; Senkus, *J. Amer. Chem. Soc.*, 1945, **67**, 1515; Hancock *et al.*, *ibid.*, 1944, **66**, 1738, 1747). Nitration of (XIV) failed to yield the required product but gave a small yield of 3-*nitro*-4 : 4-*bisnitroxymethyloxazolidine* (XVI) which resulted from fission of only one ring. Nitration of the bicyclic condensation product (XV) from 1 : 1-bishydroxymethylpropylamine and formaldehyde failed to yield any crystalline product.

EXPERIMENTAL.

Trischloromethylnitromethane (II).—The method of Kleinfeller (*loc. cit.*) gave the compound, m. p. 102—103° (from 70% ethanol), in 26% yield. The following method was more convenient. Thionyl chloride (5% excess) was added during 5—6 hours to a stirred solution of trishydroxymethylnitromethane in pyridine (5% excess) kept at 40—50°. After standing overnight the mixture was heated at 95—100° until sulphur dioxide evolution ceased (½ hour), cooled to *ca.* 35°, and poured into ice–water. The crystalline precipitate was collected and washed with water, and the moist product recrystallised first from ethanol (charcoal), and then from 70% ethanol, yielding the pure compound (needles), m. p. 102—104°; yield 72·5%.

Using crude nitro-alcohol yields were low (40—50%), but were raised to 70% when the chlorinating agents were used in 40% excess.

2-*Nitro*-2-*chloromethyltrimethylene Sulphate* (VIII).—Although the above method for the preparation of trischloromethylnitromethane usually gave the results stated when pure trishydroxymethylnitromethane was used, yields were sometimes unaccountably low and, when this occurred, (VIII) could be isolated from the reaction liquors, sometimes as the chief product. Thus in a run carried out as described, recrystallisation of the crude product in turn from ethanol and 70% ethanol gave material of m. p. 50—98°. Three additional recrystallisations from carbon tetrachloride and one from light petroleum gave needles, m. p. 85—88°. Analyses indicated that carbon tetrachloride solvation was very persistent and not readily eliminated by further recrystallisation from non-polar solvents. Sublimation, however, gave the *compound*, m. p. 62°, as a crystalline powder (Found : C, 22·5; H, 2·9; N, 6·0; Cl, 16·8; S, 15·1. $C_4H_6O_5NClS$ requires C, 22·3; H, 2·8; N, 6·5; Cl, 16·5; S, 14·9%). Further recrystallisation from acetone–light petroleum and ethanol (thrice) followed by drying at 60°/6 mm. gave opaque needles, m. p. 86—89° (with softening above 78°) (Found : Cl, 16·4%).

2-*Nitro*-2-*hydroxymethyltrimethylene Sulphate* (VII).—This was isolated in an attempted preparation of bischloromethylhydroxymethylnitromethane. Trishydroxymethylnitromethane (0·95 mole), thionyl chloride (2·0 moles), and pyridine (2·1 moles) were brought into reaction under the conditions used for the preparation of trischloromethylnitromethane. Elimination of sulphur dioxide at 95° and pouring into water gave only a small oily precipitate which failed to crystallise and was discarded. The aqueous solution (C) was saturated with sodium sulphate and extracted several times with ether. The ether extracts yielded 36% of the crude sulphate, m. p. 100°, and recrystallisation from benzene, 28%, m. p. 104°. Several recrystallisations from chloroform raised the m. p. to 105—106° (Found: C, 24·4; H, 3·4; N, 6·5; S, 16·7. Calc. for $C_4H_7O_6NS$: C, 24·4; H, 3·6; N, 7·1; S, 16·2%). Further treatment of (C) in a continuous ether extractor gave only a small quantity of unchanged trishydroxymethylnitromethane.

Trischloromethylaminomethane (III).—Iron filings (100 g.; 50 mesh) were stirred with concentrated hydrochloric acid (20 c.c.) while cooled in ice, dried in a vacuum desiccator over calcium chloride, and added rapidly in one portion to a solution of trischloromethylnitromethane (25 g.) in benzene (400 c.c.) in a 3-necked flask fitted with a Hershberg stirrer (*Ind. Eng. Chem. Anal.*, 1936, **8**, 313). Water (40 c.c.) was added in 2 c.c. portions at 15 minute intervals during 4¾ hours, and thereafter refluxing and stirring were continued for 1 hour. The solution was then decanted, the iron sludge washed twice with benzene, and most of the solvent distilled off through an 8 inch packed column. Removal of the remainder of the benzene in a vacuum gave a heavy, pale yellow liquid (19·6 g.; 91·6%) which on distillation gave trischloromethylaminomethane (17·7 g.; 82·5%, b. p. 75—84°/6·5 mm.). The substance deposited crystals on standing (see below).

Other reducing agents gave the following results : (*a*) stannous chloride in ethanol (Kleinfeller, *loc. cit.*) gave a 65% crude yield of amine (isolated by basification and steam-distillation); (*b*) hydrogen and Raney nickel at 3 atmospheres in ethanol gave slow reduction; (*c*) neither the amine nor its hydrochloride was isolated after an attempted reduction with iron and hydrochloric acid in aqueous alcohol.

The hydrochloride separated readily on addition of concentrated hydrochloric acid to the amine, and was purified by recrystallisation from ethanol–acetone. The m. p. 244—246° (decomp.) agrees with that recorded by Kleinfeller (*loc. cit.*). The picrate was prepared by adding light petroleum to an alcoholic solution of equivalent quantities of picric acid and amine in alcohol; m. p. 178° (Kleinfeller, *loc. cit.*, records 180°).

N-m-*Nitrobenzylidene-trischloromethylaminomethane*.—The theoretical quantities of *m*-nitrobenzaldehyde and amine were refluxed in ethanol for 2½ hours. Removal of solvent and recrystallisation from ethanol–light petroleum gave the *Schiff's base* (70·5% yield), m. p. 82—83°; after recrystallised from the same solvent, m. p. 83—84·5° (Found: C, 42·8; H, 3·8; N, 8·8; Cl, 34·1. $C_{11}H_{11}O_2N_2Cl_3$ requires C, 42·7; H, 3·6; N, 9·0; Cl, 34·4%).

2 : 2 : 5 : 5-*Tetrakischloromethylpiperazine* (IX).—(*a*) Trischloromethylaminomethane (5 g.) was heated at 120° for 7 hours. Filtration and washing with benzene gave trischloromethylaminomethane hydrochloride (1·06 g.), m. p. 260° (decomp.). The washings were evaporated, the residue combined with the filtrate, and the unchanged chloro-amine removed at 100°/44 mm. After being washed with methanol, the crystalline residue (0·24 g.; 12%) melted at 93—100°. For analysis the *piperazine* was recrystallised twice from ethanol–light petroleum and in turn from methanol, benzene, and benzene–light petroleum; m. p. 105—106°, mixed m. p. with trischloromethylnitromethane, 80—94° (Found : C, 34·1; H, 5·0; N, 9·8; Cl, 50·2. $C_8H_{14}N_2Cl_4$ requires C, 34·3; H, 5·0; N, 10·0; Cl, 50·7%).

(*b*) The semi-crystalline residue (5—10 g.) from the distillation of trischloromethylaminomethane (200—300 g.) was purified by recrystallisation from amyl alcohol and extraction with hot carbon tetrachloride. Evaporation of the extract and recrystallisation from 70% ethanol gave crystals melting at 104—106°.

(*c*) Samples of distilled trischloromethylaminomethane deposited crystals of the hydrochloride on standing for several weeks, indicating formation of (IX). In an isolated instance (IX) crystallised in preference to the hydrochloride.

(*d*) Refluxing a 10% solution of the trichloro-amine in toluene for 14 hours in presence of excess of sodium carbonate gave the piperazine derivative in 4·5% yield.

(*e*) Crystals of piperidine hydrochloride were deposited on refluxing a toluene solution of the trichloro-amine and piperidine, but the product was a brittle amber resin from which the piperazine derivative could not be isolated.

Benzoylation.—The substance (IX) (1·26 g.) with benzoyl chloride (1·28 c.c.; 20% excess) and pyridine, gave, on isolation by ether extraction, a crystalline product (0·23 g.) (washed with methanol), m. p. 205—210° (decomp.), and m. p. 210—215° (decomp.) after recrystallisation from glacial acetic acid.

Tosylation.—The substance (IX) (1·146 g.), treated overnight at room temperature with tosyl chloride (1·95 g.; 25% excess) in pyridine, gave a gum which dried to a buff solid (0·944 g.). Crystallisation from aqueous acetic acid gave crystals, m. p. 133—138°, and a mother liquor (D). Three more crystallisations gave the substance as a felted mass of needles of the *monotosyl* derivative, m. p. 138—140° (Found : C, 42·2; H, 4·6; N, 6·5; S, 6·6. $C_{15}H_{20}O_2N_2Cl_4S$ requires C, 41·4; H, 4·6; N, 6·5; S, 7·4%). On standing for several days (D) gave large prisms. Three recrystallisations from glacial acetic acid gave small plates of the *ditosyl* derivative, m. p. 250° (decomp.) (Found : C, 43·2; H, 4·8; N, 4·8; S, 10·7; Cl, 25·1. $C_{22}H_{26}O_4N_2Cl_4S_2$ requires C, 44·9; H, 4·4; N, 4·8; S, 10·9; Cl, 24·2%).

Trischloromethyltoluene-p-*sulphonamidomethane* (V).—Trischloromethylaminomethane (35·05 g.) was dissolved in pyridine (100 c.c.), and tosyl chloride (38·3 g.; slight excess) was added gradually with cooling. After 2 days the mixture was poured into water and the crystalline product collected and washed. The crude product (61·8 g.; 94%), m. p. 121—129°, was purified by one recrystallisation from ethanol and two from carbon tetrachloride, giving pure *compound* (irregular prisms), m. p. 134—135° (Found : C, 40·0; H, 4·3; N, 4·5. $C_{11}H_{14}O_2NCl_3S$ requires C, 40·0; H, 4·3; N, 4·2%).

Tris(*toluene*-p-*sulphonamidomethyl*)*toluene*-p-*sulphonamidomethane* (VI).—Trischloromethyltoluene-*p*-sulphonamidomethane and sodiotoluene-*p*-sulphonamide were brought into reaction under the conditions described by Litherland and Mann (*loc. cit.*) for tetrakisbromomethylmethane but at a lower temperature (140° for 10 hours). The pure *product* (colourless needles; m. p. 197—198°) was obtained by recrystallisation from acetic acid (yield 64%) (Found : C, 52·1; H, 5·1; N, 7·5; S, 17·2. $C_{32}H_{38}O_8N_4S_4$ requires C, 52·3; H, 5·2; N, 7·4; S, 17·4%). Reaction for the same time at 170° and 210° gave yields of 38% and 24% respectively.

Interaction of trischloromethyltoluene-*p*-sulphonamidomethane with toluene-*p*-sulphonamide (3 mols.) in refluxing ethanol for 9 hours in presence of excess of sodium hydroxide (added as 40% solution) gave a 42·4% yield of the tetrakistoluene-*p*-sulphonyl derivative.

Tris(*toluene*-p-*sulphonmethylamidomethyl*)*toluene*-p-*sulphonamidomethane.*—Sodiotoluene-*p*-sulphonmethylamide was prepared by adding toluene-*p*-sulphonmethylamide (25 g.) dissolved in ethanol (75 c.c.) to sodium ethoxide solution (3·7 g. sodium in 88 c.c. ethanol), precipitating by addition of a large volume of ether, and drying in a desiccator.

Equimolar amounts of trischloromethyltoluene-*p*-sulphonamidomethane and sodiotoluene-*p*-sulphonmethylamide were heated at 140° for 10 hours, as for the above preparation of (VI). Recrystallisation from acetic acid (charcoal) gave a product, m. p. 195°, yield 14%. For analysis the *compound* was recrystallised several times from acetic acid (Found : C, 54·5; H, 5·3; N, 7·2; S, 16·4. $C_{35}H_{44}O_8N_4S_4$ requires C, 54·1; H, 5·7; N, 7·2; S, 16·5%).

Trisaminomethylaminomethane Disulphate.—(*a*) Tristoluene-(*p*-sulphonamidomethyl)sulphonamidomethane (8 g.) and 80% sulphuric acid (24 c.c.) were heated for 3 hours at 200° (bath temp.). Pouring into a mixture of water (130 c.c.) and alcohol (65 c.c.) gave the *tetramine disulphate* (2·94 g.; 85·5%), m. p. *ca.* 265° (decomp.). For analysis the substance was purified by several reprecipitations with alcohol from its solution in dilute sulphuric acid and dried at 100°/0·1 mm.; m. p. 280° (decomp.) (Found : C, 15·0; H, 5·5; N, 16·0; S, 21·5. $C_4H_{18}O_8N_4S_2$ requires C, 15·3; H, 5·7; N, 17·8; S, 20·4%).

(*b*) Trischloromethylaminomethane (4 g.) was dissolved in ethanol (23 c.c.), and aqueous ammonia (70 c.c.; *d* 0·88, *i.e.*, 9·3 times theory) added. The solution was heated in an autoclave for 3 hours at 100—110°. Excess of ammonia and part of the solvent were removed under reduced pressure. By addition of sulphuric acid followed by alcohol the tetramine disulphate was precipitated as a liquid which crystallised on standing. (When only 3·3 times the theoretical quantity of ammonia was employed the precipitate did not crystallise even on seeding.) Washed with alcohol, yield 6·45 g. (91%).

Trisaminomethylaminomethane (IV).—(*a*) The tetramine disulphate prepared by ammonolysis of trischloromethylaminomethane was dissolved in hot water and an excess of barium hydroxide solution added. The excess of barium was precipitated by addition of ammonium carbonate. Evaporation of the filtered solution gave the crude tetramine as a viscous, brownish liquid. Yield 95%.

(*b*) A mixture of the crude tetramine disulphate (6·4 g.) and potassium hydroxide (6·4 g.) was extracted

4 times with boiling benzene. Evaporation of the combined extracts gave the crude tetramine. Yield 1·74 g. (73%).

(*c*) The tetramine was most conveniently prepared without previous isolation as the disulphate. A solution containing trischloromethylaminomethane (40 g.), alcohol (300 c.c.), and aqueous ammonia (600 c.c.; *d* 0·88) was heated in an autoclave at 100—110° for 3½ hours and the product evaporated to dryness under reduced pressure. The residue of brown, sticky crystals was mixed with solid sodium hydroxide (54 g.) and repeatedly extracted with boiling toluene. Evaporation of the combined toluene extracts gave the crude tetramine as a brown, viscous liquid (24·0 g., 89·5%). Distillation gave a colourless liquid, b. p. 120°/3—4 mm., containing a small amount of a waxy solid (14·0 g., 52%). A very viscous higher fraction boiled at 190° (approx.)/0·5 mm. (see below). For analysis the *tetramine* was redistilled and the distillate filtered to remove traces of a waxy solid (Found : C, 40·5; H, 11·2; N, 46·8. $C_4H_{14}N_4$ requires C, 40·7; H, 11·9; N, 47·5%). The *tetrapicrate* was prepared in ethanol and formed a sticky precipitate which hardened gradually. Recrystallisation was best from water, though not entirely satisfactory since a small insoluble gummy residue always remained undissolved. Three recrystallisations gave a product (fine needles), m. p. 140° (with softening above 127°) (Found : C, 33·0; H, 2·8; N, 22·7. $C_{28}H_{26}O_{28}N_{16}$ requires C, 32·5; H, 2·5; N, 21·7%). The *tetrahydrochloride* crystallised on addition of excess of the concentrated acid to the tetramine, m. p. 270° (decomp.) (from ethanol—ether). (Found : C, 22·8; H, 4·2; N, 6·7; Cl, 63·4. $C_4H_9NCl_4$ requires C, 22·6; H, 4·2; N, 6·6; Cl, 66·6%).

Tosylation of High-boiling Amine from Ammonolysis of Tris(chloromethyl)aminomethane.—Tosylation by the Schotten–Baumann method with excess tosyl chloride, and acidification with hydrochloric acid, gave a gummy precipitate. The part insoluble in boiling methanol was recrystallised 5 times from glacial acetic acid, giving the *hexatosyl* derivative of the secondary amine corresponding to tetramine, small irregular plates, m. p. 275—278° (Found : C, 52·6; H, 5·4; N, 8·4; S, 16·6. $C_{50}H_{61}O_{12}N_7S_6$ requires C, 52·6; H, 5·3; N, 8·6; S, 16·8%).

Tris(carbethoxyaminomethyl)carbethoxyaminomethane.—(*a*) The tetramine (4·85 g.; 0·0411 mole) was dissolved in dilute sodium hydroxide (6·6 g. in 80 c.c. of water) and ethyl chloroformate (15·6 c.c.; 0·164 mole) added during ½ hour to the stirred solution at 0—10°. When about half of the ester had been added, a sticky solid made stirring difficult, and ether (100 c.c.) was added. The reaction was completed by 2½ hours' stirring at 0—10°; the suspension was then filtered and the solid washed with water. Yield 7·5 g. Evaporation of the ether layer of the filtrate gave a further small quantity of solid (1·2 g.). The total crude yield (52%) was recrystallised 3 times from 40% alcohol to give the pure *compound* as minute needles, m. p. 145—146° (Found : C, 47·4; H, 7·2; N, 13·4. $C_{16}H_{30}O_8N_4$ requires C, 47·3; H, 7·4; N, 13·8%).

(*b*) An attempt was made to improve the yield by simultaneously adding ethyl chloroformate and alkali (both in 28% excess) during 1 hour, the system being kept slightly alkaline throughout. The starting material was the tetramine disulphate, and sufficient alkali to liberate the free base was added before any addition of ethyl chloroformate. Addition of ether was again necessary to facilitate stirring. The whole of the reaction mixture was filtered to yield the crude product, m. p. 225—235° (with much previous softening). Crystallisation from acetic acid gave 5·6 g. of a white powder (E), m. p. 268° (decomp.), and concentration of the mother liquor, a sticky solid, m. p. 120—130° (washed with alcohol). Recrystallisation from 40% alcohol gave tris(carbethoxyaminomethyl)carbethoxyaminomethane (20%; m. p. 143—145°).

Recrystallised three times from acetic acid, (E) yielded minute needles of NN′-*bis*[*tri*(*carbethoxyaminomethyl*)*methyl*]*urea* (XIII), m. p. 272° (decomp.) (Found : C, 46·6; H, 7·2; N, 16·1. $C_{27}H_{50}O_{13}N_8$ requires C, 46·7; H, 7·2; N, 16·2%).

Attempted Preparation of Trisnitroaminomethylnitroaminomethane.—Triscarbethoxyaminomethylcarbethoxyaminomethane (5 g.) was added during 15 minutes to a stirred mixture of nitric acid (20 c.c.; *d* 1·52) and acetic anhydride (20 c.c.) at 0°, and stirring continued for a further 1½ hours. Pouring on ice gave a sticky gum which was washed with water until free from acid, but could not be crystallised. An attempt was made to hydrolyse the gum to the free tetranitroamine by heating it on a steam-bath with ammonia for 10 minutes. Acidification with concentrated hydrochloric acid gave no precipitate, and ether extraction gave ethyl carbamate, m. p. 48°, as the only crystalline product.

The gum from another nitration was dissolved in ether and ammonia gas passed in. A yellowish gum separated almost at once, and after decantation of the ether was dissolved in water and reprecipitated by hydrochloric acid. The product could not be crystallised, but dried to a hard, clear glass which did not give correct analyses for the tetranitroamine (Found : C, 29·1; H, 4·1; N, 26·2. Calc. for $C_4H_{10}O_8N_8$: C, 16·1; H, 3·4; N, 37·6%).

8-*Hydroxymethyl*-2 : 6-*dioxapyrrolizidine* (XIV).—(*a*) By the method of B.P. 564, 506, trishydroxymethylaminomethane (12·2 g.) was dissolved in 37% (w/w) formaldehyde (16·4 g.) and the solution evaporated at 30° under reduced pressure, giving the crude substance, m. p. 56—62° as colourless hygroscopic crystals.

(*b*) A mixture of trishydroxymethylaminomethane (20 g.), paraformaldehyde (10·2 g.), and benzene (75 c.c.) was refluxed in an apparatus fitted with a trap for collection of the azeotropically removed water. When the theoretical quantity (6 c.c.) had been collected (1½—2 hours) a small amount of solid was filtered off and the solution evaporated to yield the theoretical amount (24 g.) of non-hygroscopic product, m. p. 54—57°. Alternatively, the filtered benzene solution was allowed to crystallise giving very large crystals, m. p. 58—62°, and after removal of ⅘ of the benzene from the mother liquors a further yield of less pure substance resulted. Total yield 88%.

Methiodide. The tertiary amine (2·06 g.) was dissolved in methanol (1 c.c.) and methyl iodide (1·75 c.c., *i.e.*, twice theory) was added. After 1 day the product (3·71 g.; 91·5%) was precipitated by addition of ether. Four recrystallisations from 96% alcohol gave the *methiodide*, m. p. 215° (decomp.) (Found : I, 46·6. $C_7H_{14}O_3NI$ requires I, 44·3%).

Acetyl derivative (XV). (*a*) 8-Hydroxymethyl-2 : 6-dioxapyrrolizidine was dissolved in a large excess of acetic anhydride containing 0·1% of sulphuric acid. After 1 day the excess of anhydride was decomposed by stirring with sodium acetate solution, and the product isolated by extraction with chloroform. Recrystallisation of the crude product from ethanol–light petroleum gave the substance, m. p. 93—95°; yield 45%. The pure 8-*acetoxymethyl*-2 : 6-*dioxapyrrolizidine* (plates and needles), m. p. 94—95°, was obtained by recrystallisation in turn from ethanol–light petroleum, benzene, and ethanol (Found: C, 51·3; H, 6·7; N, 7·7. $C_8H_{13}O_4N$ requires C, 51·3; H, 7·0; N, 7·5%).

(*b*) Refluxing the hydroxy-compound for 2½ hours with a large excess of acetic anhydride gave the acetyl derivative, m. p. 89—93°. Yield 41%.

3-*Nitro*-4 : 4-*bisnitroxymethyloxazolidine* (XVI).—Finely powdered 8-hydroxymethyl-2 : 6-dioxapyrrolizidine (4 g.) was added gradually during 15—30 minutes to a stirred mixture of concentrated sulphuric acid (25 c.c.) and nitric acid (30 c.c.; *d* 1·52) at 0—5°. After a further 2 hours' stirring the mixture was poured on crushed ice and the crystalline precipitate collected, washed, and dried, giving the derivative, m. p. 67° (1·6 g., 22%). The pure *compound*, irregular plates, m. p. 67·5—70°, was obtained by 3 recrystallisations from methanol (Found: C, 22·7; H, 3·0; N, 21·1. $C_5H_8O_9N_4$ requires C, 22·4; H, 3·0; N, 20·9%).

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