

UNCLASSIFIED

|                                                                                                                                                                                                                                 |              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| AD NUMBER                                                                                                                                                                                                                       |              |
| ADA492912                                                                                                                                                                                                                       |              |
| CLASSIFICATION CHANGES                                                                                                                                                                                                          |              |
| TO:                                                                                                                                                                                                                             | UNCLASSIFIED |
| FROM:                                                                                                                                                                                                                           | CONFIDENTIAL |
| LIMITATION CHANGES                                                                                                                                                                                                              |              |
| TO:<br>Approved for public release; distribution is unlimited. Document partially illegible.                                                                                                                                    |              |
| FROM:<br>Distribution authorized to DoD only; Foreign Government Information; NOV 1944. Other requests shall be referred to British Embassy, 3100 Massachusetts Avenue, NW, Washington, DC 20008. Document partially illegible. |              |
| AUTHORITY                                                                                                                                                                                                                       |              |
| DSTL ltr dtd 16 Feb 2007; DSTL ltr dtd 16 Feb 2007                                                                                                                                                                              |              |

THIS PAGE IS UNCLASSIFIED

A.C. 7791

Chem/Ex. 380  
H.E.I. 442  
R.D.X. 204

~~CONFIDENTIAL~~

A.C. 7791

Chem/Ex. 380  
H.E.I. 442  
R.D.X. 204



Decl OADR

## MINISTRY OF SUPPLY

REVIEWED ON:

10/2/85  
Date

*Mli*  
Signature



ADVISORY COUNCIL ON SCIENTIFIC RESEARCH

AND TECHNICAL DEVELOPMENT

EXPLOSIVES RESEARCH COMMITTEE (CHEMISTRY)

SUB-COMMITTEE H.E.I.

R.D.X. RESEARCH PANEL

INDEX OF COMPOUNDS RELATED TO HEXAMINE AND TO R.D.X.

by

H. D. Springall, M.A., D. Phil.

20081208322

REVIEW OF

Communicated by C.S.A.R.

Gloucester Branch, A.R.D.  
Bristol Report No. 143

November, 1944

Reviewed on  
1 JUL 1985  
INV. 201  
T. R. Sack

~~CONFIDENTIAL~~

Received February 12th 1945

013848

# CONTENTS

|                                                                   | Paragraph |
|-------------------------------------------------------------------|-----------|
| Introduction .....                                                | 1         |
| I. Nitroxy derivatives of formaldehyde .....                      | 7         |
| II. Simple nitramines .....                                       | 10        |
| III. Derivatives of methylenimine, $\text{CH}_2=\text{NH}$ .....  | 17        |
| IV. Derivatives of methylene diamine .....                        | 24        |
| MEDA or "3-chain" series                                          |           |
| V. Derivatives of <u>lin</u> dimethylenetriamine .....            | 46        |
| "5-chain" series                                                  |           |
| VI. Derivatives of <u>lin</u> trimethylenetetramine .....         | 72        |
| "7-chain" series                                                  |           |
| VIIa. Derivatives of <u>lin</u> tetramethylenepentamine .....     | 82a       |
| "9-chain" series                                                  |           |
| VIIa. Derivatives of <u>cyclotrimethylenetriamine</u> .....       | 83        |
| "6-Ring" series<br>(not substituted on C)                         |           |
| VIIb. Derivatives of <u>cyclotrimethylenetriamine</u> .....       | 112       |
| "6-Ring" series<br>(substituted on C)                             |           |
| VIII. Derivatives of <u>cyclooxotrimethylenediamine</u> and ..... | 117       |
| <u>cyclodioxotrimethylenediamine</u>                              |           |
| IX. Derivatives of <u>cyclotetramethylenetetramine</u> .....      | 123       |
| "8-Ring" series                                                   |           |
| X. Derivatives of pentamethylenetetramine .....                   | 142       |
| "P.T." series                                                     |           |
| XI. Derivatives of Hexamine (Hex. series) .....                   | 157       |
| XII. Derivatives of ethylenediamine .....                         | 181       |
| XIII. Derivatives of trimethylenediamine .....                    | 193       |
| XIV. Derivatives of Tröger's Base .....                           | 196       |
| XV. Miscellaneous substances of uncertain constitution .....      | 201       |
| XVI. M.P. Identification List .....                               | 225       |
| XVII. SR7/Nos. for Div. 8 N.D.R.C. of O.S.R.D. Interim .....      | 236       |
| Reps. (R.R.C. 1 to 21)                                            |           |
| XVIII. SR7/Nos. for Canadian Explosives Research .....            | 238       |
| Extramural Summaries                                              |           |
| XIX. SR7/Nos. for U.S.A. and Canada RDX Committee .....           | 240       |
| Meeting Reports                                                   |           |
| XX. Index .....                                                   | 241       |

Para. 1

INTRODUCTION

It is hoped that this collection of data will serve as a guide to workers in RDX chemistry who are, not unreasonably, baffled by the strange assortment of initials by which many of the polymethyleneamine ( $-\text{CH}_2-\text{NH}-$ )<sub>x</sub> derivatives have come to be designated.

The collection is based on those British and Transatlantic reports which have been available and on conversations with members of the staffs of the A.R.D. and of various "out-stations".

Some related compounds, prepared long ago in early academic work on hexamine, and related topics, are included.

The treatment for each compound is as follows:- The "Initial" designation is given, followed by the structural formula, "short systematic name"\*, m.p., solvent for recrystallisation, and references to methods of preparation. No direct consideration of the reactions of the compound is given, though most transformations are, automatically, included as preparative methods for other compounds, and from the paragraph index at the end of the work a list of the positive reactions of any given compound can be at once set down.

Wherever possible, reference to transatlantic work is made by

- (a) the laboratory concerned in the work;
- (b) The O.S.R.D. (U.S.A.) or C.E. or X.R. (Canada) number;
- (c) The date of writing the report\*\*;
- (d) The S.R.7/number of the report.

British work is similarly treated for reference:

- (a) the laboratory concerned in the work;
- (b) the Laboratory Report number;
- (c) the date of writing the report\*\*;
- (d) the A.C. number of the report.

Para. 2

For a more detailed review of the work up to October, 1943, the serial report on RDX research by Linstead, British Central Scientific Office, Washington, D.C., U.S.A., SR7/876 (to Oct. 1941); SR7/2600 (to Oct. 1942); M.O.S. London, A.C.5224 (to Oct. 1943) and the report by Haworth, Lamberton and Woodcock, Sheffield, A.C.5053, Oct. 1943, should be consulted.

There are several systems of nomenclature and numbering in use in this field. The system followed here is that treated in Bristol Br. Rep. 32, Nov. 1943, A.C.5403, in which the following typical compounds have the given systematic names and numbering, and convenient "short names". (p.3).

A very similar system is now in use in Canada.

\* See below, pp. 2 and 3.

\*\* The date on which the report was written is given as accurately as possible. Thus, for example, a progress report covering January, 1942, written during February, 1942, and received at the appropriate control office in March, 1942, would be quoted here as "Feb. '42." Some overlapping of work has resulted from the unavoidable delay in transmission of reports between Transatlantic and British workers, e.g. Toronto, X.R.16 Rep. 1 Sept. '44, SR7/44/3158 was received in Bristol on 27 Oct. '44.

C13248  
(11)

For convenience in discussion, the hexamine cage system is indicated by the short name "Hex."; similar short names used are "PT" for the pentamethylene tetramine cage.

"8-ring" for the cyclo-2:4:6:8-tetramethylene-1:3:5:7-tetramine ring.

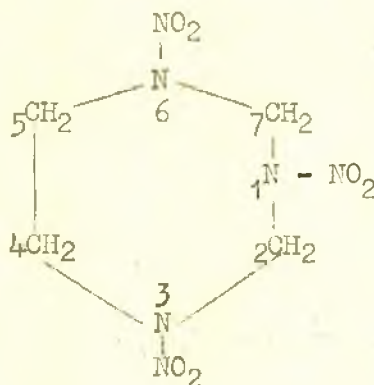
"6-ring" for the cyclo-2:4:6-trimethylene-1:3:5-triamine ring.

"7-chain" for the lin\*-2:4:6-trimethylene-1:3:5:7-tetramine chain.

"5-chain" for the lin-2:4-dimethylene-1:3:5-triamine chain.

"3-chain" for the lin-2-methylene-1:3-diamine chain.

For related compounds not containing the simple alternating system N-C-N-C-N- the "aza" system, similar to that in use in Canada, is used here. For example,



1:3:6-trinitro-cyclo-1:3:6-azaheptane.

Yields of RDX are calculated on the basis  $3\text{CH}_2\text{O} \longrightarrow 1 \text{ RDX}$  represents a yield of 100%.

#### Para. 4

'HNO<sub>3</sub>' means 98-100% HNO<sub>3</sub>. The actual percentage of HNO<sub>3</sub> is given for more dilute acid.

'CH<sub>2</sub>O' means paraformaldehyde.

'aq. CH<sub>2</sub>O' means 40% formalin.

'Me-' means CH<sub>3</sub>-

'Et' means C<sub>2</sub>H<sub>5</sub>-

'Ø'- means C<sub>6</sub>H<sub>5</sub>-

'Ac'- means CH<sub>3</sub>-CO-

"P" - means paragraph

Following the Harvard and University of Pennsylvania workers, 'AcONO<sub>2</sub>' is used for the equimolecular mixture of HNO<sub>3</sub> and Ac<sub>2</sub>O.

The general arrangement of the material is in order of increasing complexity of the parent structures.

A Table of Melting Points is given to assist in identification of compounds prepared in the laboratory.

\* The term "lin", which may be read "linear", is used to facilitate the recognition of the parent skeleton structures of the open chain compounds, just as the term "cyclo" is used for the ring compounds.

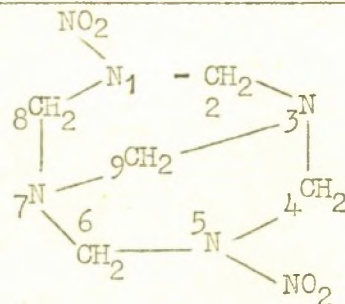
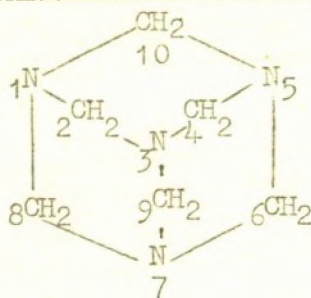
Para. 3

"Trivial  
name" or  
Initial  
Designation

Hexamine

D.P.T.

Formula



Systematic  
name

1:5-Endomethylene  
(10)-3:7-Endo-  
methylene(9)-cyclo-  
2:4:6:8-tetramethyl-  
ene-1:3:5:7-tetra-  
mine

1:5-Dinitro-3:7-endo-  
methylene(9)-cyclo-  
2:4:6:8-tetramethyl-  
ene-1:3:5:7-tetramine

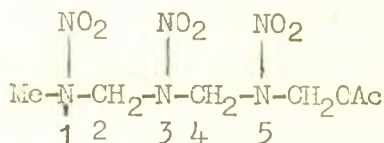
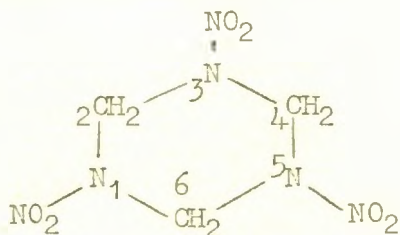
Short name

Hex.

1:5-Dinitro-(P.T.)

RDx

M. S. X.



1:3:5-Trinitrocyclo-  
2:4:6-trimethylene-  
1:3:5-triamine

1-Methyl-5-acetoxymethyl-  
1:3:5-trinitrolin- 2:4-dimeth-  
ylene-1:3:5-triamine

1:3:5-Trinitro-(6-ring)

1-Methyl-5-acetoxymethyl-  
1:3:5-trinitro-(5-chain)

Lists to facilitate "literature searching" are set out giving the British SR7/ reference numbers for the following Transatlantic serial reports:

- (a) The Division 8 N.D.R.C. of O.S.R.D. Interim Reports "Studies on RDX and Related Compounds." R.R.C. 1 to 22 from Jan. 1943 - Oct. 1944.
- (b) The Canadian Explosives Research Extramural Summaries from March 1942.
- (c) The Reports of the U.S.A. - Canada RDX Committee Meetings from 4th September 1942.

British work is reviewed up to Oct. 1944 and Transatlantic work up to Sept. 1944.

Para. 7

NITROXY DERIVATIVES OF FORMALDEHYDE

Para. 8

P<sub>1</sub>



Methylene dinitrate.

b.p. 48°/15 mm.

Moreschi, Atti.R.Accad.Lincei, 1919, 28, 227; Chem.Abs., 1919, 13, 3519.

Houben and Pfankuch, Ber., 1926, 59, 86.

Travagli, Gazzetta chim.ital., 1958, 68, 718; Chem.Abs., 1939, 33, 2486.

For early A.R.D. work, see R.D. Rep. RDX 15 (? 1939).

Hex. normal nitrolysis,

then extract reaction system

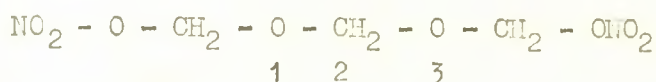


Separate by vac. distillation.

(Above structure accepted by A.R.D. and quoted in A.R.D. Exp. Rep. 591/44, June '44, A.C.6455).

Para. 9

P<sub>2</sub>



1:3-Bis (nitroxymethyl) lin-1:3-dioxo-2-methylene.

b.p. 89°/9 mm.

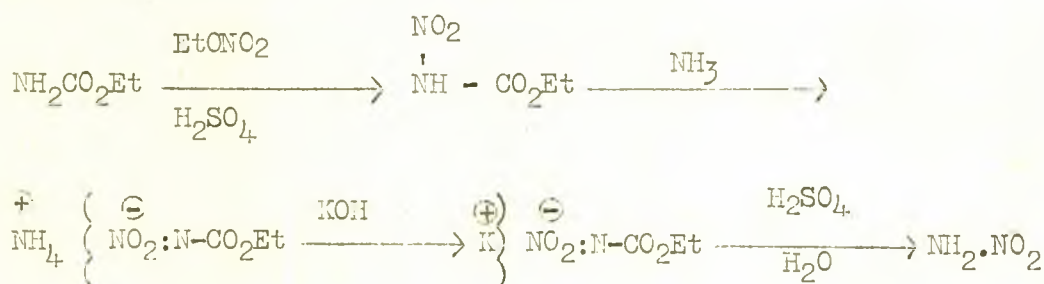
Refs. as for P<sub>1</sub>.

Prepared with P<sub>1</sub> and separated by vacuum distillation.

SOME SIMPLE MONONITRAMINESPara. 11Nitramine (Nitramide)

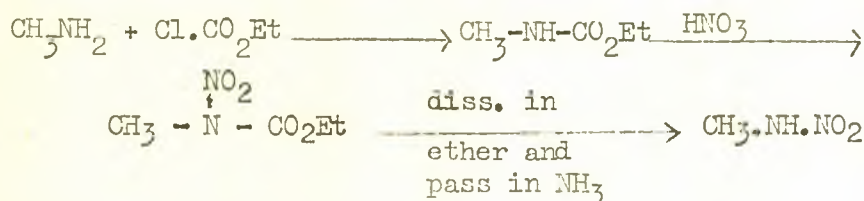
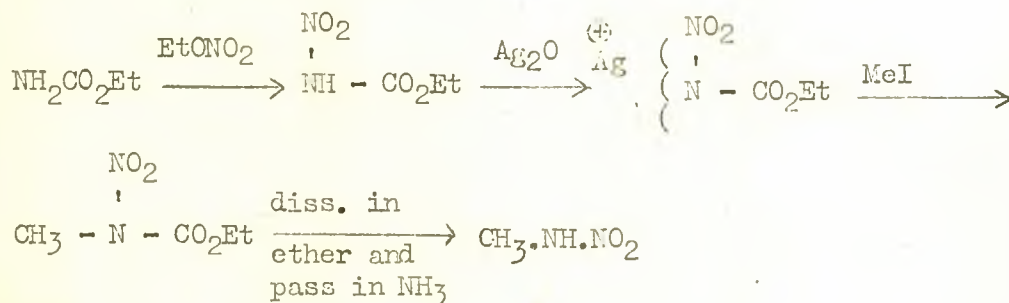
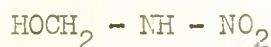
Ppt. from ether by light petroleum.

m.p. 72-75°.

Thiele and Lachmann, Annalen, 1895, 288, 267.Inorganic Syntheses. I. New York, 1939, p. 68.Para. 12Methylnitramine

From ether.

m.p. 38°.

Franchimont and Klobbie, Rec.Trav.Chim., 1888, 7, 355.Thiele and Lachmann, Annalen, 1895, 288, 291.-Para. 12aMethylolnitramine

not isolated.

Postulated as possible by-product in hexamine nitrolysis system;

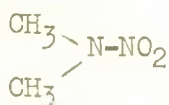
Bristol Res. Rep. 120, April '44; A.C.6302.

A.R.D. Exp. Rep. 591/44, May '44; A.C.6455.

Bristol Br. Rep. 43, Aug. '44; A.C.7119.

Para. 13

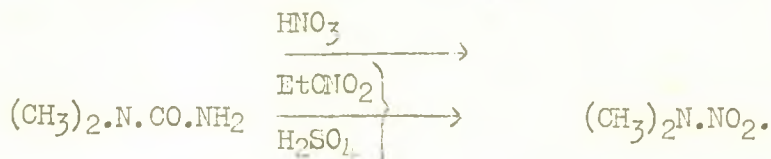
Dimethylnitramine



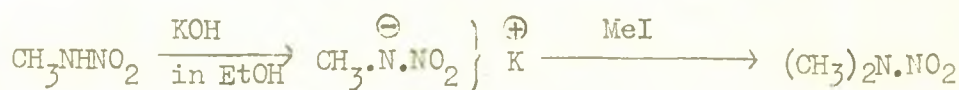
From ether.

m.p. 57°.

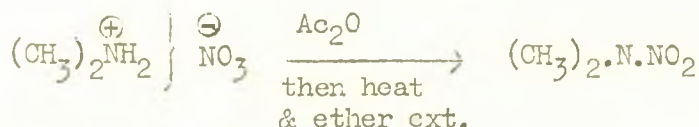
Franchimont, Rec. Trav. Chim., 1883, 2, 123.



Franchimont and Klobbie, Rec. Trav. Chim., 1888, 7, 355.

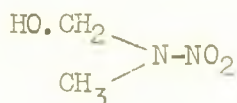


Bamberger and Kirpal, Ber., 1895, 28, 537.



Para. 14

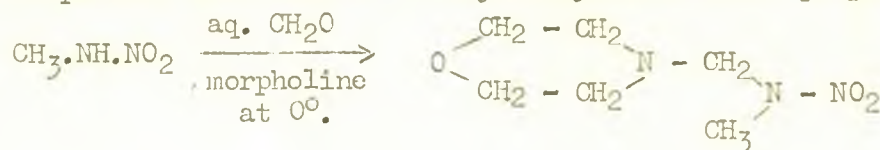
Methylmethylnitramine



Not isolated.

Sheffield Rep. 43. May '44, A.C.6406.

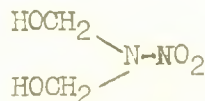
Morpholine derivative of methylmethylnitramine prepared:-



m.p. 84-86°.

Para. 15

Bis methylnitramine



Not isolated.

Toronto workers (X.R.16 Rep. 31, Jan. '44, SR7/44/984) consider the stabilisation of  $\text{NH}_2\text{NO}_2$  by excess aq.  $\text{CH}_2\text{O}$  to be due to the formation of bismethylnitramine.

Postulated as probable by-product in hexamine nitrolysis system:

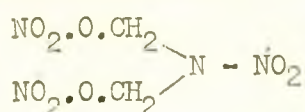
Bristol Res. Rep. 120, April '44; A.C.6302;

A.R.D. Expl. Rep. 591/44, May, '44; A.C.6455;

Bristol Br. Rep. 43, Aug. '44; A.C.7119.

Para. 15a

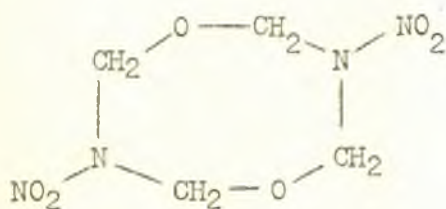
Bis(nitroxymethyl)nitramine



From ether.

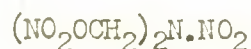
m.p. 59-60°.

Toronto, X.R.16 Prog. Rep., 1 Sept. '44, SR7/44/3158.



20 HNO<sub>3</sub>

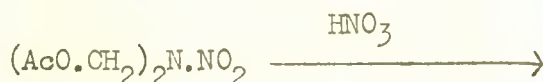
7 mins. at 0°  
drown in  
slurry (ice +  
water)



in 68% yield.

P.S.1.

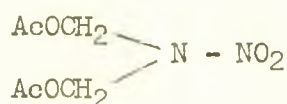
(see p. 203)



see p. 15b

Para. 15b

Bis(acetoxymethyl)nitramine

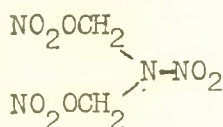


b.p. 153-156°/12 mm.

Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/3158.

Filtrate from Ross or Bachmann runs (see pp. 85, 86).

Evap. HOAc at 11 mm. Ether extract → oil. Wash with H<sub>2</sub>O (pH 8), ether extract, evap. and flash distil (12 mm., bath at 200-215°). Repeat washing and extraction, and distillation.



HOAc:NaOAc

reflux: 3 mins.

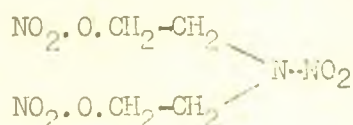
bis acetoxymethyl deriv.

(69%).

Hex. in HOAc  $\xrightarrow{4\text{HNO}_3}$  ppt. BSX (see p. 63)  
5 Ac<sub>2</sub>O at 15-20°, filtrate distilled at  
heat to 75°, 12 mm. → bisacetoxymethyl  
cool and neutralise with NaOH nitramine (39%).

Para. 16

DINA



Bis ( $\beta$ -Nitroxyethyl) nitramine.

From AcMe or EtOH.

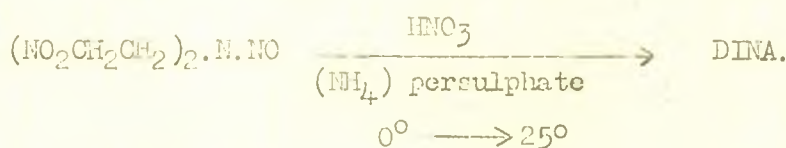
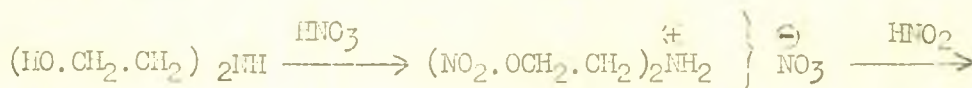
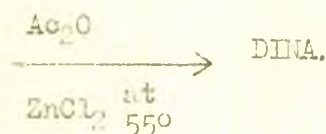
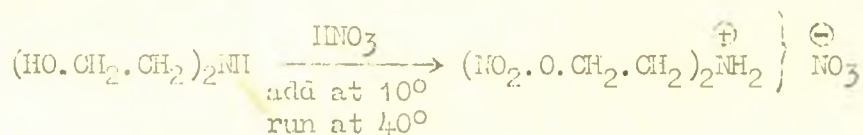
m.p. 51-52°.

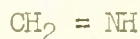
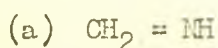
A review of the extensive and specialised literature devoted to DINA is outside the scope of this work: see Toronto X.R.19 Reports,

e.g. Toronto, X.R.19 Rep., June '43, SR7/4748.

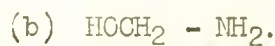
See also Cornell. Div.8.N.D.R.C. of O.S.R.D. Interim Rep. on Organic Development Problems. O.D.P.18. May '44, SR7/44/1872.

There are two standard preparations.



DERIVATIVES OF METHYLENEIMINEPara. 18

and

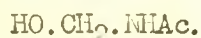


(a) Methylene imine

and

(b) Methyloamine.

Toronto workers, X.R.16 Rep., 31 Jan. '44; SR7/44/984, consider that "Henry's solution" (Henry, Bull.Acad.Roy.Belg., 1902, ii, 721) consisting of an equimolecular mixture of aq.  $\text{CH}_2\text{O}$  and .880 aq.  $\text{NH}_3$  "dried with  $\text{K}_2\text{CO}_3$ " probably contains  $\text{CH}_2 = \text{NH}$  and/or  $\text{HOCH}_2 - \text{NH}_2$  in equilibrium with cyclotrimethylene-triamine ("6-ring").

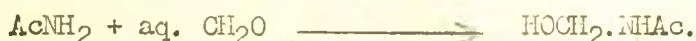
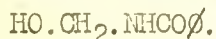
Para. 19N-Methylolacetamide

Evap. AcMe solution.

m.p.  $54^\circ$ .Einhorn and Ladisch, Annalen, 1905, 343, 265.

Michigan, Div.8 Int. Rep., R.R.C.3, Feb.-March '43; SR7/4179.

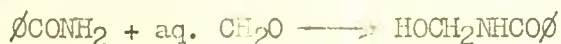
Bristol Br. Rep. 27, Oct. '43; A.C.5051.

Para. 20N-Methylolbenzamide

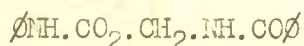
From aq. EtOH.

m.p.  $108-110^\circ$ .Einhorn, Bischkopf and Szelinski, Annalen, 1905, 373, 223.

Bristol Br. Rep. 27, Oct. '43, A.C.5051.

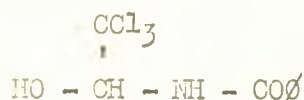
Characterised as N- $\phi$  urethane.

Bristol Br. Rep., 27 Oct. '43, A.C.5051.

m.p.  $177^\circ$ .

Para. 21

Chloral-benzamide



N( $\alpha$ -Hydroxy- $\beta$ : $\beta$ : $\beta$ -trichloroethyl)-benzamide.

From EtOH.

m.p. 150°.

Beilstein, 9, 209.

Jacobsen, Annalen, 157, 245.



Para. 22

Tris(benzamidomethyl)amine

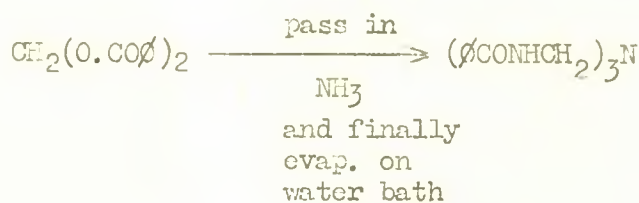


From EtOH.

m.p. 187°.

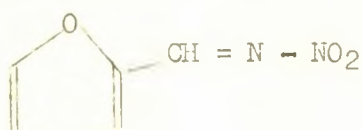
Beilstein, 9, 208.

Descudé, Ann.Chim., [7], 29, 542; Comptes rendus, 1902, 135, 694.



Para. 23

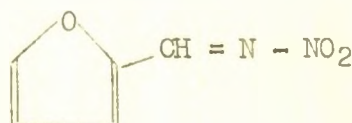
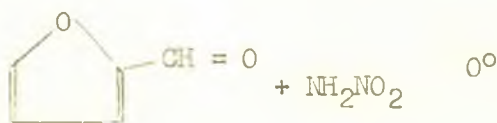
Furfurylidene nitramine



From  $\phi\text{H}$

m.p. 116°.

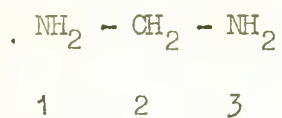
Toronto, X.R.16. Rep., 31 Jan. '44; SR7/44/984.



(does not trimerise).

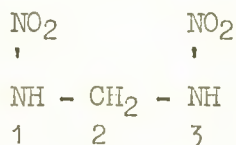
DERIVATIVES OF METHYLENE DIAMINE

lin-2-methylene-1:3-diamine



MEDA or "3 - Chain" Series.

Para. 25

MEDNA

1:3-Dinitro-(3-chain).

"Methylene dinitramine."

From ether and light petroleum.

m.p. 103°.

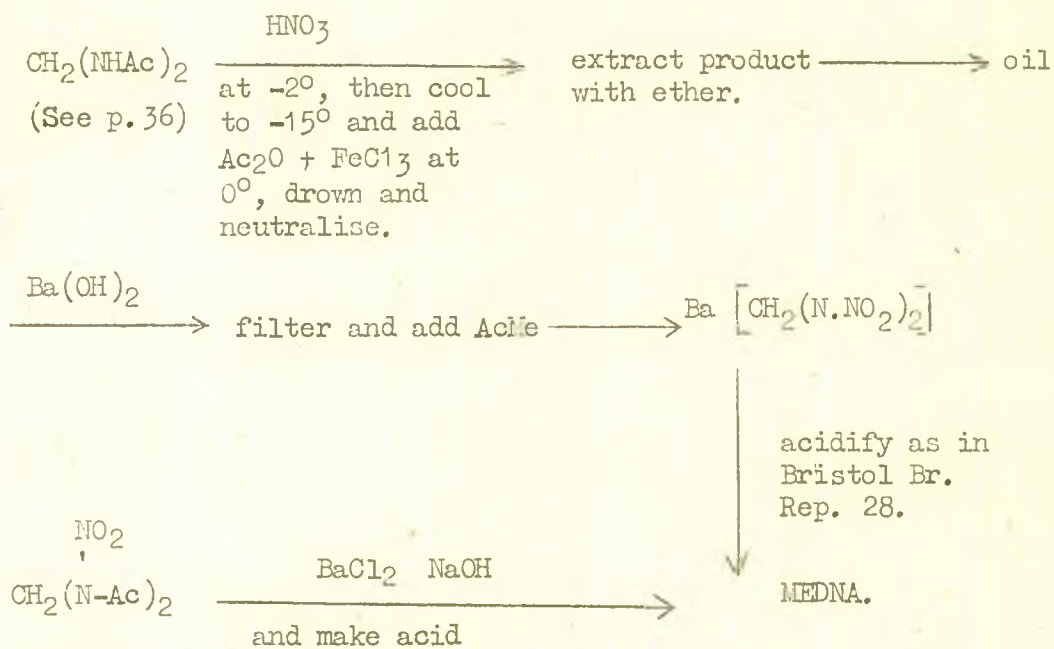
Bristol Br. Rep. 28, Oct. '43; A.C.5058.

|        |              |   |       |
|--------|--------------|---|-------|
| PCX    | NaOH aq      | → | MEDNA |
| (see   | then acidify |   |       |
| p. 95) | & extract    |   |       |
|        | with ether.  |   |       |

Para. 26

MEDNA (Continued)

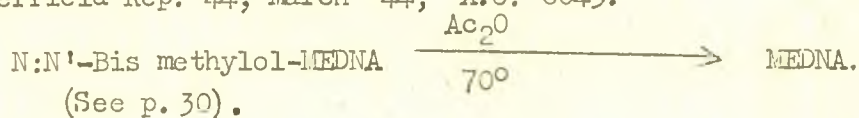
Sheffield Rep. 42, Fe. '44; A.C.5996.



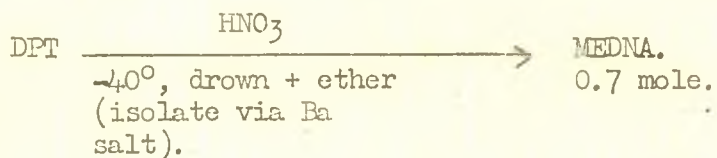
(private communication  
from Dr. Lamberton  
(Sheffield), June '44).

(See p. 29a).

Sheffield Rep. 44, March '44; A.C. 6045.



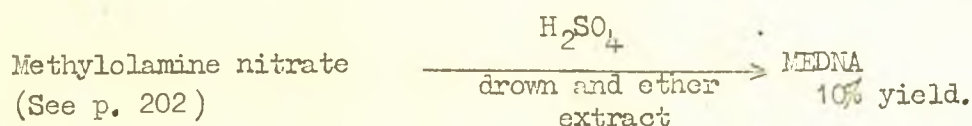
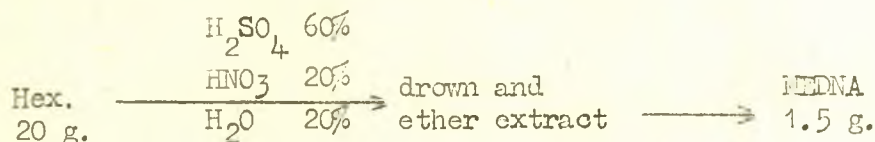
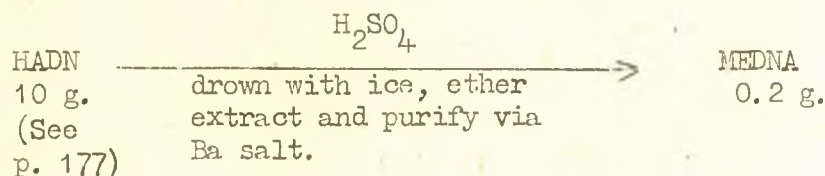
Bristol Res. Rep. 128, June '44; A.C. 6477.



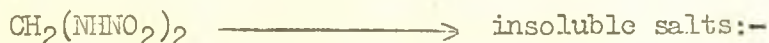
Para. 27

MEDNA (Continued)

Bristol Res. Rep. 131, June '44.



Bristol Br. Rep. 28, Oct. '43; A.C.5058.



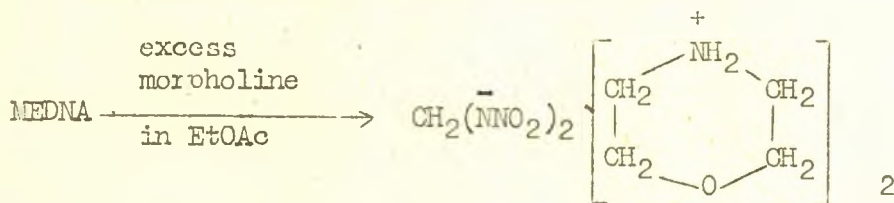
Ba<sup>++</sup>, (Ag)<sub>2</sub>, unstable in alkali.

Pb<sup>++</sup> salt, detonator props.

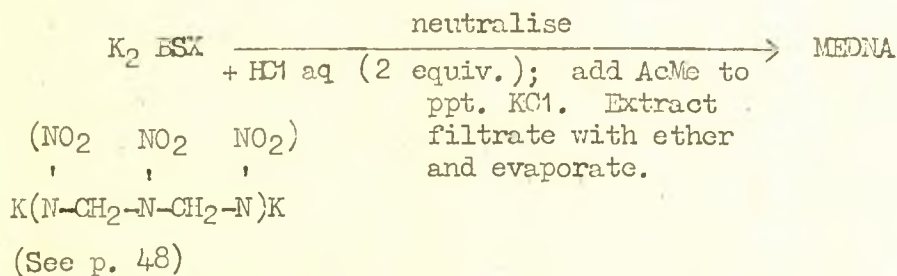
(NH<sub>4</sub><sup>+</sup>)<sub>2</sub> m.p. ca 125° rapid decomp.

Morpholine salt of MEDNA.

Sheffield Rep. 44, March '44, A.C.6045.



McGill, X.R.4 Prog.Rep., 1 July '44; SR7/44/2740.



Para. 28

MEDNA is chemically and physically different from the isomeric product from the Traube Reaction on AcMe. This latter product is



and is only known in the form of its salts and esters.

For the Traube Reaction see Toronto X.R.20 Reports, particularly XR.20 Rep. May '43; SR7/4550.

For the constitutions of MEDNA and the Traube products see

Bristol, Res.Rep.110, Dec. '43; A.C.5602.

Queen's University, Kingston, X.R.13 Reps., (recently reviewed in Canadian Exp.Res.Extramural Summary 15 March to 15 April, 1944, S.R.7/44/1747).

University of Pennsylvania, O.S.R.D., 3565, May '44, SR.7/44/2002.

Bristol views accepted by U.S.A., Canada RDX Committee at meeting April '44; SR7/44/1594.

Para. 29

Methylene Dinitramine Dimethyl Ether



M.E.D.N.A. Dimethyl Ether.

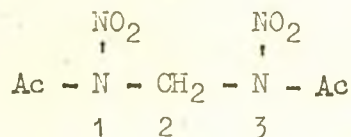
An oil.

Bristol Br. Rep. No. 28, Oct. '43; A.C.5058.



Para. 29a

N:N'-Diacetyl-MEDNA

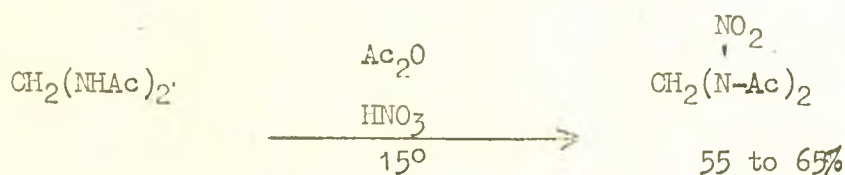


1:3-Diacetyl-1:3-dinitro-(3-chain).

From aq. MeOH.

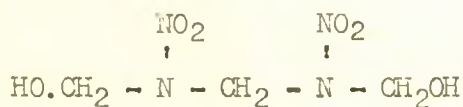
m.p. 63°.

Sheffield, June '44 (Private communication from Dr. A. Lamberton).



Para. 30

N:N'-Bismethylol MEDNA



1:3-Bismethylol-1:3-dinitro(3-chain).

From OH - AcMe.

m.p. 68 - 72°.

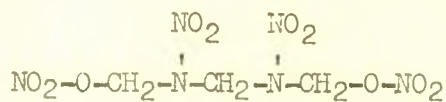
Sheffield Rep. 41, Feb. '44; A.C. 5995.

Sheffield Rep. 44, March '44; A.C. 6045.



Para. 31

COX

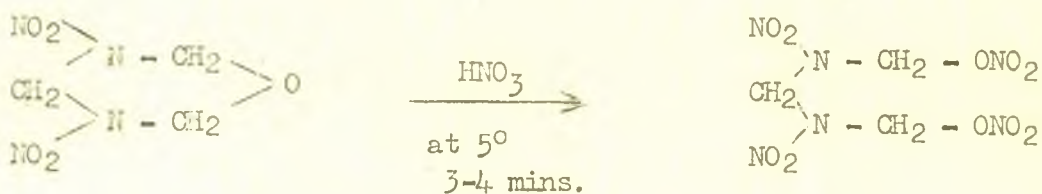


1:3-Bisnitroxymethyl-1:3-dinitro-(3-chain).

Ppt. from  $\text{HNO}_3$  by  $\text{H}_2\text{O}$ .

m.p. 98-101°.

A.R.D. Prep. RDX(B). Prog.Rep.9; Exp.Rep.239/43, July '43; A.C.4628.

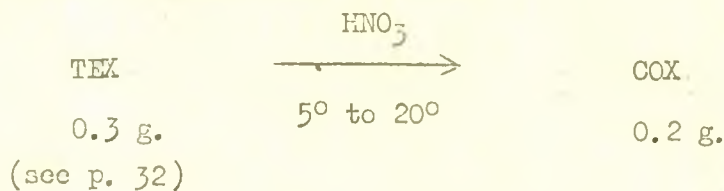


Cyclonite Oxide

COX

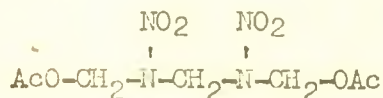
(see p. 118)

Sheffield, Rep. 44, March '44; A.C.6045.



Para. 32

TEX



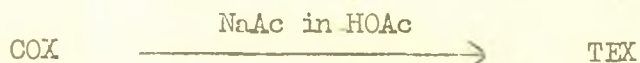
1:3-Bisacetoxymethyl-1:3-dinitro-(3-chain).

From reaction mixture.

m.p. 103-104°.

(Postulated by Davy, RDX committee at Toronto, Dec. '42).

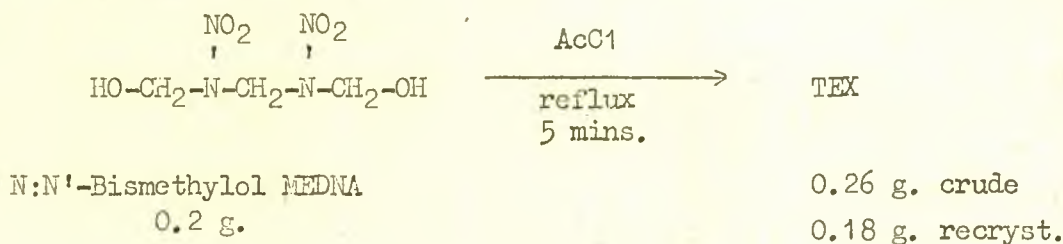
A.R.D. Prep. RDX(B) Prog. Rep. 9; Exp. Rep. 239/43, July '43; A.C.4628.



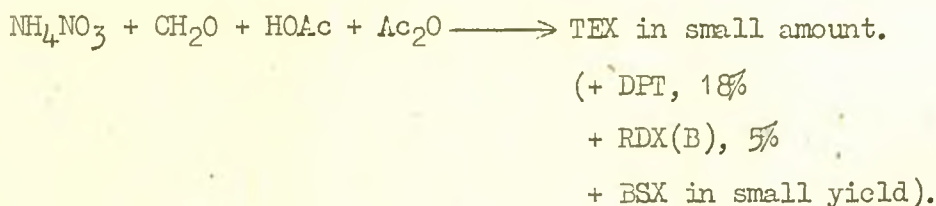
Para. 32 (Continued)

TEX (Continued)

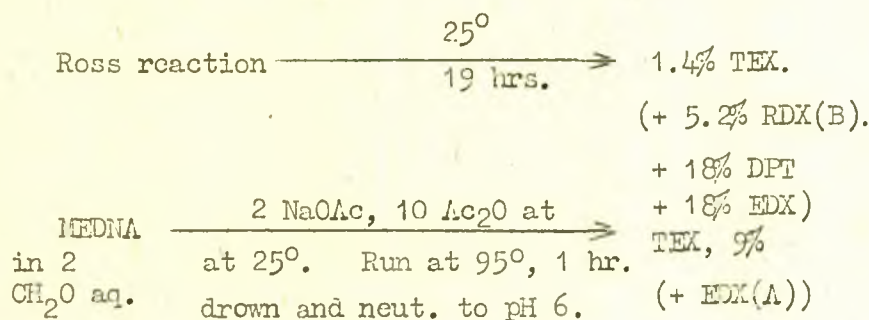
Sheffield Rep. 44, March '44; A.C.6045.



Toronto, X.R.16, Canadian Exp. Res. Extramural Summary, April, '44, S.R.7/44/1747.

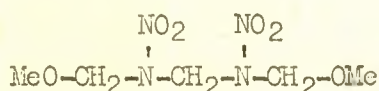


Toronto, X.R.16 Proj., RDX Committee (U.S.A. and Canada), 26 May '44;  
SR7/44/2801, See X.R.16 Rep. 1 Sept. '44; SR7/44/3158.



Para. 33

N:N'-Bismethoxymethyl-1:3-dinitro



1:3-Bismethoxymethyl-1:3-dinitro-(3-chain).

From MeOH.

m.p. 79-80°.

A.R.D. Prep. RDX(B) Prog. Rep. 9; Exp. Rep. 239/43, July '43, A.C.4628.

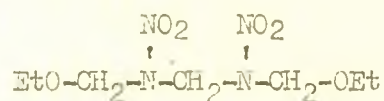


Sheffield Rep. 44, March '44, A.C.6045.

Repeat preparation with COX from MEDNA.

Para. 34

N:N'-Bisethoxymethyl-MEDNA



1:3-Bis(ethoxymethyl)-1:3-dinitro-(3-chain). "an oil".

A.R.D. Prep. RDX(B) Prog. Rep. 9; Exp. Rep. 239/43, July '43; A.C.4628.

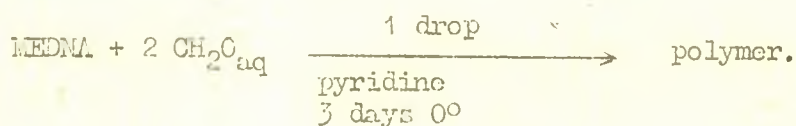


Para. 34a

(MEDNA - CH<sub>2</sub>O) polymer

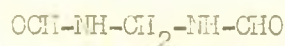
m.p. 219-230°.

Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/5158.



Para. 35

Methylene bisformamide

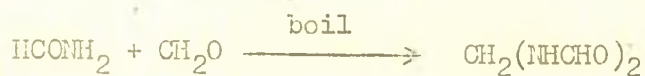


1:3-Diformyl-(3-chain).

From HCONH<sub>2</sub>.

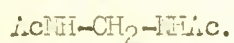
m.p. 142°.

Knudsen, Ber., 1914, 47, 2698.



Para. 36

H.7.



1:3-Diacetyl-(3-chain).

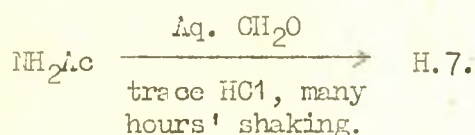
Methylene bisacetamide.

From EtOH.

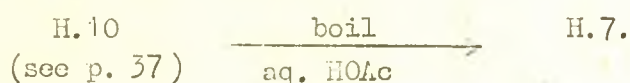
m.p. 197°.

Pulvermacher, Ber., 1892, 25, 310.

Beilstein's Handbuch, 2, 179.

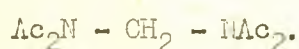


Harvard, N.D.R.C., Rep., Oct. '42; SR7/3263.



Para. 37

H.10.



1:1:3:3-tetracetyl-(3-chain).

N:N:N':N'-tetracetylmethylenediamine.

From acetone.

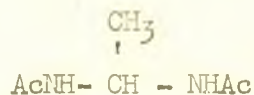
m.p. 218-220°.

Harvard, N.D.R.C. Rep., Oct. '42; SR7/3263.

Preparation. Oily layer from prepn. (2) of H.6 (sec p. 151), after separation of H.6 deposits crystals of H.10 ('comparatively high yield').

Para. 38

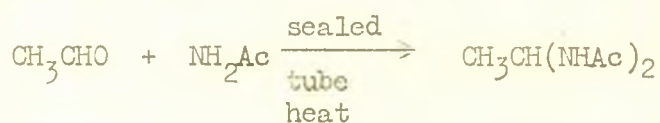
1:3-Diacetyl-2-methyl-(3-chain)



Ethylidene bisacetamide.

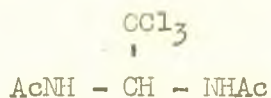
m.p. 169°.

Tawildarow, Ber., 1872, 5, 477.



Para. 39

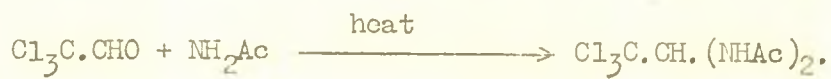
1:3-Diacetyl-2(trichloromethyl)-(3-chain)



From HOAc.

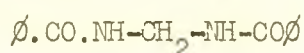
Sublimes.

Hepp, Ber., 1877, 10, 1651.



Para. 40

Methylene bisbenzamide



1:3-Dibenzoyl-(3-chain).

Cryst. from EtOH.

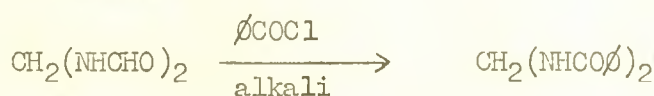
m.p. 224-226°.

Kraut and Schwartz, Annalen, 1884, 223, 47.

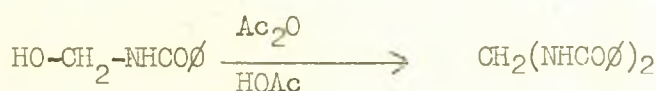
See Duden and Scharff, ibid., 1895, 288, 249.



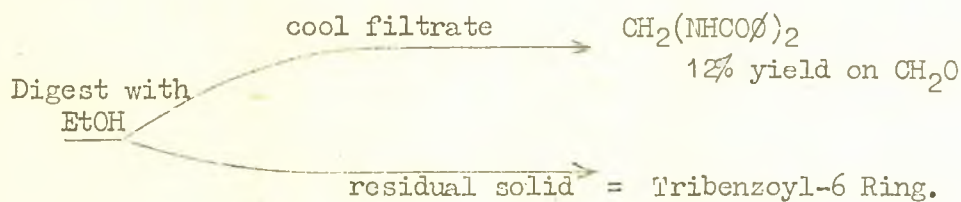
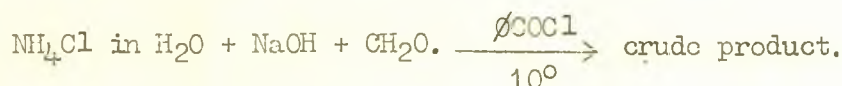
Knudsen, Ber., 1914, 47, 2698.



Bristol Res. Rep. 112, Jan. 1944, A.C.5603.



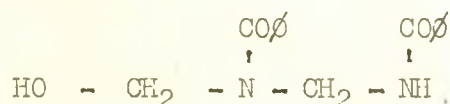
Toronto, X.R.16. Rep., 31 Jan. '44; SR7/44/984.



(See p. 109).

Para. 41

1-Methylol-1:3-dibenzoyl-(3-chain)



From EtOH.

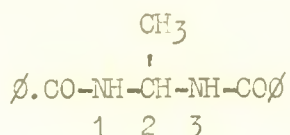
m.p. 182.5°.

Einhorn, Bischkopff and Szelinski, Annalen, 1905, 343, 225.



Para. 42

Ethylidene bisbenzamide



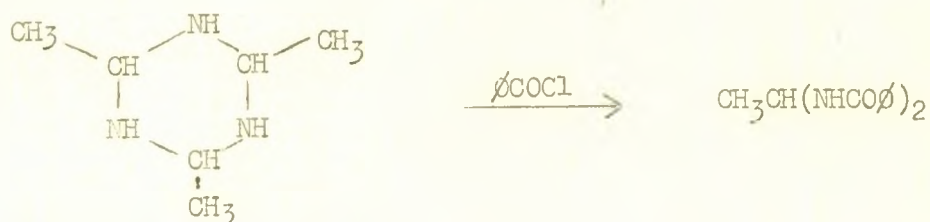
1:3-Dibenzoyl-2-methyl- (3-chain).

From EtOH.

m.p. 202-4°. (187 - 8°\*).

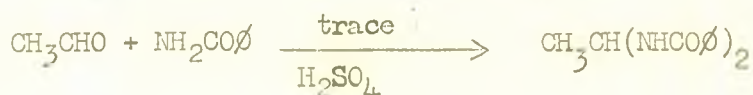
Limpricht, Annalen, 99, 119.

(Delepine, Comptes rendus, 1899, 128, 105).



dehydrated "aldehyde ammonia".  
(see p. 113)

Nencki, Ber., 1874, 7, 159.

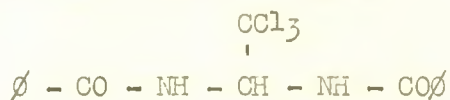


See Beilstein, 9, 209.

\* Henle and Schupp, Ber., 1905, 38, 1370 give this m.p.

Para. 43

1:3-Dibenzoyl-2-(trichloromethyl)-(3-chain)



Trichloroethylidene bisbenzamide.

From EtOH.

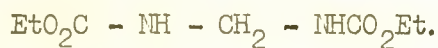
m.p. 257°.

Hepp and Spiess, Ber., 1876, 9, 1428.



Para. 44

Methylene Bisurethane

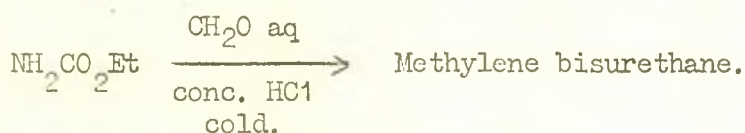


1:3-Dicarbethoxy-(3-chain).

From EtOH.

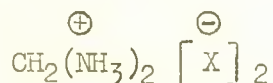
m.p. 131°.

Conrad and Hock, Ber., 1903, 36, 2206.

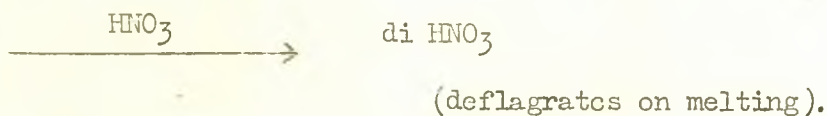
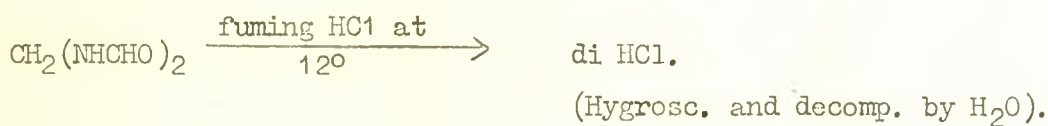


Para. 45

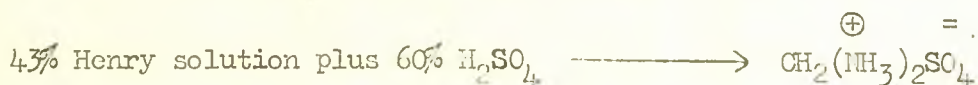
Methylenediamine salts

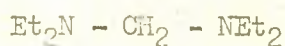


Knudsen, Ber., 1914, 47, 2698.



Sulphate also prepared by Toronto workers, X.R.16 Rep. Jan. '44, SR7/44/984.



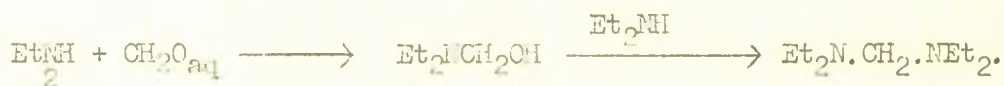


1:1:3:3-Tetraethyl-(3-chain).

b.p./760 mm., 166-169°.

Beilstein's Handbuch, 1, 106.

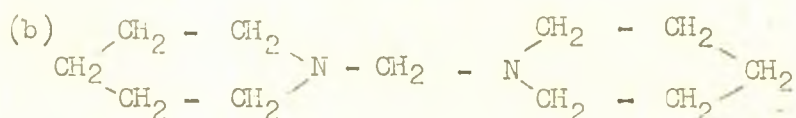
Chicago, N.D.R.C. Div.8 Int. Rep. R.R.C.17, April-May '44; SR7/44/2047.



Analogous compounds:-

(a)  $\text{Me}_2\text{N}-\text{CH}_2-\text{NMe}_2$ , Tetramethyl-(3-chain), b.p./760 mm., 85°.

Similarly prepared, Beilsteins Handbuch, 1, 54.

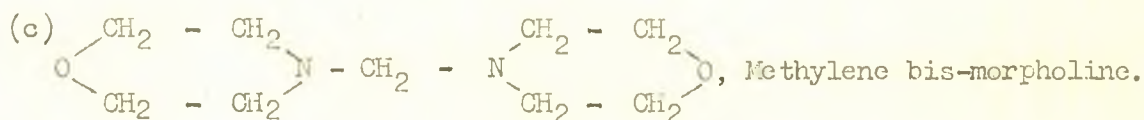


Methylene bis piperidine, b.p./760°, 230°.

b.p./15°, 115°.

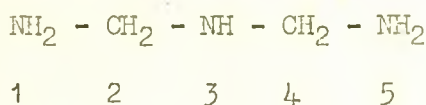
2-piperidine + 1 aq  $\text{CH}_2\text{O}$   $\longrightarrow$  compd.

Beilsteins Handbuch, 20, 36.



Sheffield, preliminary communication to RDX Research Panel Meeting,  
London, 21 June '44.

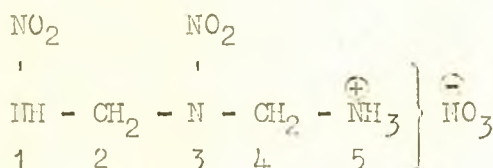
DERIVATIVES OF lin-2:4-DIETHYLENE-1:3:5-TRIAMINE



"5-Chain" Series.

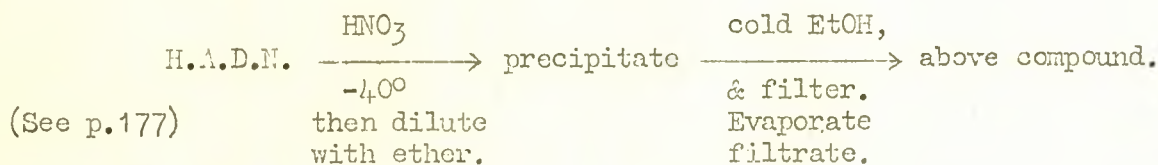
Para. 47

1:3-Dinitro-(5-chain) - 5-nitrate



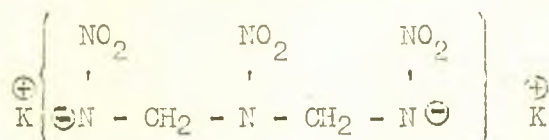
From EtOH, m.p. 129°.

Bristol Br. Report No. 28, Oct. '43; A.C.5058.

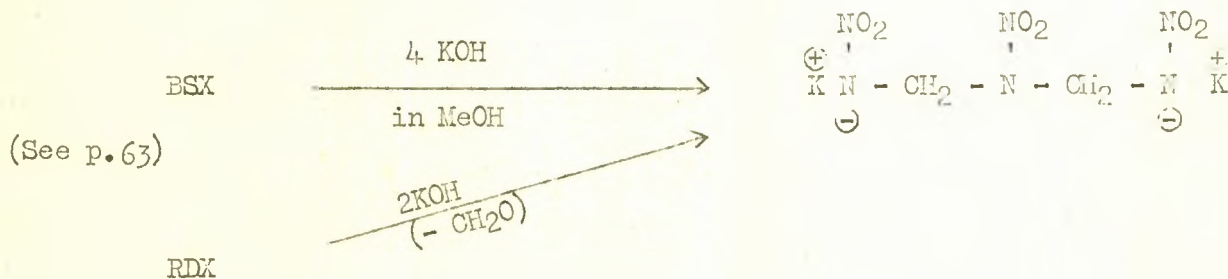


Para. 48

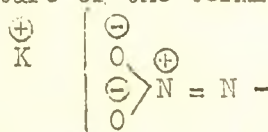
1:5-Dipotassio-1:3:5-trinitro-(5-chain) (K<sub>2</sub>B SX)



McGill, X.R.4, Prog.Rep., 1 Mar. '44, SR7/44/1001.

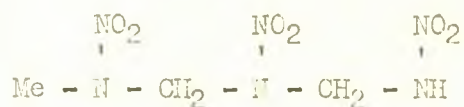


The structure of the terminal grouping is probably



Para. 49

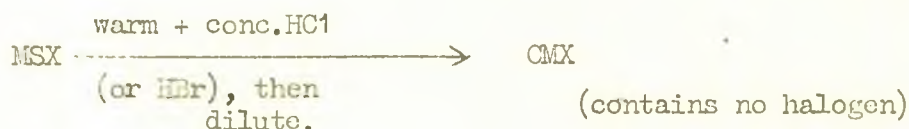
C.M.X.



1-Methyl-1:3:5-trinitro-(5-chain).

From C<sub>6</sub>H<sub>6</sub>-light petroleum. m.p. 130-131°

McGill, X.R.4.Prog.Rep., 1 Feb. '43; SR7/4036.

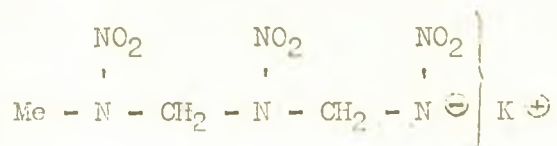


McGill, X.R.4.Prog.Rep., 1 Mar. '44; SR7/44/1001.

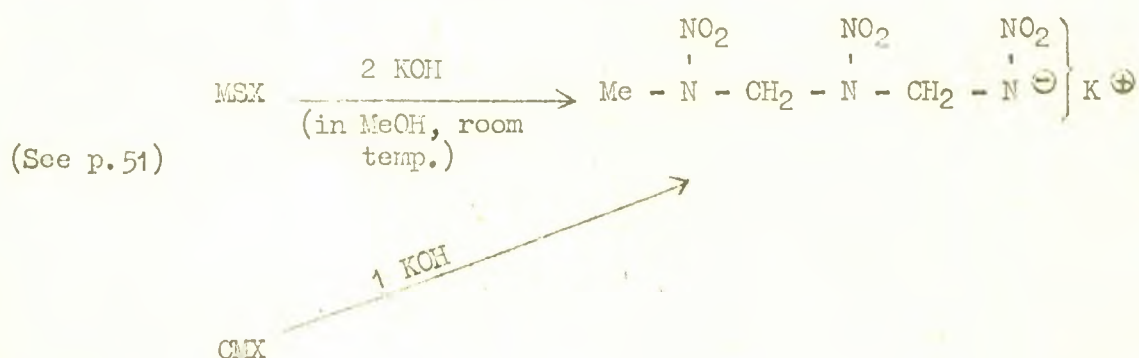
C, H, and N analysis and structure suggested.

Para. 50

1-Methyl-5-potassio-1:3:5-trinitro-(5-chain) (KCMX)



McGill, X.R.4.Prog.Rep., 1 Mar. '44; SR7/44/1001.



K in this and similar compounds is very unreactive, but will give silver derivative.

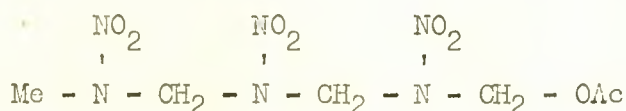
See also McGill, X.R.4 Prog.Rep., April '44; SR7/44/1308.

The  $\text{K}^\oplus \left\{ \begin{array}{c} \ominus \\ \text{NNO}_2 \\ | \\ \text{R} \end{array} \right.$  system probably has the structure  $\text{K}^\oplus \left\{ \begin{array}{c} \ominus \\ 0 \\ \ominus \\ 0 \end{array} \right\} \text{N}=\text{N}-\text{R}$

Para. 51

M.S.X. (McGill).

H.21 (Univ. Penn.)



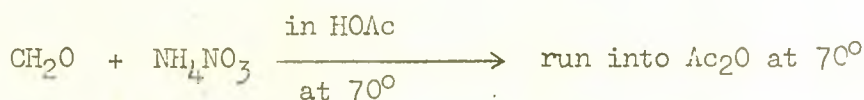
1-Methyl-5-acetoxymethyl-1:3:5-trinitro-(5-chain).

From  $\text{CHCl}_3$  - AcMe or MeOH.

m.p.  $155^\circ$ .

McGill. C.E.53 Prog.Reps., 1 Sept. '42: SR7/3042:

1 Nov. '42: SR7/3454.

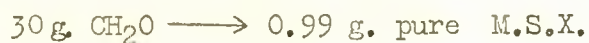


Separate by fract. cryst. (see Cornell,

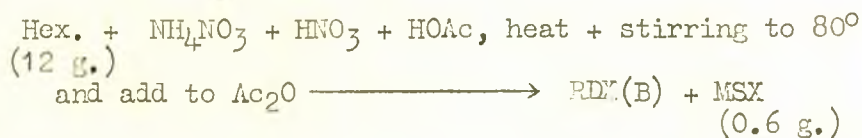
Div. 8. Int.Rep.R.R.C.3, Mar. '43; SR7/4179,

for working up).

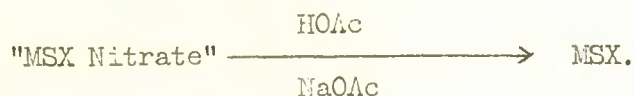
Checked by Penn. State, Div. 8 Int.Rep.R.R.C.5, May '43; SR7/4766



McGill X.R.4 Prog.Rep., 1 Feb. '43; SR7/4036.



McGill X.R.4 Prog.Reps., 1 Feb. '43 and Mar. '43; SR7/4036 and 4037.



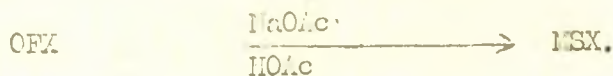
(See p. 54)

Both checked by A.R.D. Prep. RDX(B) Prog.Rep.9, Expl.Rep. 239/43, July '43;

A.C.4628.

MSX (Continued)

McGill X.R.4.Prog.Rep., 1 Mar. '43; SR7/4037.



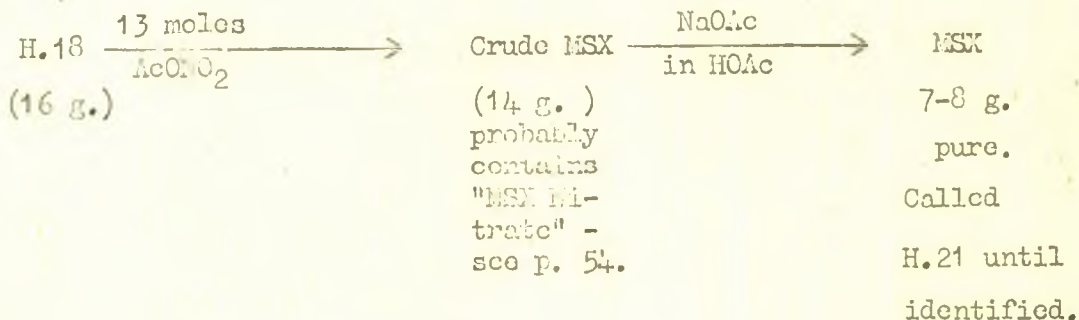
(See p. 57)

University Penn., Div. 8. Int. Rep., R.R.C.5, May '43; SR7/4766.

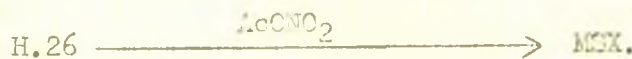


(Hex.methoni-  
trate; see  
p. 164)

Separated by fractional cryst.  
from  $\text{CH}_3\text{NO}_2$  + AcMe.  
(1 g. MSX from 18 g. H.18).



See also Univ.Penn., O.S.R.D., 1733 Rep., July '43; SR7/43/448.

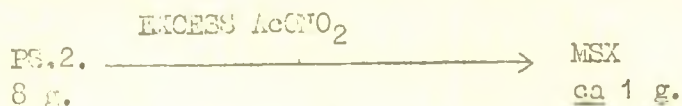


(Hex.nitrate,  
methonitrate,  
see p. 179)

McGill X.R.42 Rep. May and June '43; SR7/43/319.

Using  $\text{Me}_3\text{N} \cdot \text{HNO}_3$  for  $\text{NH}_4\text{NO}_3$  in the Bachmann Combination  
RDX(D) process, got a mixture of MSX and BSX, m.p.  $125^\circ$ , difficult  
to separate by crystallisation.

Univ.Penn., Div. 8, Int. Rep. R.R.C.9, Sept. '43; SR7/43/924.

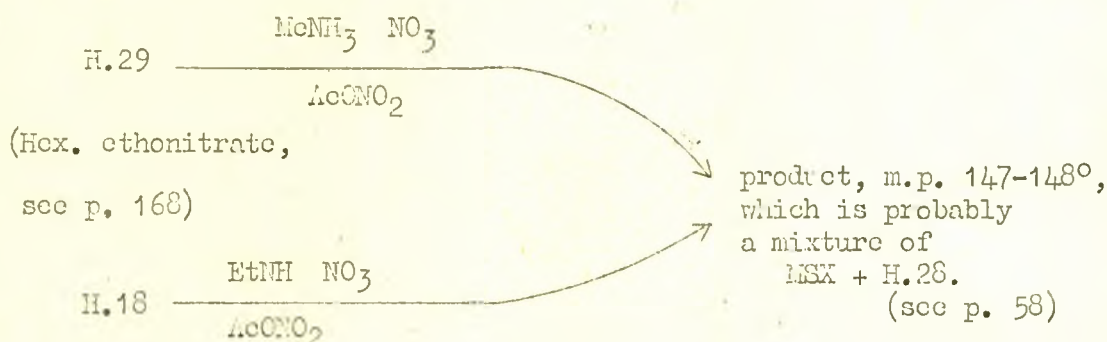


(Hexa methopicate,  
see p. 166).

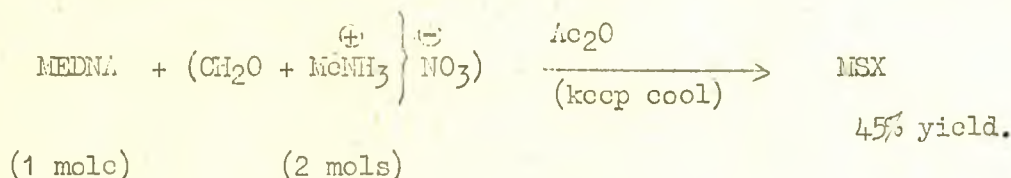
Para. 53

MSX (Continued)

Univ. Perm. Div. 8 Int.Rep. R.R.C.11, Nov. '43; SR7/44/70.

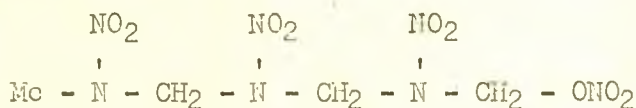


Bristol Res. Rep. 131. June '44; A.C.6657.



Para. 54

'M.S.X. nitrate'

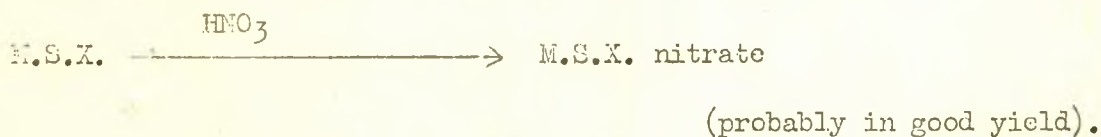


1-Methyl-5-nitroxymethyl-1:3:5-trinitro-(5-chain).

Washed with water, m.p. 136-139°.

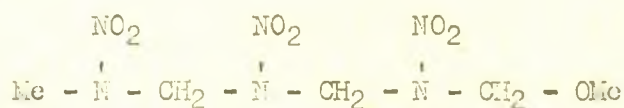
McGill, X.R.4 Prog.Reps., 1 Feb. and 1 March '43. SR7/4036 and 4037.

A.R.D., Prep.RDX(B) Prog.Rep.9, Exp.Rep.239/43, July '43, A.C.4628.



Para. 55

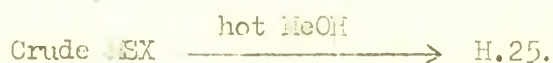
H.25. (MSX - Me).



1-Methyl-5-methoxymethyl-1:3:5-trinitro-(5-chain).

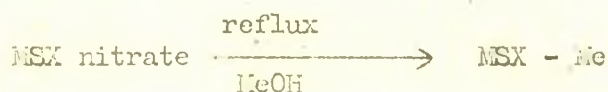
From MeOH. m.p. 102°.

Univ. Penn., Div. 8 Int.Rep. R.R.C.5. May '43. SR7/4766.



(from H.18 plus 13 mols AcONO<sub>2</sub>).

A.R.D., Prep. RDM(3) Prog.Rep.9, Exp.Rep. 239/43, July '43; A.C.4628.



m.p. 114-115°.

Found: C, 23.45; H, 4.94%

C<sub>5</sub>H<sub>12</sub>N<sub>6</sub>O<sub>7</sub> requires C, 22.4; H, 4.48; N, 31.3%.

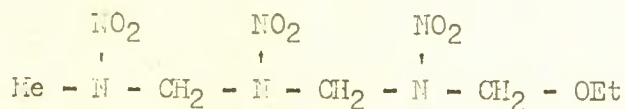
Univ.Penn., O.S.R.D. 1733 Rep., July '43; SR7/43/448;

States that the material m.p. 102° was impure.

Found: C, 22.9; 23.0; H, 4.56, 4.40; N, 31.0, 31.3%.

Para. 56

H.24 (MSX - Et)



1-Methyl-5-ethoxymethyl-1:3:5-trinitro-5(chain).

From EtOH, m.p. 109-110°.

Univ. Penn., Div. 8 Int.Rep., R.R.C.5, May '43; SR7/4766.

Crude MSX  $\xrightarrow{\text{Hot EtOH}}$  H.24.  
(from H.18 plus  
13 mols AcONO<sub>2</sub>)

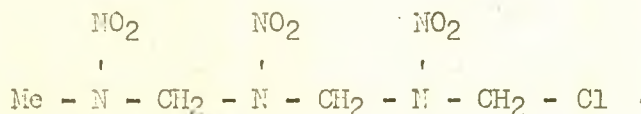
Univ. Penn, O.S.R.D. 1733 Rep., July '43; SR7/43/448.

Found: C, 25.1; H, 4.5; N, 29.8%.

C<sub>6</sub>H<sub>14</sub>N<sub>6</sub>O<sub>7</sub> requires C, 25.5; H, 5.0; N, 29.8%.

Para. 57

OFX

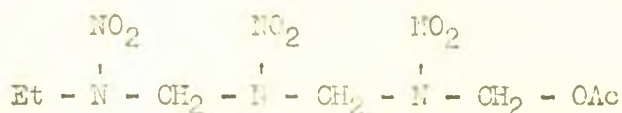


1-Methyl-5-chloromethyl-1:3:5-trinitro-(5-chain).

(from CHCl<sub>3</sub> + ligroin; m.p. 140.5-141.5°.

McGill X.R.4 Prog.Rep. 1 March '43; SR7/4037.

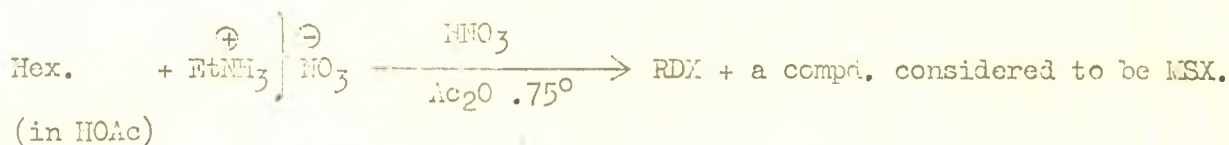
MSX  $\xrightarrow[\text{sealed tube at } 100^\circ \text{ 1 hr.}]{\text{CHCl}_3 \text{ sat. with HCl at } -60^\circ}$  OFX (0.4 g.)



1-Ethyl-5-acetoxymethyl-1:3:5-trinitro-(5-chain).

From MeOH or HOAc m.p. 133-134°.

Penn.State, Div.8. Int.Rep., R.R.C.8, Aug. '43; SR7/43/391.



(Bachman Combination RDX(B) process with EtNH<sub>3</sub> NO<sub>3</sub> for the NH<sub>4</sub>NO<sub>3</sub>).

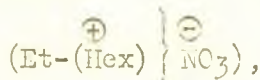
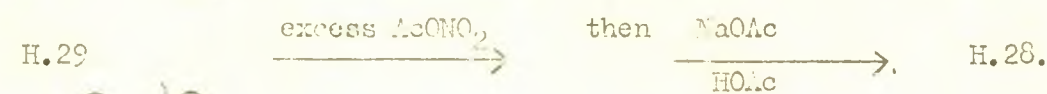
Univ.Penn., Div.8. Int.Rep. R.R.C.9, Sept. '43; SR7/43/924;

Div.8. Int.Rep. R.R.C.10, Oct. '43; SR7/43/925;

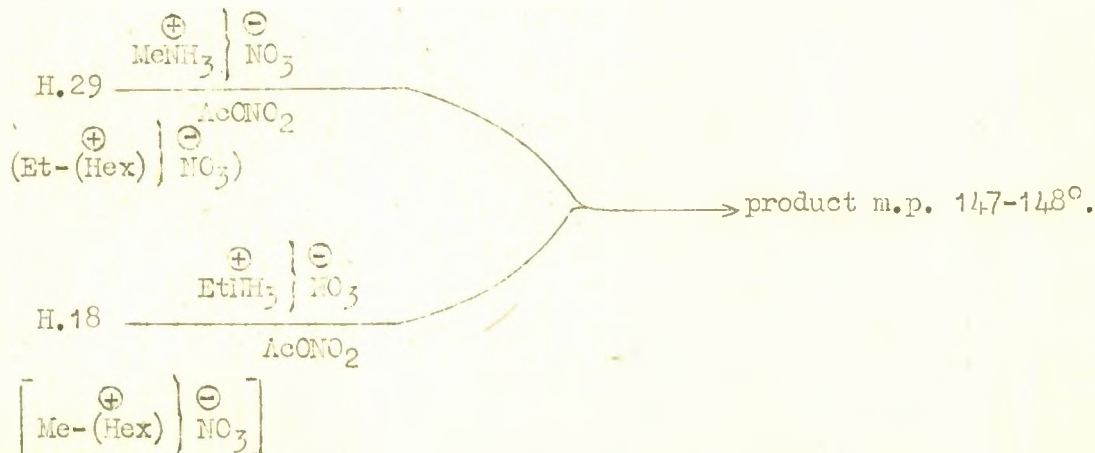
Div.8. Int.Rep. R.R.C.11, Nov. '43; SR7/44/70,

repeat above reaction and isolate (by separation via CHCl<sub>3</sub> and crystallisation from MeOH) the compound H.28 (1 g. from 25 g. hex.), which is very similar to MSX in many physical properties but is the EtN analogue of MSX.

Univ.Penn. in these three papers also report other preparations:



see p. 160)



Para. 59

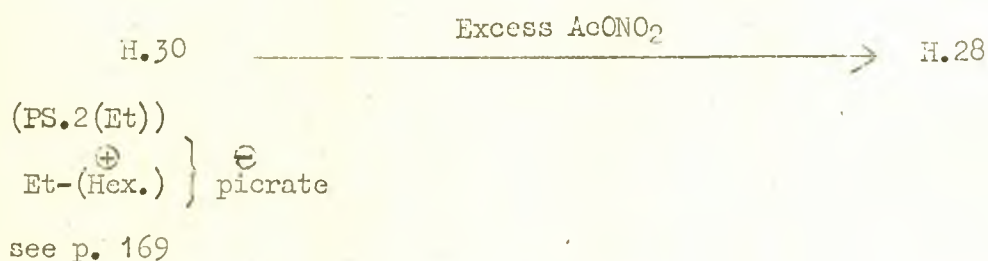
H.28 (Continued)

See also U.S.A.-Canada-RDX Committee Rep., April '44;

SR7/44/1594.

Mixed m.p. of authentic (MSX + H.28) is 148-152°.

∴ probably above product is MSX + H.28.



Crystallographic evidence:-

Cornell. Div.8 Int.Rep.R.R.C.8, Aug. '43; SR7/43/391.

H.28 and MSX identical.

Univ.Penn.Div.8 Int.Rep.R.R.C.11, Nov. '43; SR7/44/70.

H.28 and MSX not identical.

McGill X.R.4 Prog.Rep., 1 Jan. '44; SR7/44/334.

H.28 and MSX not identical.

C. H, and N analysis and m.p. trends reviewed in Univ.Penn.Div.8

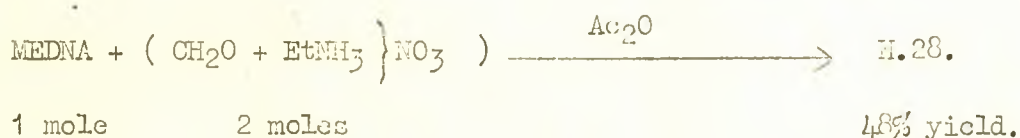
Int.Rep.R.R.C.11, Nov. '43; SR7/44/70, indicating that H.28 and derived compounds are Et-N derivatives.

Et-N identified by HI distillation.

(Univ.Penn.Div.8 Int.Rep.R.R.C.13, Jan. '44; SR7/44/915.

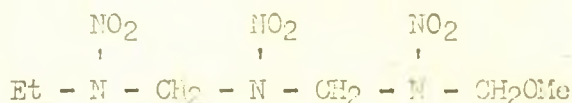
Div.8 Int.Rep.R.R.C.14, Feb. '44; SR7/44/952).

Bristol Res.Rep. 131, June '44; A.C.6657.



Para. 60

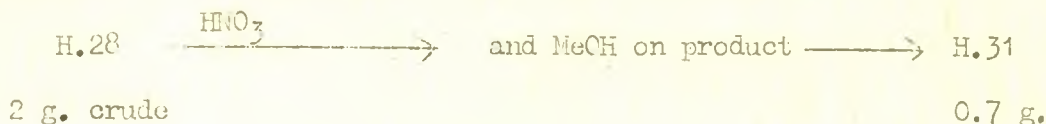
H.31



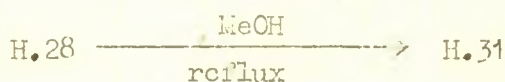
1-Ethyl-5-methoxymethyl-1:3:5-trinitro-(5-chain).

Cryst. from MeOH. m.p. 94.5-95.5°.

Univ. Penn. Div. 8 Int. Rep. R.R.C. 10; Oct. '43; SR7/43/925.

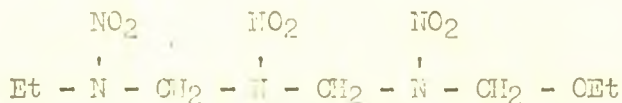


Univ. Penn. Div. 8 Int. Rep. R.R.C. 11, Nov. '43; SR7/44/70.



Para. 61

H.32

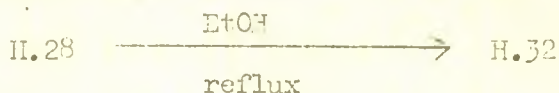


1-Ethyl-5-ethoxymethyl-1:3:5-trinitro-(5-chain).

From EtOH.

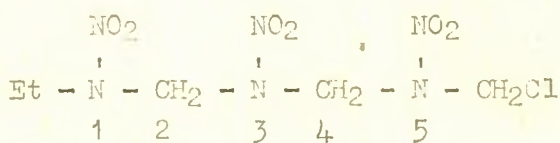
m.p. 87°.

Univ. Penn. Div. 8 Int. Rep. R.R.C. 11, Nov. '43; SR7/44/70.



Para. 62

H.33

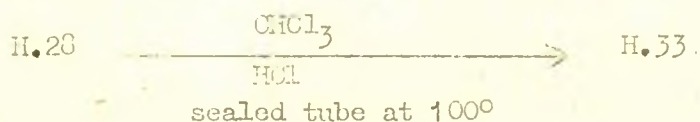


1-Ethyl-5-chloromethyl-1:3:5-trinitro-(5-chain).

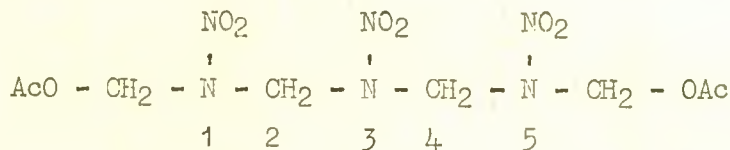
From CHCl<sub>3</sub> reaction liq. by dilution with

light petroleum, m.p. 116-117°.

Univ. Penn. Div. 8 Int. Rep. R.R.C. 11, Nov. '43; SR7/44/70.



BSX

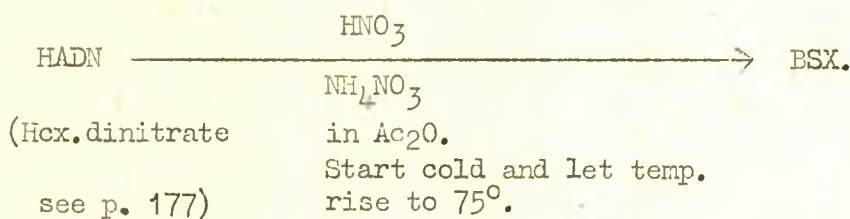


1:5-Bisacetoxymethyl-1:3:5-trinitro-(5-chain).

From AcMe or HOAc.

m.p. 155-156°

Michigan N.D.R.C.Prog.Rep., 18 Oct. '41; SR7/874.

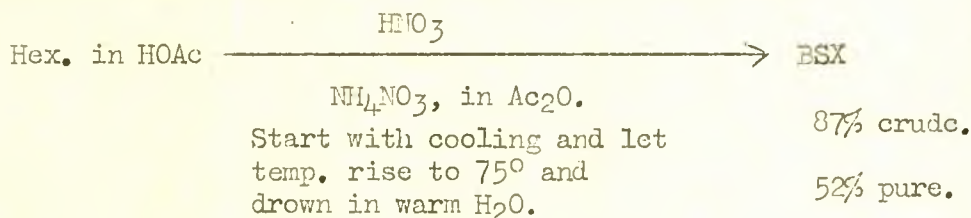


Toronto C.E.12 Prog.Rep., 1 March '42; SR7/1845,

isolated BSX as by-product in Bachmann Combination RDX(B) process.

(See pp. 86 and 88).

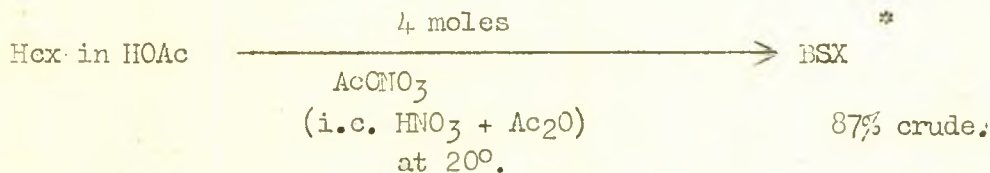
A.R.D. Prep.RDX(B) Prog.Rep.4; R.D.Expl.Rep.107/42, April '42.



Michigan, N.D.R.C. Prog.Rep.B.M.324, 15 Nov. '42; SR7/3339,

(a) found heating to 75° in A.R.D. prep. unnecessary;

(b) found NH<sub>4</sub>NO<sub>3</sub> unnecessary and use



(See Univ.Penn., O.S.R.D., 1733 Rep., July '43; SR7/43/448).

\* Toronto X.R.16 Rep., 1 Sept. '44; SR7/44/3158 show

yield of BSX = 51% and isolate 39% bisacetoxymethylnitramine from filtrate (see p. 15b).

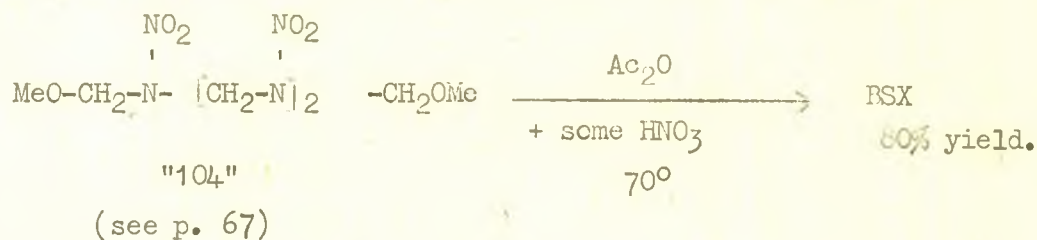
Para. 64

BSX (Continued)

Michigan, Div.8 Int.Rep., R.R.C.12, Dec. '43; SR7/44/508, use this process  
with heating to 75° and then cool, seed, and stand for 12 hrs.

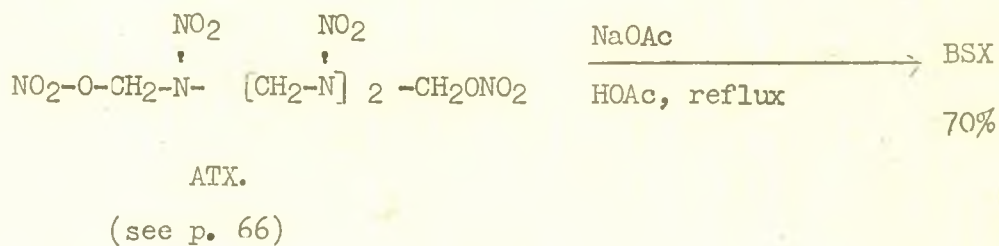
BSX separates direct. Yield 51% after recrystallisation.

Toronto, C.E.12 Reps., 28 Feb. '42; SR7/1700; 1 Nov. '42, SR7/3466.

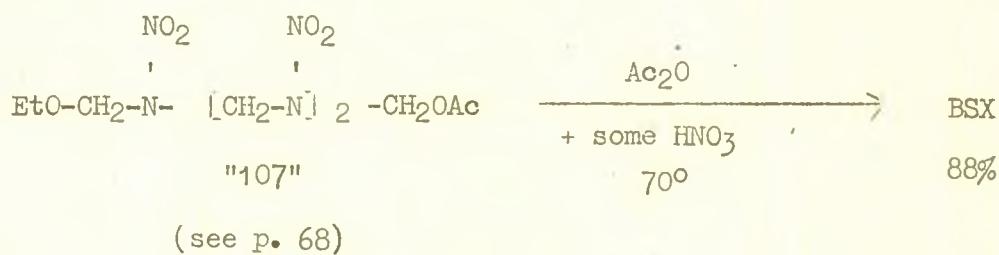


Toronto, C.E.12 Reps., 1 June '42; SR7/2350: 1 July '42, SR7/2558.

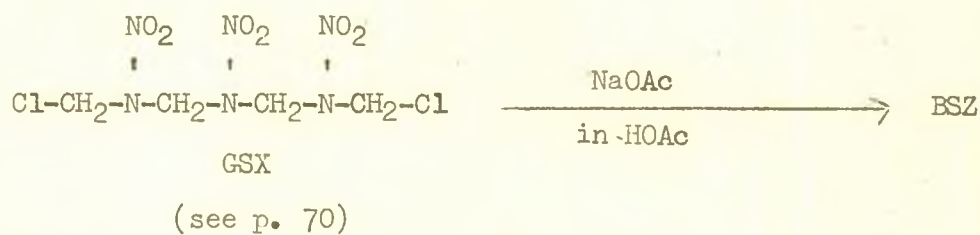
A.R.D. Prep.RDX(B) Prog.Rep.5, Expl.Rep., 254/42; Sept. '42.



Toronto, C.E.12 Rep., 1 Nov. '42; SR7/3466.



McGill, X.R.4 Prog.Rep., 1 March '43; SR7/4037.

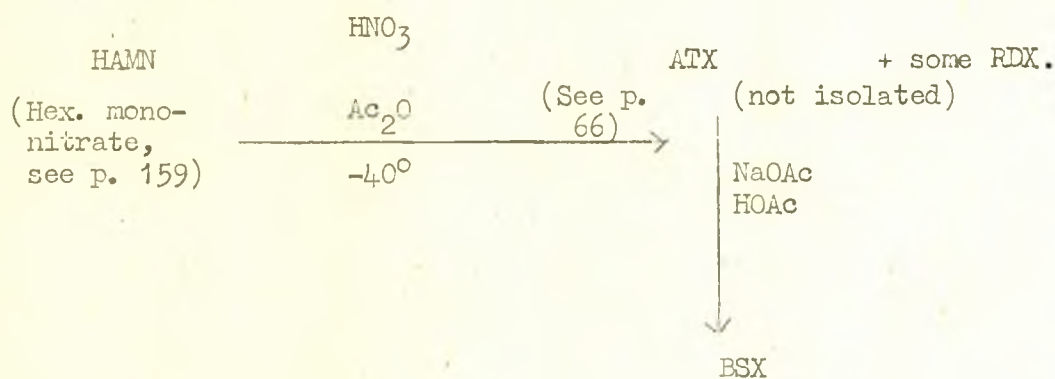


BSX (Continued)

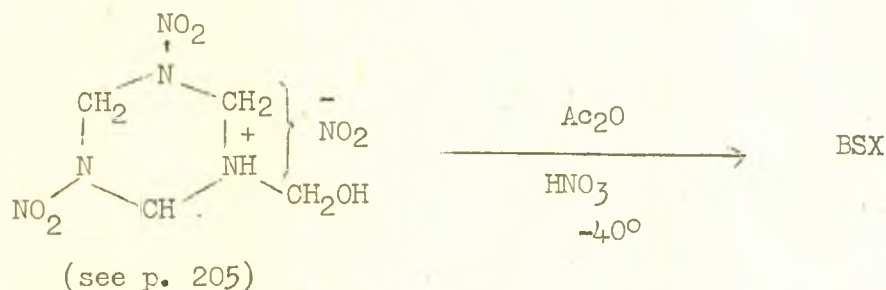
McGill, X.R.42 Prog.Rep., May and June '45; SR7/43/319.

Used  $\text{MeNH}_3 \text{NO}_3$  for  $\text{NH}_4\text{NO}_3$  in normal Bachmann Combination RDX(B) process (see p. 86) and got a mixture of BSX and ISX (see p. 52), m.p.  $125^\circ$ , and very difficult to separate by fractional crystallisation.

Bristol Br. Rep.26, Oct. '43; A.C.5049.



Dr. J. K. N. Jones (Bristol, private communication, June, '44).



Toronto, X.R.16, Canadian Exp.Res.Extramural Summary, March-April '44;  
 SR7/44/1747.

Ross Reaction<sup>II</sup> filtrates  $\longrightarrow$  2.1% BSX.  
 (see p. 85)

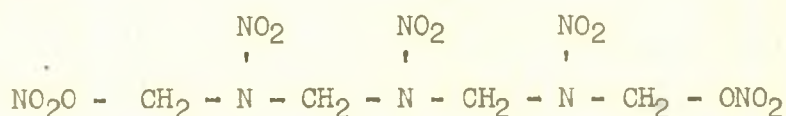
$\text{NH}_4\text{NO}_3 + \text{CH}_2\text{O} + \text{HOAc} + \text{Ac}_2\text{O} \longrightarrow$  BSX in small amt.  
 (+ 18% DPT  
 + 5% RDX(B)  
 + TEX, small amount).

(See X.R.16 Rep., 1 Sept. '44; SR7/44/3158).

Para. 66

A.T.X. (Toronto)

N.B.S.X. (A.R.D.)



1:5-Bisnitroxymethyl-1:3:5-trinitro-(5-chain).

Ppt. from dioxan by  $\text{CCl}_4$  or ppt. from AcMe by  $\text{H}_2\text{O}$ , and wash with cold EtOH,

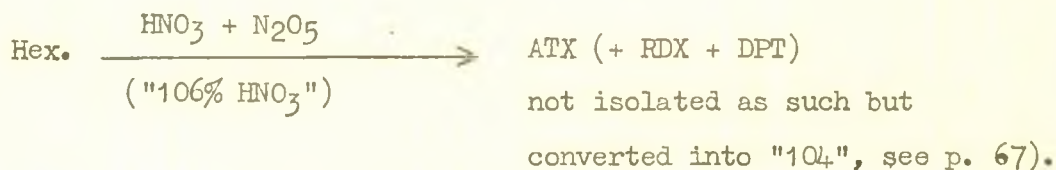
m.p.  $154^\circ$ .

(If crystallised from AcMe, ATX separates with solvent of

crystallisation:- 2ATX.AcMe,

m.p.  $103^\circ$ ).

Toronto, C.E.12 Prog.Reps., 28 Feb. '42; SR7/1700; 1 Nov. '42; SR7/3466.



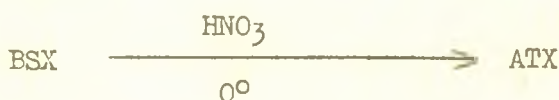
Toronto, C.E.12 Prog.Rep., 1 March '42; SR7/1845.



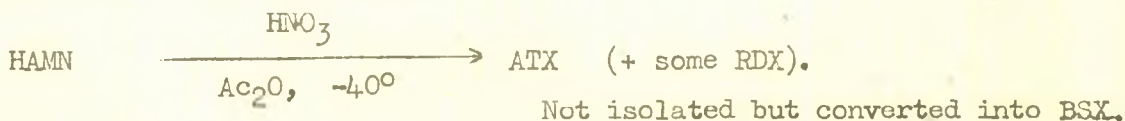
(See p. 68)

Toronto C.E.12 Prog.Reps. 1 June '42; SR7/2350; 1 July '42; SR7/2558;  
1 Nov. '42; SR7/3466.

A.R.D. Prep.RDX(B) Prog.Rep.5, Exp.Rep.284/42, Sept. '42.

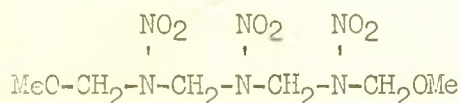


Bristol Br.Rep. 26, Oct. '43; AC.5049.



Para. 67

"104"



1:5-Bismethoxymethyl-1:3:5-trinitro-(5-chain).

From MeOH.

m.p. 104°.

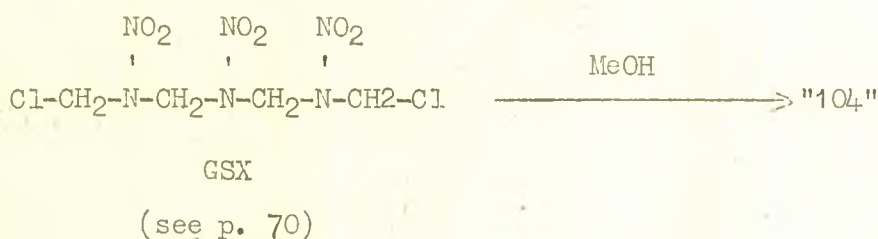
Toronto, C.E.12. Prog.Rep., 28 Feb. '42; SR7/1700.



Toronto, C.E.12. Prog.Rep., 1 Nov. '42; SR7/3466.

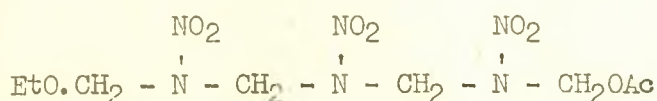


McGill X.R.4 Prog.Rep., 1 Dec. '43; SR7/44/181.



Para. 68

"107"

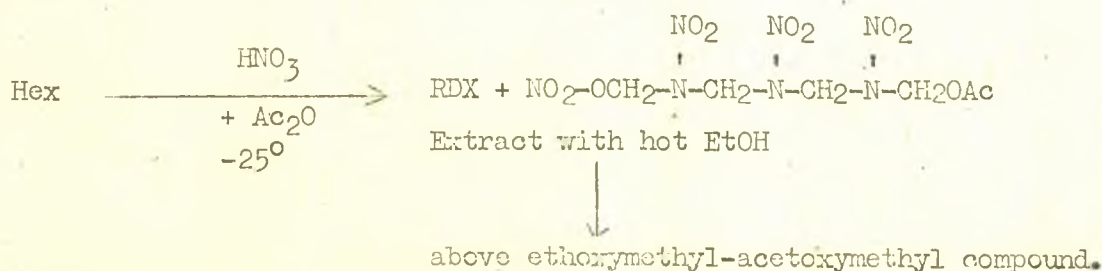


1-Ethoxymethyl-5-acetoxymethyl-1:3:5-trinitro-(5-chain).

From EtOH.

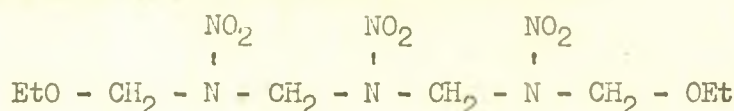
m.p. 107°.

Toronto, C.E.12 Rep., 1 March '42; SR7/1845.



Para. 69

1:5-Bis(ethoxymethyl)-1:3:5-trinitro-(5-chain)



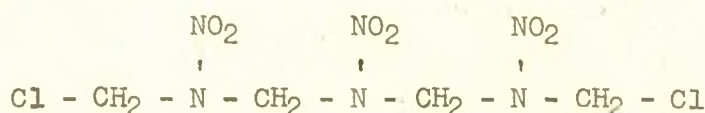
From EtOH, m.p. 80°.

Toronto, C.E.12. Prog.Rep., 1 Nov. '42; SR7/3466.



Para. 70

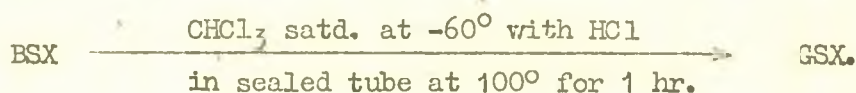
GSX



1:5-Bis(chloromethyl)-1:3:5-trinitro-(5-chain).

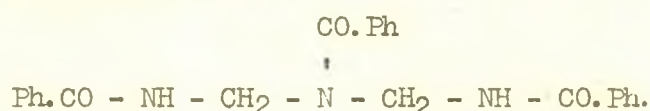
From CHCl<sub>3</sub>. m.p. 145.5 - 146.5°C.

McGill, X.R.4 Prog.Rep., 1 March 1943; SR7/4037.



Para. 71

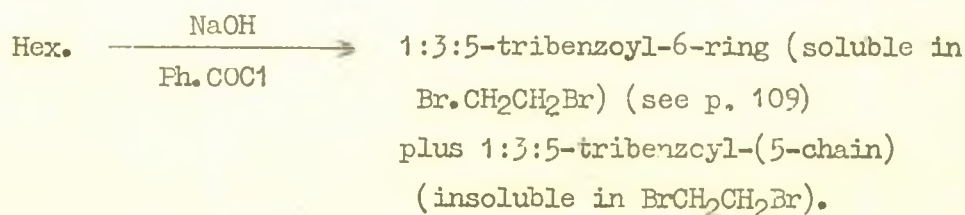
1:3:5-Tribenzoyl-(5-chain)

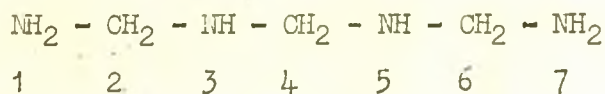


From EtOH, HOAc, or CHCl<sub>3</sub> with ether.

m.p. 266-267°.

Duden and Scharff, Annalen, 1895, 288, 250.

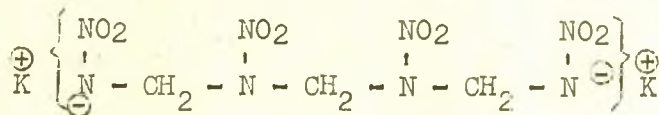


DERIVATIVES OF lin- 2:4:6-TRIMETHYLENE-1:3:5:7-TETRAMINE

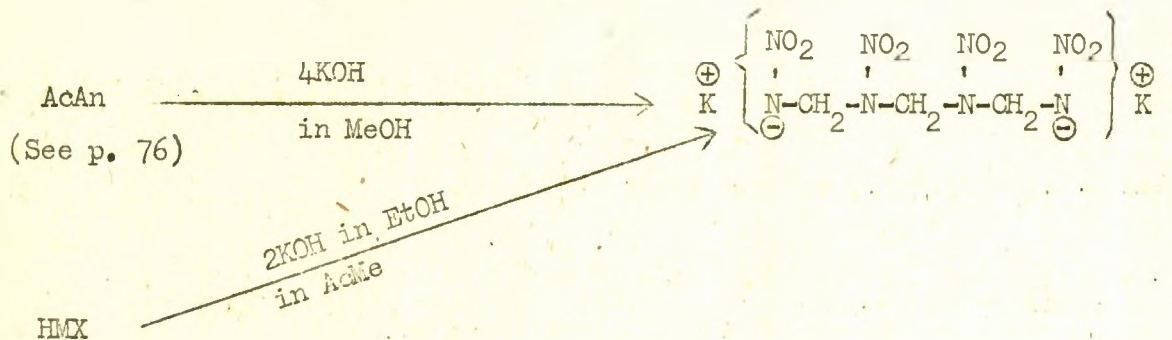
"7 - Chain" Series.

Para. 73

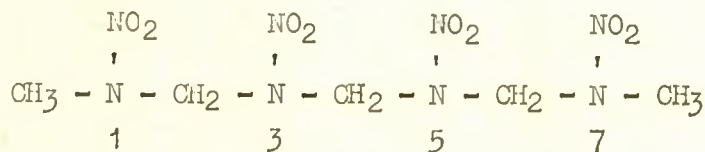
1:7-Dipotassio-1:3:5:7-tetranitro-(7-chain). (K<sub>2</sub>AcAn)



McGill, X.R.4 Prog.Rep., 1 March '44; SR7/44/1001.



(McGill, X.R.4 Prog.Rep.,  
1 April '44; SR7/44/1308).

Para. 74DMTN

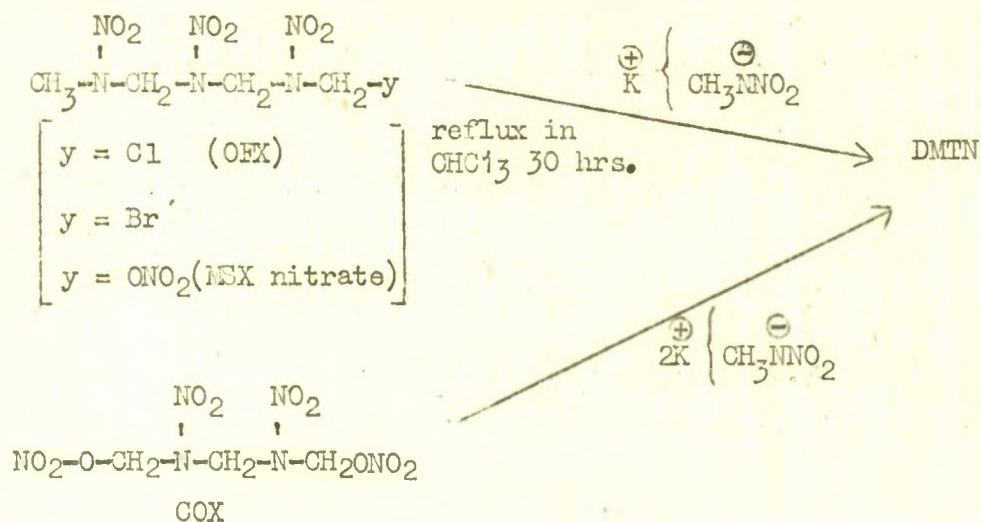
1:7-Dimethyl-1:3:5:7-tetranitro-(7-chain).

m.p. 244°.

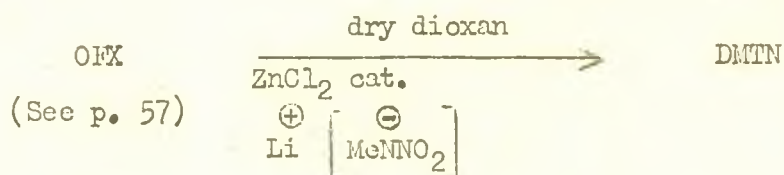
Para. 74 (Continued)

DMTN (Continued)

McGill, X.R.4 Prog.Rep., 1 Dec. '43; SR7/44/181.



Best prep. McGill, X.R.4 Prog.Rep., 1 Jan. '44; SR7/44/334.

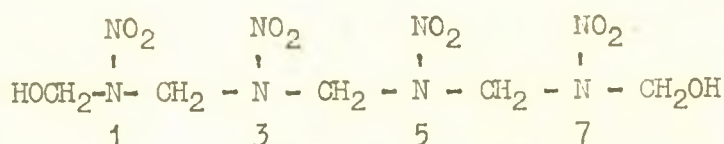


McGill, X.R.4 Prog.Rep., 1 March '44; SR7/44/1001.

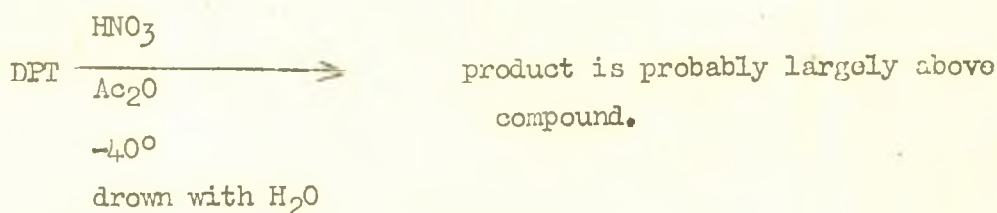
C, H, and N analysis.

Para. 75

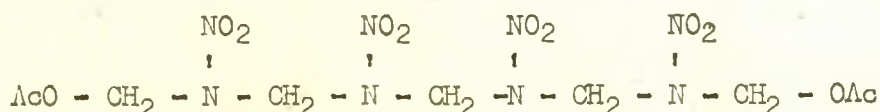
1:7-Bis(methylol)-1:3:5:7-Tetranitro-(7-chain).



Bristol Res. Rep. 128, June '44; A.C.6477.



AcAn



1:7-Bis(acetoxymethyl)-1:3:5:7-tetranitro-(7-chain).

From AcMe or  $\text{CH}_3\text{NO}_2$

m.p.  $187^\circ$ .

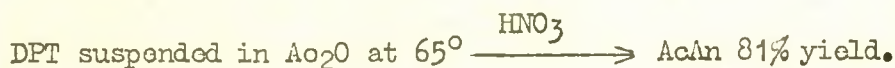
McGill, C.E.53 Prog.Rep., 1 Jan. '42, SR7/1436.

First prepared (impure)



Toronto C.E.12 Prog.Rep., 31 Jan. '42; SR7/1562.

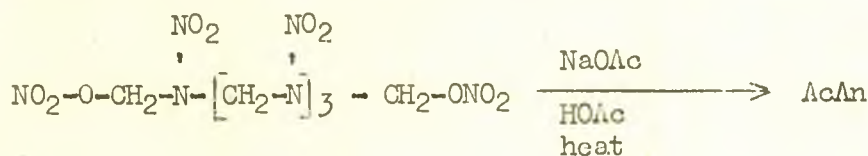
First prepared pure.



Toronto C.E.12 Prog.Rep., 28 Feb. '42; SR7/1700.

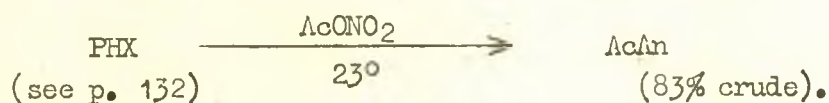
Above preparation runs better at  $44^\circ$ .

Toronto C.E.12 Prog.Rep., 1 June '42; SR7/2350.



"106"  
(see p. 78)

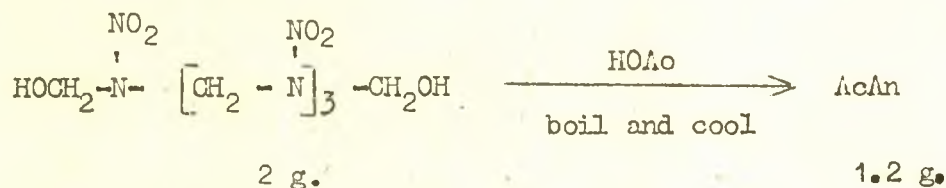
Michigan, Div.8 Int.Rep.R.R.C.1, Jan. '43; SR7/3748.



Checked by Cornell, Div. 8 Int. Rep. R.R.C.1, Jan. '43; SR7/3748.

Para. 77

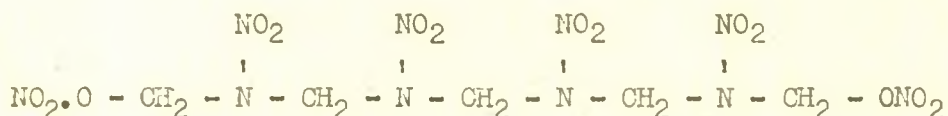
Bristol Res.Rep. 128, June '44; A.C.6477.



Cal.Tech., Div.8, Int.Rep. R.R.C.22, Oct. '44; SR7/44/3502

Chromatography of AcAn.

"106"



1:7-Bisnitroxymethyl-1:3:5:7-tetranitro-(7-chain).

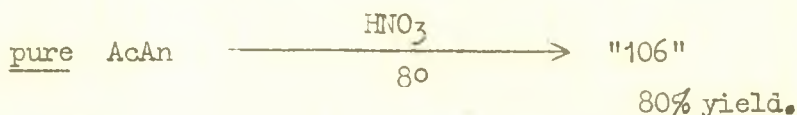
From  $\text{CH}_3\text{NO}_2$

m.p. 204.5-205°.  
(rapid heating).

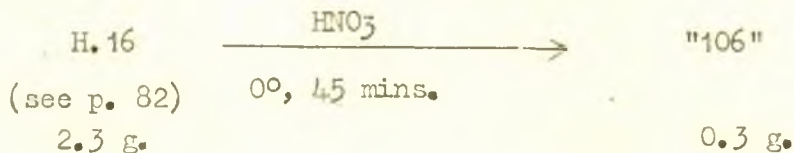
Toronto, C.E.12 Prog.Rep., 31 Jan. '42; SR7/1562.



Toronto, C.E.12 Prog.Reps., 31 Jan. '42; SR7/1562; 1 June '42; SR7/2350:  
1 July '42; SR7/2558.



Univ.Penn., Div.8 Int.Rep., R.R.C.1, Jan. '43; SR7/3748.



(See also Univ.Penn., O.S.R.D., 1733 Rep., July '43; SR7/43/448).

Toronto, X.R.16 Prog.Rep., 15 Jan. '43; SR7/3721.

Crude RDX from Hexamine nitrolysis contains a trace of "106" -  
identified as bisethoxymethyl derivative.

A.R.D. Exp.Rep. 505/44 Jan. '44; A.C.5605,

had indications of "106" in hexamine nitrolysis system  
(by  $\text{CH}_2\text{O}$  and  $\text{HNO}_3$  analysis).

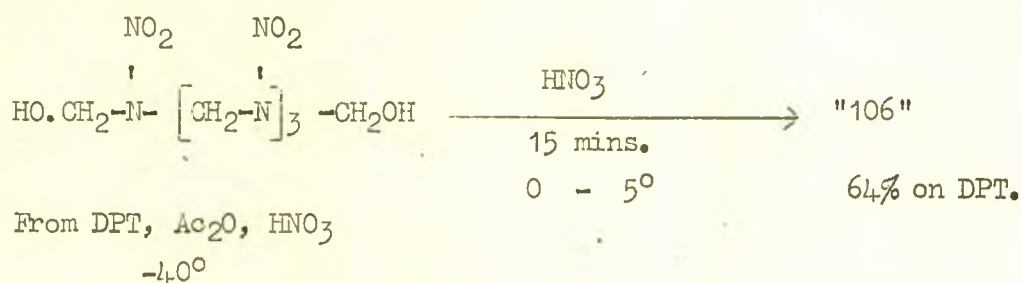
A.R.D. Exp.Rep. 591/44, May '44; A.C.6455

confirmed this by isolation of bis-methoxymethyl- and  
bis-ethoxymethyl- derivatives. (See pp. 80 and 81).

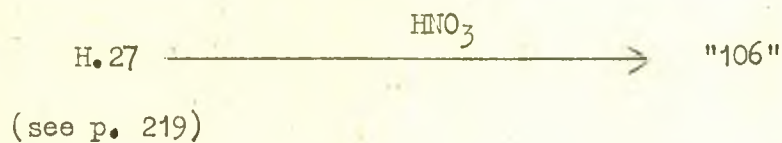
Para. 79

"106" (Continued)

Bristol Res.Rep.128, June '44; A.C.6477.

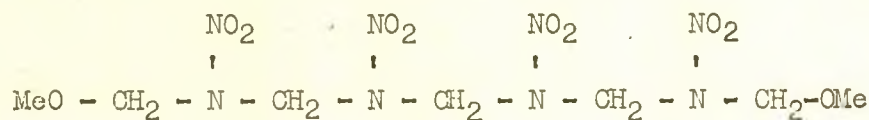


Univ. Penn., Div. 8 Int.Rep.R.R.C.8, August, '43; SR7/43/391.



Para. 80

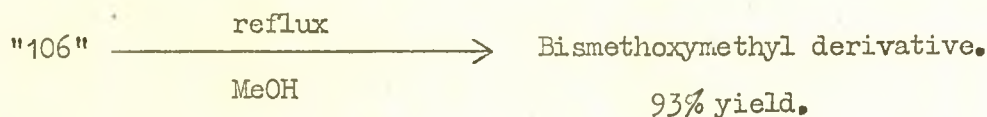
1:7-Bis(methoxymethyl)-1:3:5:7-tetranitro-(7-chain)



From MeOH.

m.p. 182-183°.

Toronto C.E.12 Prog.Rep. 1 Nov. '42; SR7/3466.

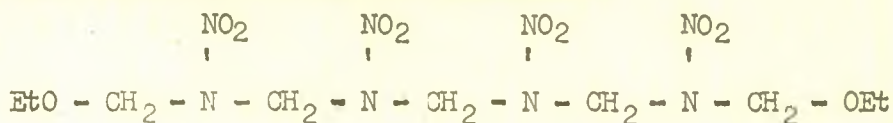


Similarly by

A.R.D., Exp.Rep.591/44, May '44; A.C.6455.

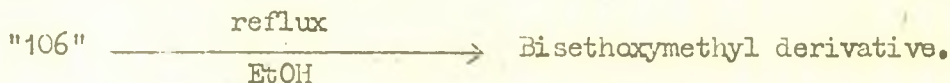
Para. 81

1:7-Bisethoxymethyl-1:3:5:7-tetranitro-(7-chain)



m.p. 166-167°.

Toronto C.E.12 Prog.Rep., 1 Nov. '42; SR7/3466.



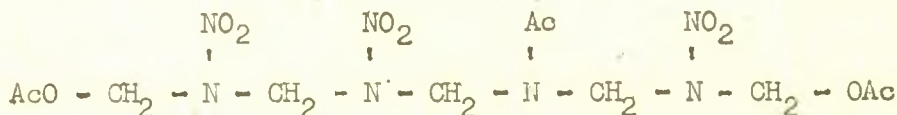
Also by

A.R.D., Exp.Rep. 591/44, May '44, A.C.6455.

Para. 82

H.16. (Univ. Penn.).

WRX. (McGill).

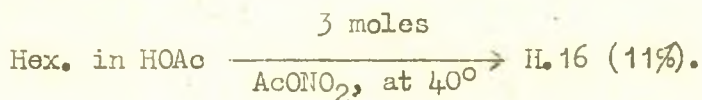


1:7-Bis(acetoxymethyl)-1:3:7-trinitro-5-acetyl-(7-chain).

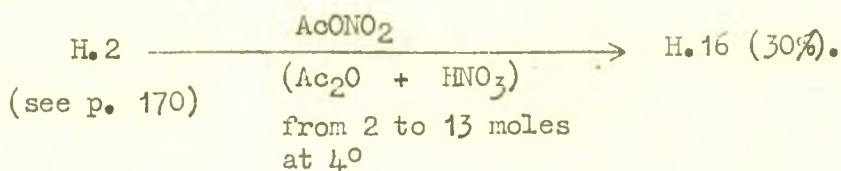
From aq. AcMe or AcMe + EtOH.

m.p. 157°.

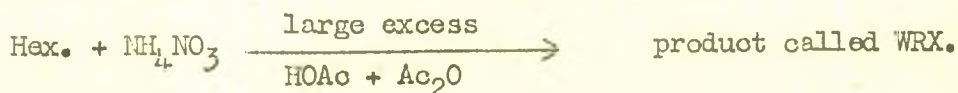
Univ.Penn. Div.8 Int.Rep.R.R.C.1; Jan. '43; SR7/3748.



Univ.Penn. Div.8 Int.Rep.R.R.C.3, March '43; SR7/4179.



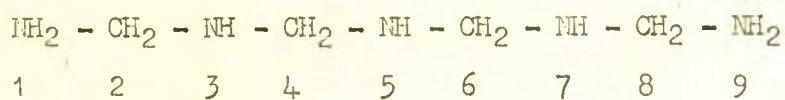
McGill X.R.4 Prog.Rep., 1 June '43; SR7/4908.



McGill X.R.4 Prog.Rep., 1 July '43; SR7/43/298.

WRX identical with H.16.

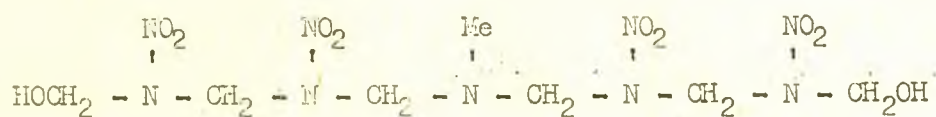
DERIVATIVES OF lin-2:4:6:8-tetramethylene-1:3:5:7:9-  
pentamine



"9-chain" series.

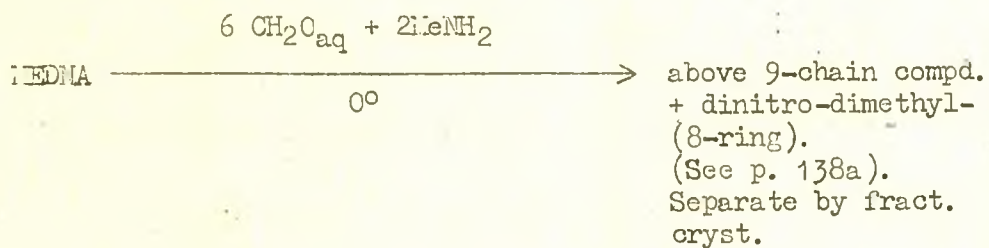
Para. 82b

1:9-Bismethylol-1:3:7:9-tetranitro-5-methyl-(9-chain)

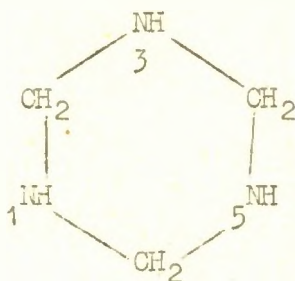


Fract. cryst. from EtOH - AcMe, m.p. 134-135°.

Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/3158.



DERIVATIVES OF cyclo-2:4:6-TRIMETHYLENE-1:3:5-TRIAMINE

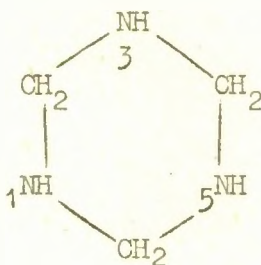


"6-Ring".

Section A: Derivatives not substituted on the C atoms.

Para. 84

Cyclo-2:4:6-Trimethylene-1:3:5-triamine

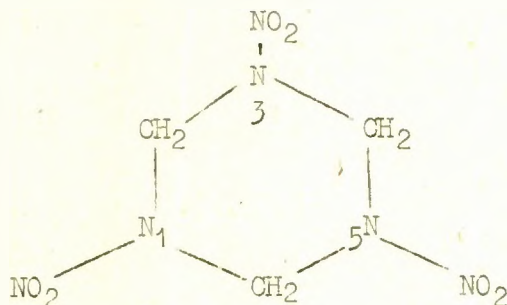


"6-ring".

Toronto workers, X.R.16 Rep., 31 Jan. '44; SR7/44/984, consider that "Henry's solution" (Henry, Bull.Acad.roy.Belg., 1902, 11, 721), consisting of an equimolecular mixture of aq.  $\text{CH}_2\text{O}$  and .880  $\text{NH}_3$  "dried with  $\text{K}_2\text{CO}_3$ " contains a high proportion of cyclotrimethylenetriamine (probably in equilibrium with  $\text{CH}_2 = \text{NH}$  and/or  $\text{HO.CH}_2\text{-NH}_2$ ) but contains no hexamine.

Para. 85

RDX



1:3:5-Trinitro-(6-ring).

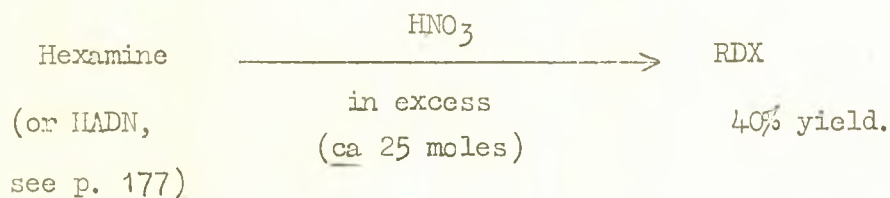
From Aché

m.p. 204.5-204.8°.

Henning, D.R.P. 104280 (June 1899).

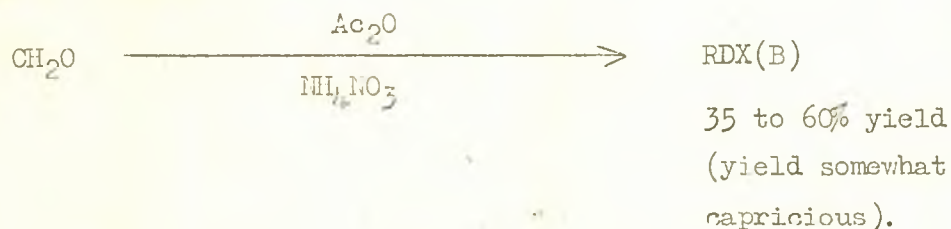
See Hale, J.A.C.S., 1925, 47, 2754, for early work.

A.R.D. "Woolwich Process" or "Hex. nitrolysis".



McGill, C.E.53 Prog.Rep.1, 1 Nov. '40; SR7/33.

"Ross Reaction".



See McGill, C.E.53 Prog.Rep.9, 1 July '41; SR7/543, for review.

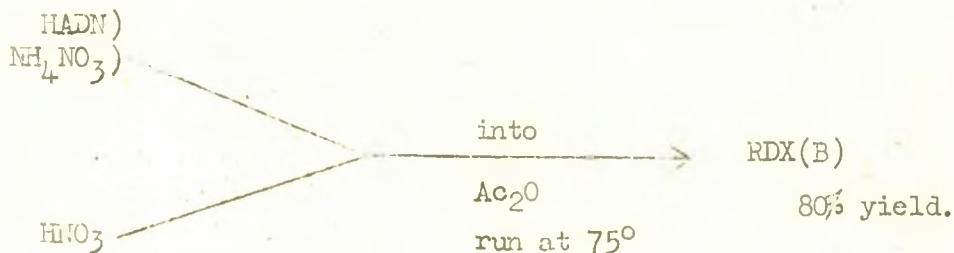
Best conditions Cornell, O.S.P.D.979 Rep. 30 July, '42; SR7/3333.

Para. 86

RDX (Continued)

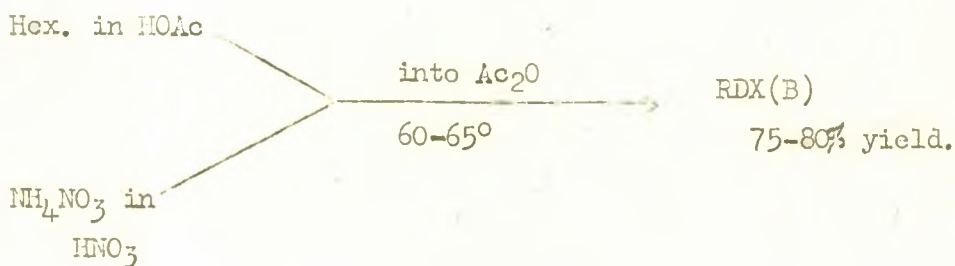
Michigan O.S.R.D.150 Rep. (to 15 Sept. '41) 8 Oct. '41; SR7/813.  
(1st reported at N.D.R.C. meeting May '41).

Bachmann Combination Process.

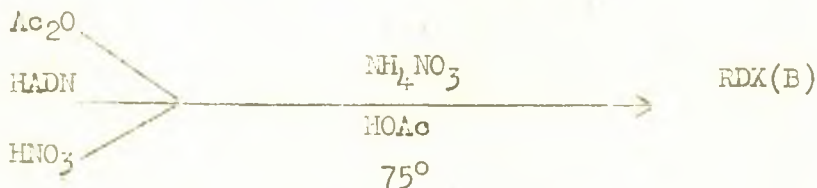


(Bachmann "C - 6 - C" procedure).

Toronto, C.E.12 Rep. 15 Aug. '41, SR7/643, added HOAc to Combination system, and C.E.12 Prog.Reps. 1 Sept. '41; SR7/689: 15 Sept. '41; SR7/749, used

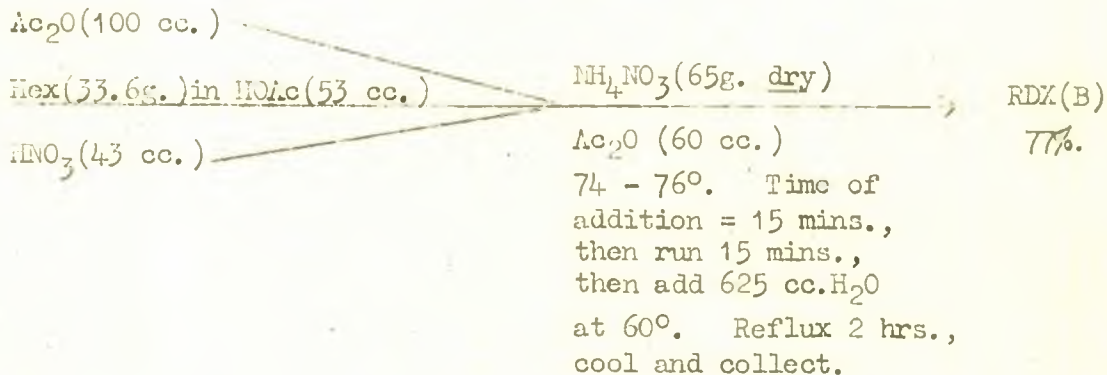


Michigan, Int.Prog.Rep. 19 Dec. '41; SR7/1330



(Bachmann's V-86 procedure).

Cornell, O.S.R.D.800 rep., up to 30 July '42; SR7/2856.

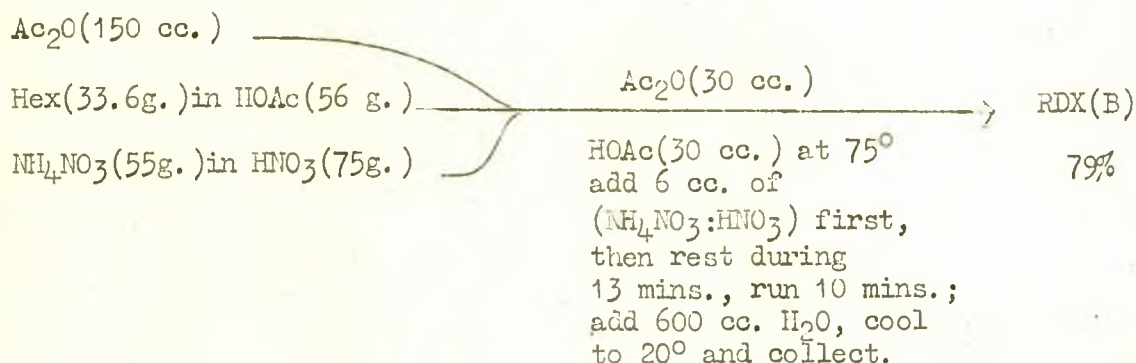


(Johnson's C.U.10 procedure).

Para. 87

RDX (Continued)

Michigan O.S.R.D. 820 Rep., 15 Aug. '42; SR7/2982.

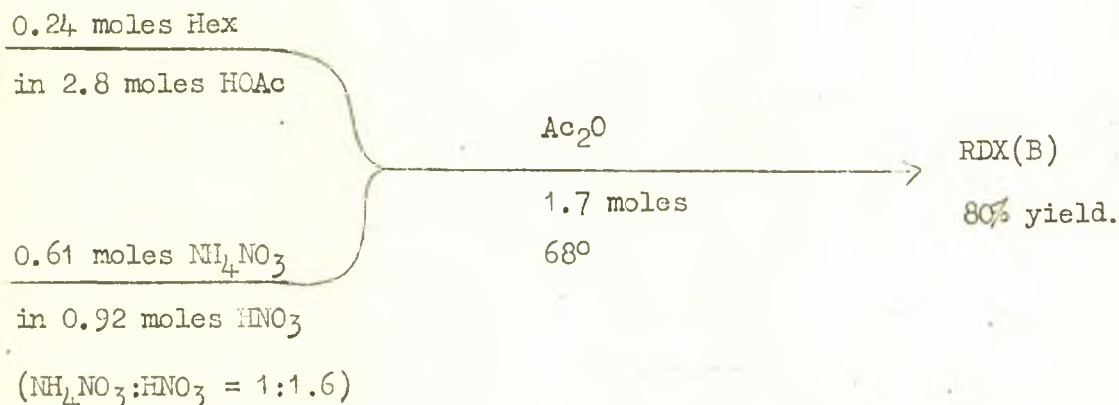


(Bachmann's V-167 procedure).

Michigan, B.M.324, 15 Nov. '42; SR7/3339.

70% aq. HNO<sub>3</sub> plus Ac<sub>2</sub>O, equiv. to the 30% H<sub>2</sub>O, can be used for HNO<sub>3</sub> in Bachmann Combination RDX(B) Process, without loss of yield.

Toronto, X.R.16 Rep. 15 May '43; SR7/4549.



A.R.D. investigated the preparation of RDX(B) by the process "nitration of hexamine in Ac<sub>2</sub>O by the complex 2HNO<sub>3</sub>.NH<sub>4</sub>NO<sub>3</sub>". See Prep. RDX(B) Prog.Reps. Nos. 1 to 6 (from Oct. '41 to Dec. '42). These reports have not been circulated but a summary of the work is given in the review by Linstead "Chemistry of RDX and Related Compounds" (to Oct. '43), M.O.S. London, 31 Oct. '43; A.C.5224 (page 41). The term RSX was originally used for the crude RDX(B) obtained in this A.R.D. work.

RDX (Continued)

RDX prepared by "Hexamine nitrolysis" contains traces of HMX; (Toronto, X.R.16 Prog.Rep. May '43; SR7/4436: Bristol Br Rep. 23, May '43; A.C.4237: A.R.D.Exp.Rep. 256/43, Aug. '43; A.C.4629) and "106" (Toronto, X.R.16 Prog.Rep., 15 Jan. '43; SR7/3721: ARD, Exp.Reps. 505/44, Jan. '44; A.C.5605: and 591/44, May '44; A.C.6455).

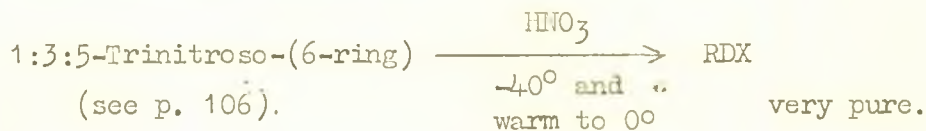
"106" is destroyed by heating to 75° with aq.  $\text{HNO}_3$  (50-70%).

RDX(B) prepared by the Bachmann Combination Process contains HMX (up to 10%; usually ca 3% by weight of RDX(B)). First found by Toronto workers, C.E.12 Prog.Reps., 1 Sept. '41; SR7/689: 15 Sept. '41; SR7/749, by fractional crystallisation of crude RDX(B) from dioxane: BSX, Toronto C.E.12 Prog.Rep. 1 March '42; SR7/1845, and ARD (see Prep.RDX(B) Prog.Rep.4, April '42, Exp.Rep. 107/42). The BSX is destroyed by heating (75°) with aq.  $\text{HNO}_3$  (50-70%).

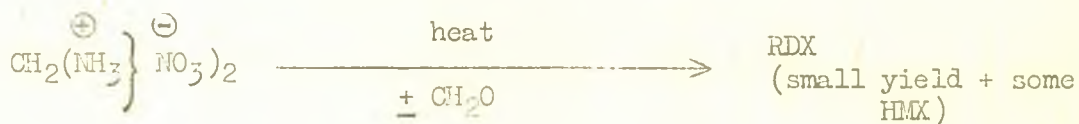
Mother liquors after separation of RDX(B) contain small amounts of Acn (see p. 76), QDX (see p. 130), TIX (see p. 98).

Toronto, C.E.12 Prog.Rep., 30 Sept. '41, SR7/840, can use phthalic anhydride for  $\text{Ac}_2\text{O}$  in Ross Reaction and still get some RDX.

Toronto, C.E.12 Prog.Reps., 30 Nov. '41; SR7/1173: 31 Dec. '41; SR7/1438.



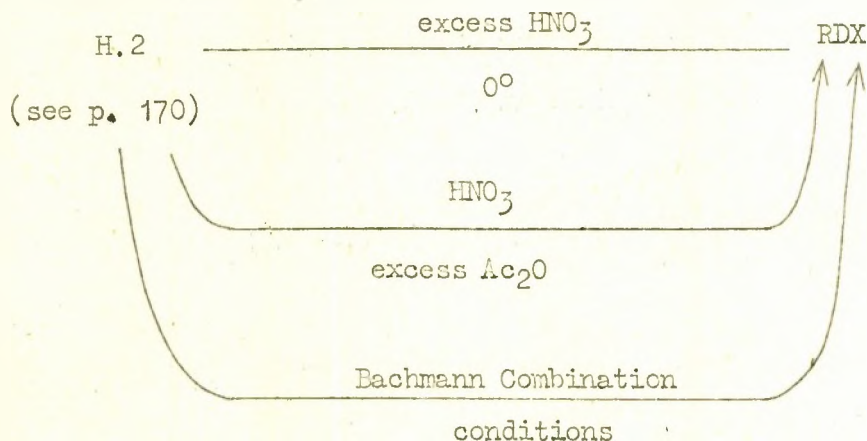
McGill, C.E.53 Prog.Rep., 1 Jan. '42; SR7/1426.



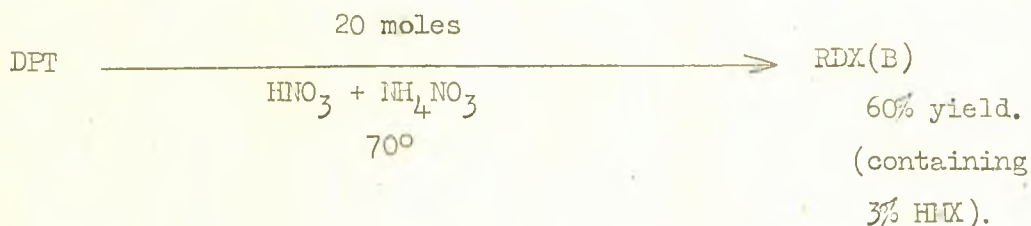
RDX (Continued)

Harvard, N.D.R.C.Rep., Oct. '42; SR7/3263.

Univ. Penn., Div.8 Int.Rep.R.R.C.3, March '43; SR7/4179.



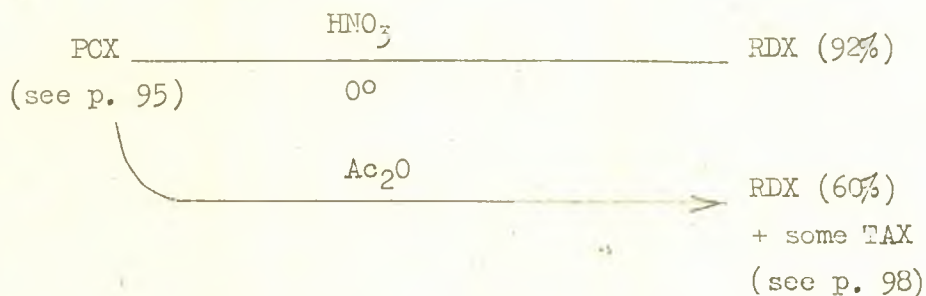
Toronto, X.R.16 Prog.Rep., 15 Jan. '43; SR7/3721.



McGill, X.R.6 Prog.Rep., April '43; SR7/4315:

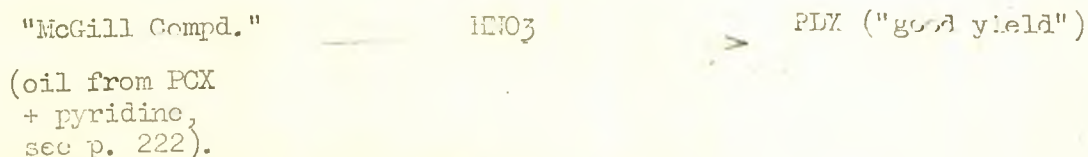
Bristol, Res.Rep.89, June '43; A.C.4417 and

Bristol Br. Rep. 28, Oct. '43; A.C.5058



McGill, X.R.6, Canadian Exp.Res.Extr.m.Summary, Oct. '43;

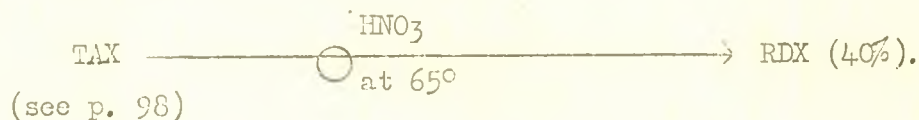
SR7/43/848 and X.R.6.Prog.Rep., Feb. '44; SR7/44/578.



RDX (Continued)

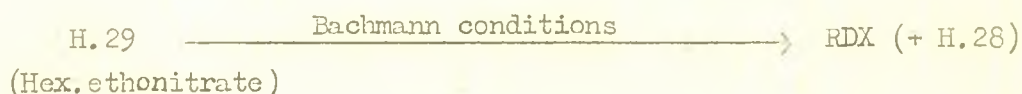
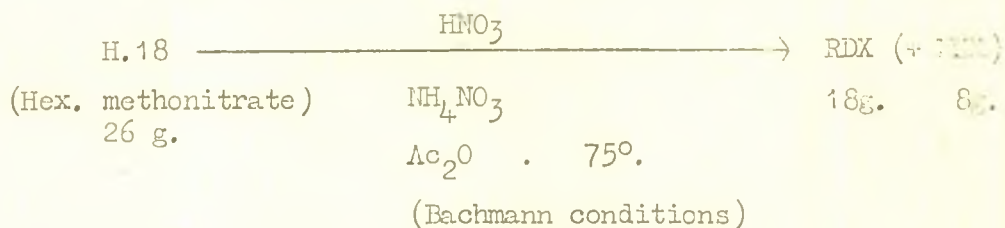
Toronto, X.R.16 Reps., May '43; SR7/4549, July '43; SR7/43/303.

Bristol Br. Rep. 28, Oct. '43; A.C.5058.



Univ. Penn. Div.8 Int.Rep.R.R.C.6, June '43; SR7/4879:

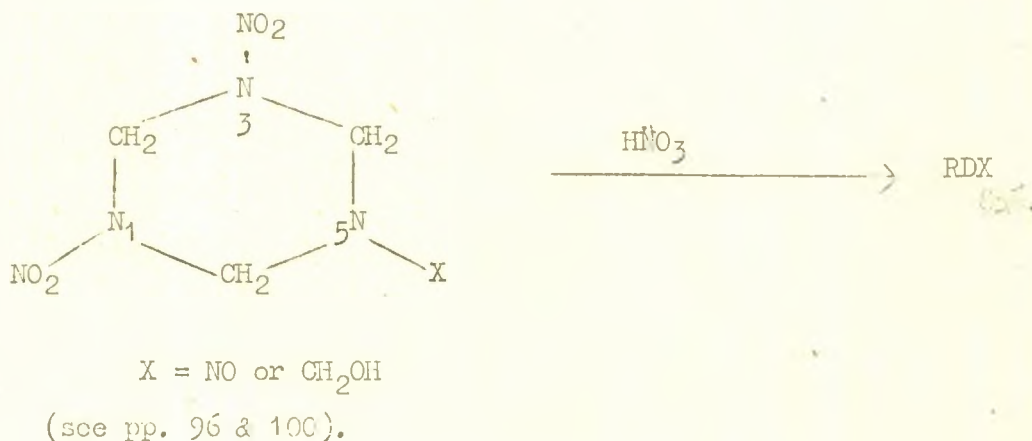
R.R.C.8, Aug. '43; SR7/43/391



McGill, X.R.4 Prog.Rep., Nov. '43; SR7/43/1057.



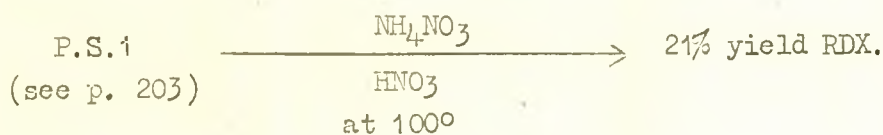
Bristol Br. Rep. 28, Oct. '43; A.C.5058.



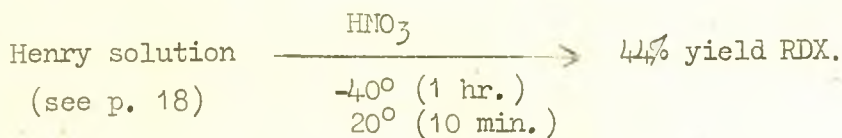
(McGill, X.R.6 Prog.Rep., Feb. '44; SR7/44/578, checked above for X = CH<sub>2</sub>OH).

RDX (Continued)

Penn. State, Div.8.Int.Rep. R.R.C.11, Nov. '43; SR7/44/70.



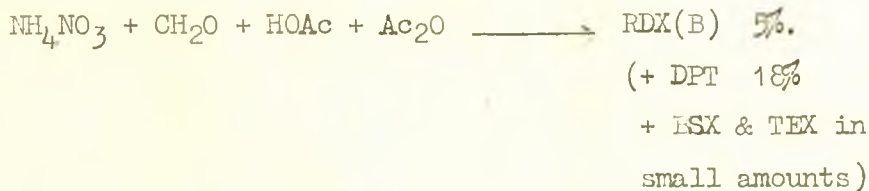
Toronto, X.R.16 Rep., 31 Jan. '44; SR7/44/984.



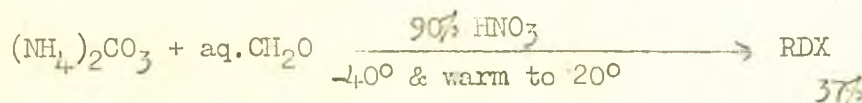
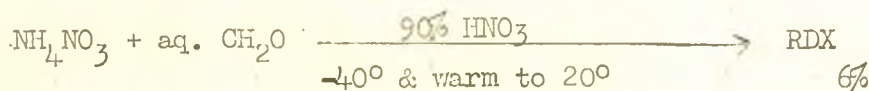
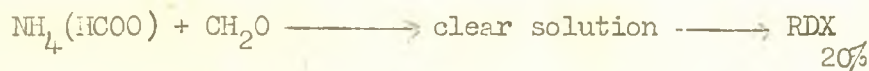
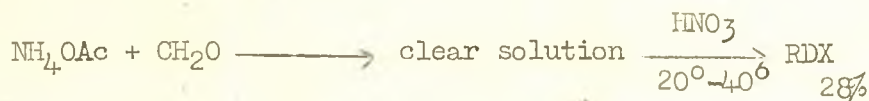
Bristol Res.Rep.117, March '44; A.C.6046.



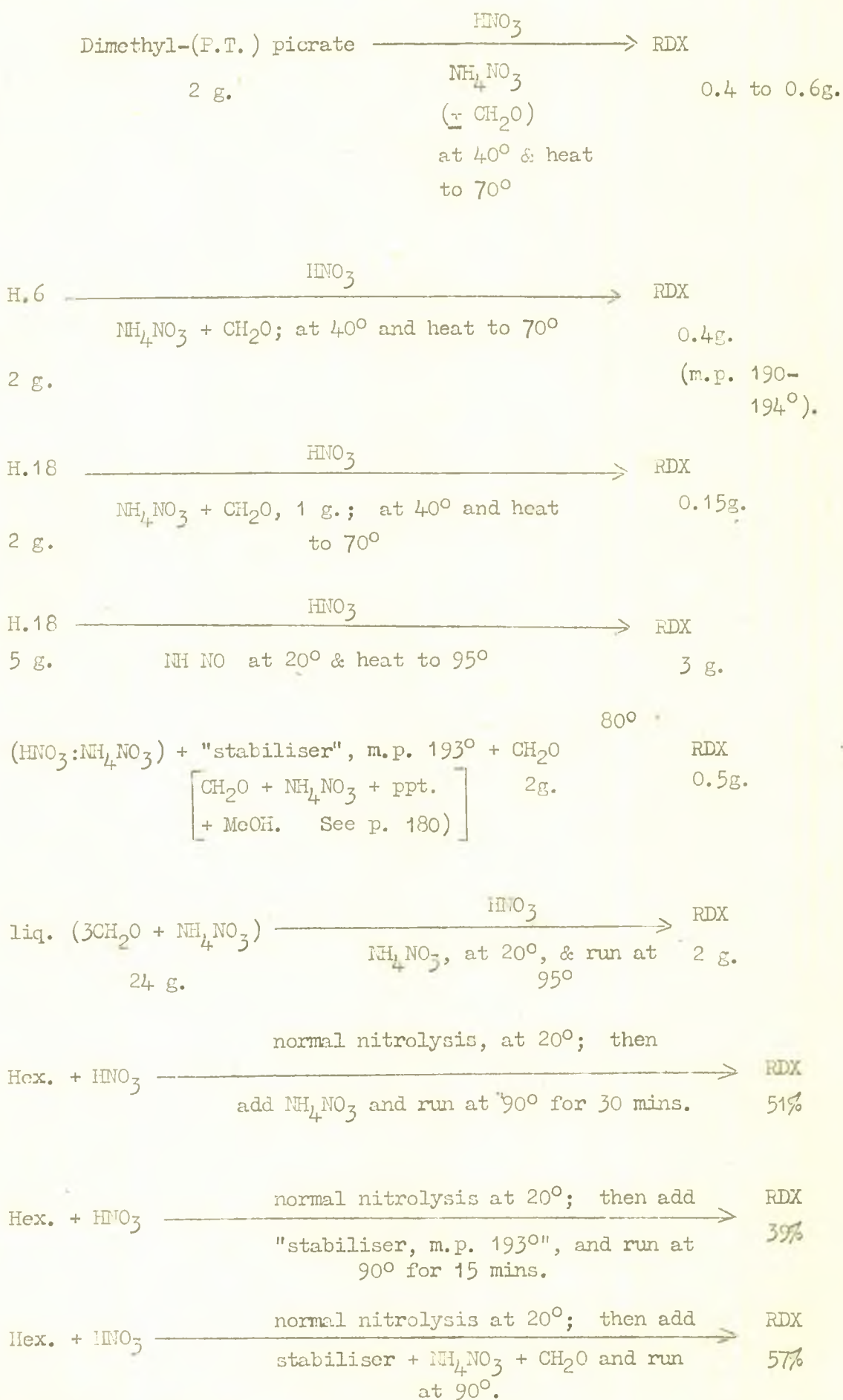
Toronto, Canadian Exp.Res.Extram.Summary, April '44, SR7/44/1747.



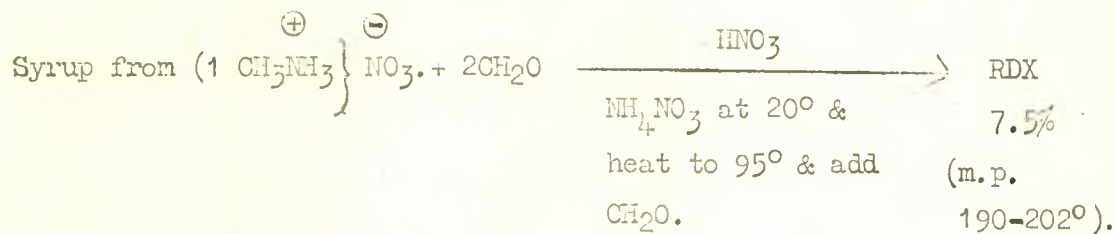
Bristol Res.Rep. 129, June '44; A.C.6486.



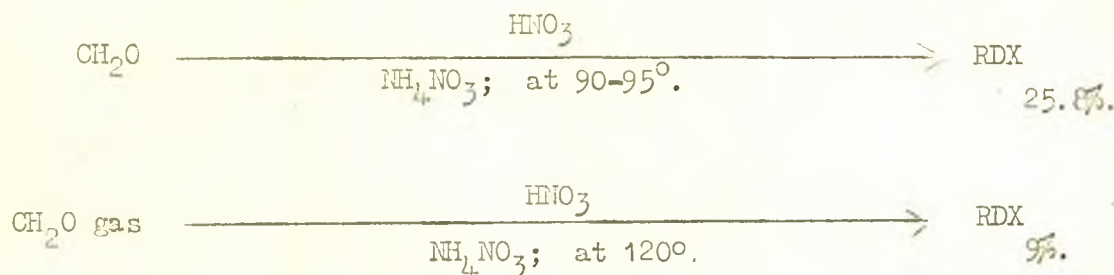
RDX (Continued)



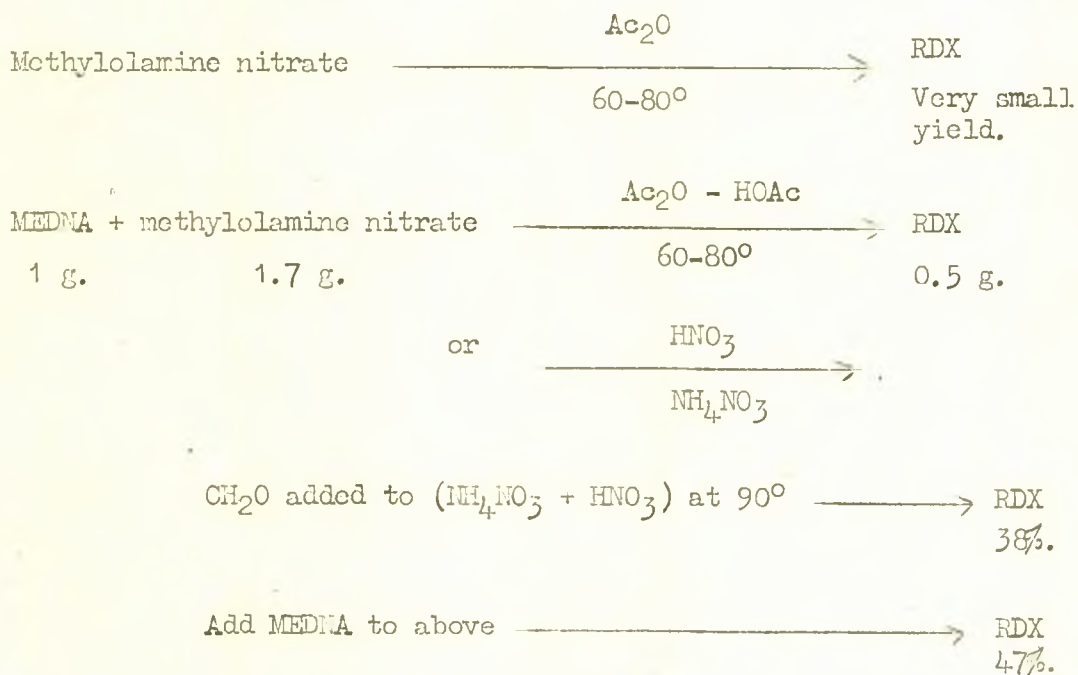
RDX (Continued)



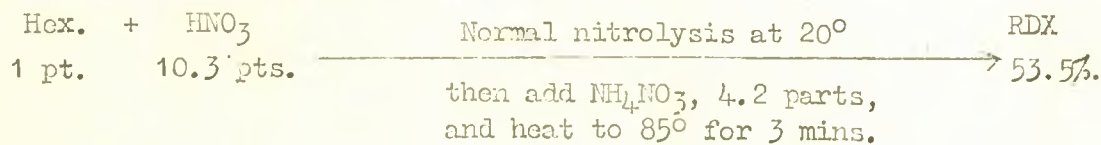
Bristol Res. Rep. 130, June '44; A.C.6478.



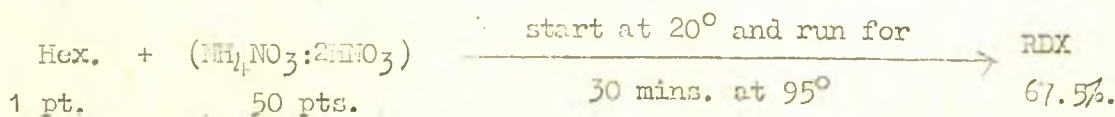
Bristol Res. Rep. 131, June '44; A.C.6657.



A.R.D. Exp. Rep. 593/44; June '44; A.C.6456.



(CH<sub>2</sub>O also added at 95°, then yield is 59.5%).



Para. 94

RDX (Continued)

A.R.D. Exp.Rep. 594/44, June '44, A.C.6457.



A.R.D. RDX Res.Panel, London, 21 June '44.

RDX obtained in yields varying from about 30 to about 60% by adding x to  $(\text{NH}_4\text{NO}_3 : 2\text{HNO}_3)$  either at  $95^\circ$  or at  $20^\circ$  and heat to  $95^\circ$ .

x =  $\text{CH}_2\text{O}$  gas.

$\text{CH}_2\text{O}$ .

$\text{P}_1 + \text{P}_2$ .

Cyclonite Oxide.

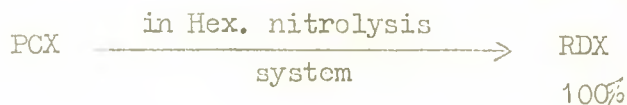
BSX.

AcAn.

DPT.

(all probably acting as sources of  $\text{CH}_2\text{O}$ ).

Bristol, June '44; private communication from Dr. A. Carruthers.



Toronto, X.R.16 Proj., Canadian E.R.Extram.Summary 20, May-June '44;  
SR7/44/2426 (following A.R.D.).

Compd. (1 part) +  $\text{HNO}_3 : \text{NH}_4\text{NO}_3$  (75:60 parts) at  $100^\circ$ .

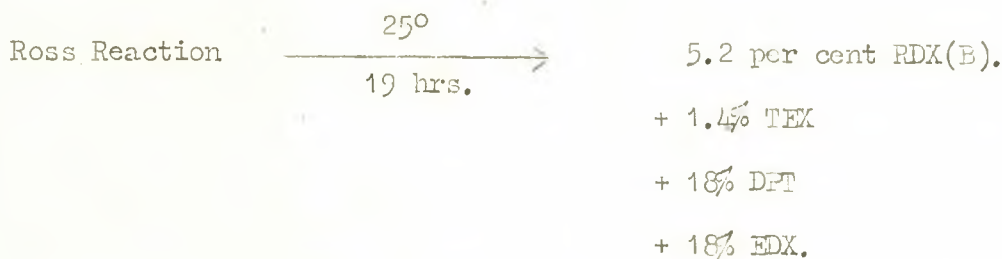
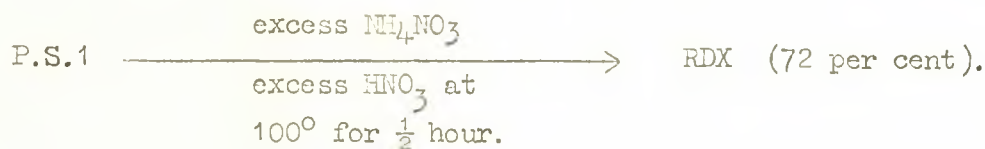
| Compound        | % RDX * |
|-----------------|---------|
| Hexamine        | 136     |
| DPT             | 117     |
| Cyclonite Oxide | 69      |
| COX             | 64      |
| TEX             | 64      |
| BSX             | 81      |
| AcAn            | 97      |
| 106             | 79      |
| H.16            | 90      |

\* Calc. on basis: 1 mole. Compd.  $\longrightarrow$  1 mole RDX = 100%.

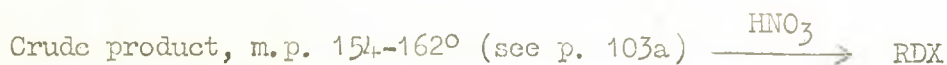
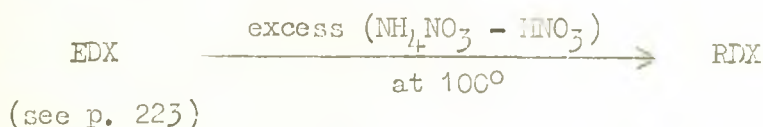
Para. 9/a

RDX (Continued)

RDX Committee (U.S.A. and Canada) Meeting, 26 May '44; SR7/44/2801:  
(Toronto, X.R.16 Proj.).



Toronto X.R.16 Rep., 1 Sept. '44; SR7/54/3158.

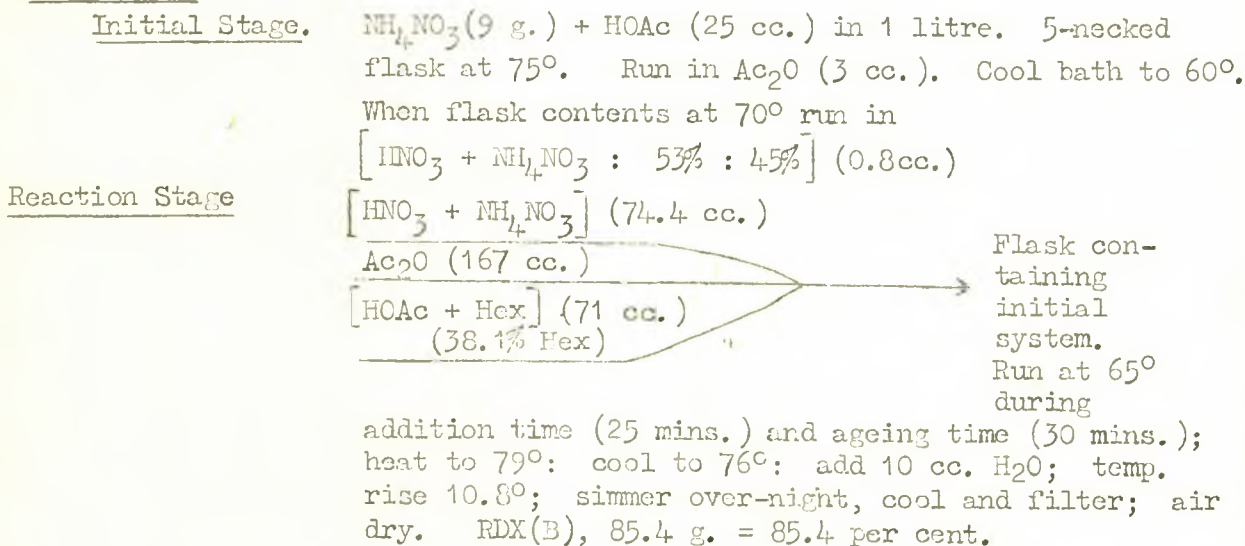


Michigan, N.D.R.C. Div.8 Int. Reps.; R.R.C.21, Sept. '44; SR7/44/3207.

R.R.C.22, Oct. '44; SR7/44/3502.

Latest work on the Bachmann Combination Process.

"Run A - 248"

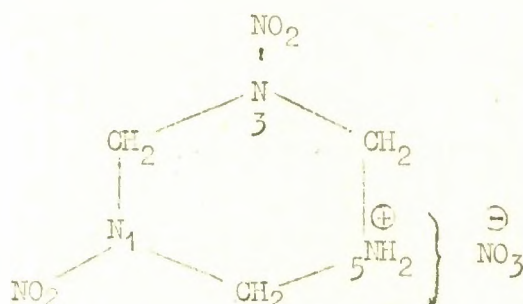


Contour plots are given showing the effect on RDX(B) yield of variation of Ac<sub>2</sub>O and HNO<sub>3</sub>. Optimum yield, 86.7 per cent using Ac<sub>2</sub>O (6.7 moles), HNO<sub>3</sub> (4.4 moles) to Hex (1 mole).

Para. 95

PCX (McGill)

HOX (Davy)

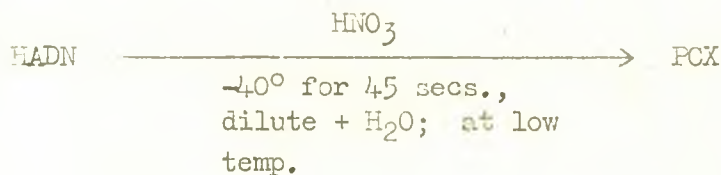


1:3-Dinitro-(6-ring) - 5-nitrate.

ppt. from HNO<sub>3</sub> at -20° by ice + H<sub>2</sub>O → cryst. material,

m.p. 98-99°.

McGill, X.R.6 Prog.Rep., April, '43; SR7/4315.



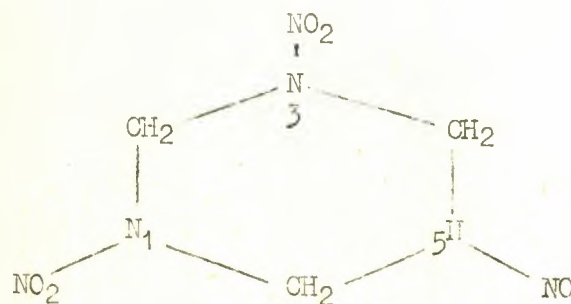
Bristol Res.Rep. 89, June '43; A.C.4417:

Bristol Br. Rep. 28, Oct. '43; A.C.5058, confirm preparation and determine structure.

See also McGill, X.R.6 Prog.Rep., Feb. '44; SR7/44/578.

This compound was postulated by Davy (U.S.A.-Canada-RDX Committee Meeting, Dec. '42) under the name of "HOX" as an intermediate in the Bachmann Combination RDX(B) process.

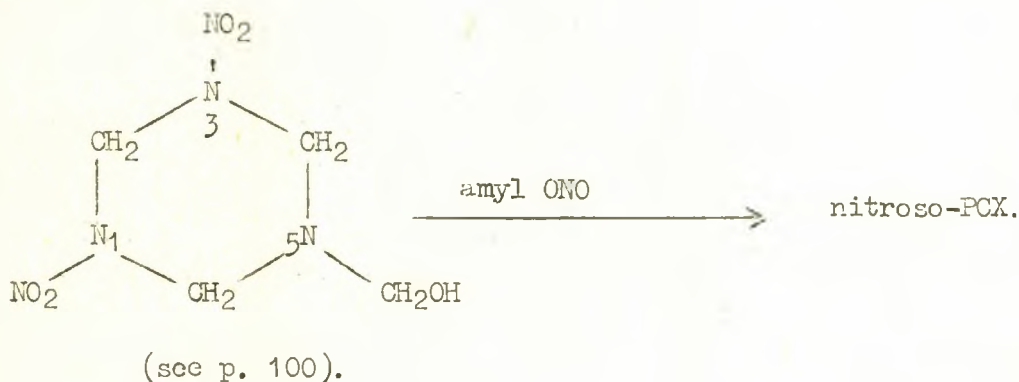
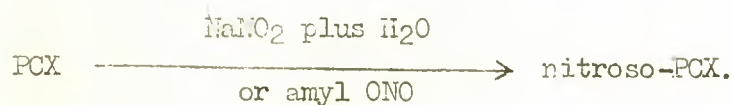
"NITROSO-PCX"



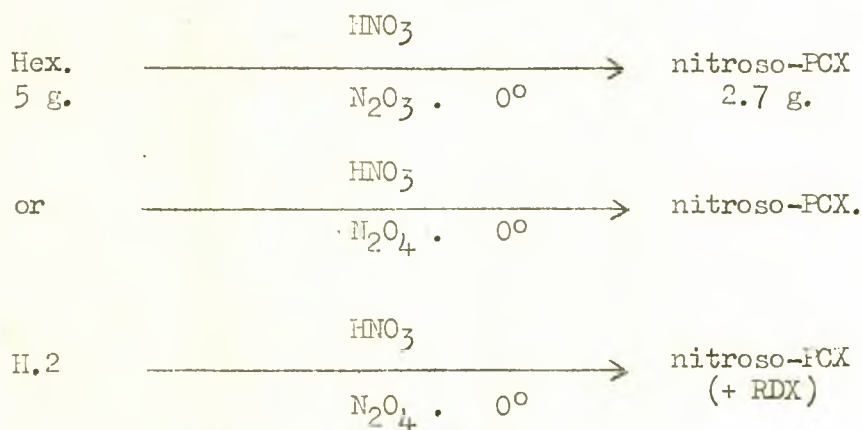
1:3-Dinitro-5-nitroso-(6-ring).

From MeOH. m.p. 168°.

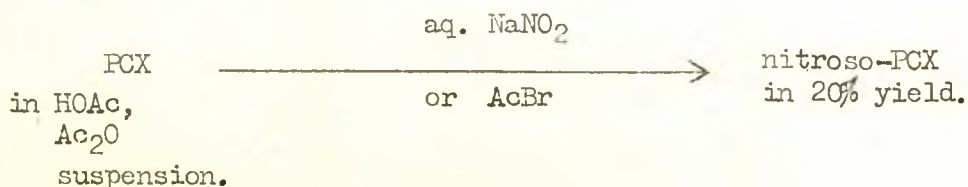
Bristol Br. Rep. No. 28, Oct. '43; A.C.5058.



Bristol Res.Rep. 117, March '44; A.C.6046.



McGill, X.R.4 Project C.E.R.Extram.Summary, 20, May-June '44; SR.7/44/2426.



Para. 97

"NITROSO-PCX" (Continued)

Add AcBr, aq. NaNO<sub>2</sub> or HCl to Bachmann Combination Process

reaction system  $\longrightarrow$  yellow crystals

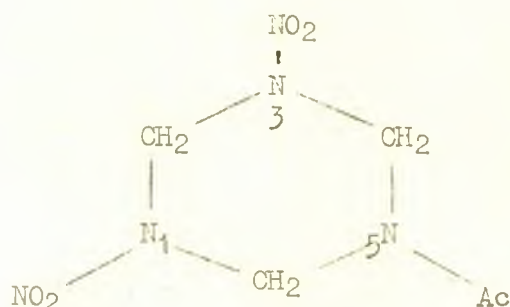
"in good yield".

nitroso-PCX

purify

Paras. 98, 99

TAX



1:3-Dinitro-5-acetyl-(6-ring).

From EtOH and EtOH - AcMe. m.p. 156°.

Toronto, X.R.16 Prog.Rep., April '43; SR7/4313.

Isolated TAX as a by-product in the Bachmann Combination RDX(B) process, using excess Ac<sub>2</sub>O. Neutralised filtrate and separated resulting BSX, AcAn, QDX (see p. 130) and TAX by fractional crystallisation (0.3 g. TAX from 33.6 g. Hex.).

A.R.D., Prep.RDX(B) Prog.Rep. 8, Expl. Rep./173/43, May '43;

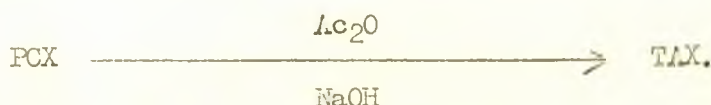
A.C.4293: and Prog.Rep.9, Exp.Rep. 239/43, July '43; A.C.4678.

Isolated TAX from mother liquor from normal Bachmann Combination RDX(B) run.

Toronto, X.R.16 Prog.Rep., May '43; SR7/4549.

Dissolve NH<sub>2</sub>Ac (1 mole) in usual Hex.-HOAc solution (1 mole Hex.) for normal Bachmann Combination RDX(B) run. TAX isolated from product in yield 3.5%.

Toronto, X.R.16 Prog.Rep., July '43; SR7/43/303.

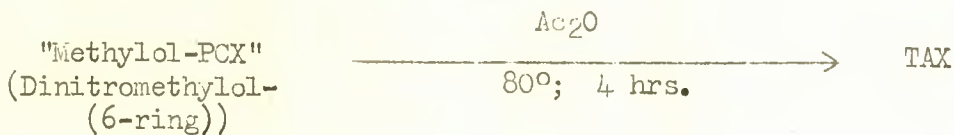
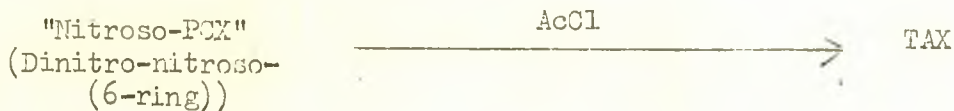


(Repeated independently, Bristol Br.Rep.28, Oct. '43; A.C.5058).

Para. 99

TAX (Continued)

Bristol Br.Rep.28, Oct. '43; A.C.5058.



Toronto, X.R.16, Canadian Exp.Res.Extram.Summary, April '44; SR7/44/1747:

X.R.16 Rep., 1 Sept. '44; SR7/44/3158.

TAX isolated in 1.1% yield from Ross Reaction filtrates.

University Penn., RDX Committee (U.S.A. and Canada) Meeting, 26 May '44;

SR7/44/2801.

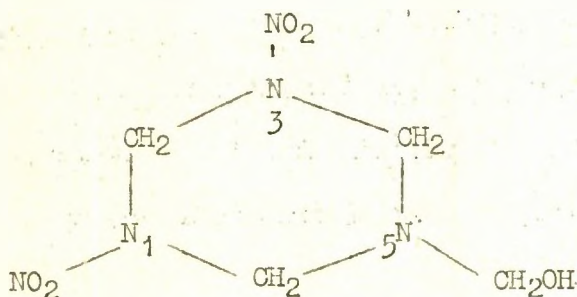


Reaction needs a few drops of water.

Para. 100

"METHYLOL-PCX" (Bristol)

PCX(A) (McGill)



1:3-Dinitro-5-methylol-(6-ring).

From anhydrous AcMe plus ether.

m.p. 136°.

"METHYLOL-FCX" (Continued)

Crude PCX  $\xrightarrow[\text{collect insoluble residue}]{\text{triturate with H}_2\text{O}}$  DFT plus above  $-\text{CH}_2\text{OH}$  compd.  
plus unidentified products  
 $\downarrow$  fract.  
 $\downarrow$  crystn.  
Above  $-\text{CH}_2\text{OH}$  compd.

$$\text{PCX} + \text{alkali} \longrightarrow \text{PCX(A)}. \quad \text{m.p. } 133^{\circ}.$$

Reaction goes better in AcMe suspension.

X.R. 16 Rep., 1 Sept. '44; SR7/44/3158.

Para. 101

COCN1CCN(C1)C2CCN(C2)C3=CC=CC=C3

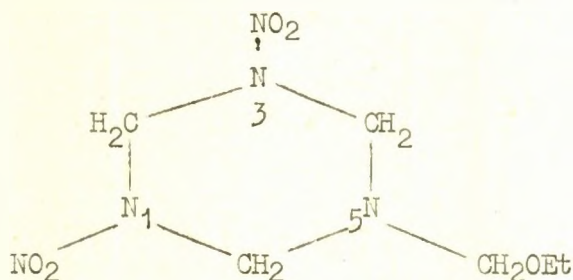
m.p. 128°.

Compd.  $C_4H_{10}N_6O_7$   $\xrightarrow[\text{(loss of HNO}_2 \text{ \& methylation)}]{\text{MeOH}}$  Dinitromethoxymethyl-(6-ring).  
(see p. 205)

62015-1

Para. 102

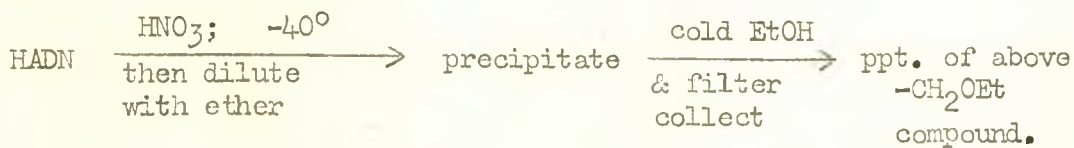
1:3-Dinitro-5-ethoxymethyl-(6-ring)



From EtOH.

m.p. 114°.

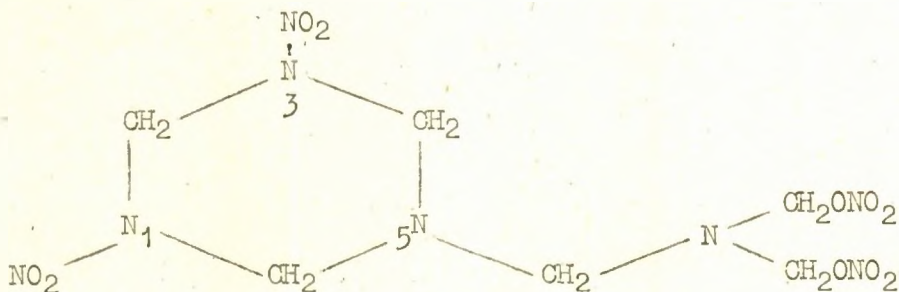
Bristol Br. Rep. 28. Oct. '43; A.C.5058.



Para. 103

P. P.C.X. (Bristol)

P.3. (A.R.D.)



Not isolated.

1:3-Dinitro-5-bis(nitroxymethyl)aminomethyl-(6-ring).

Bristol, Br. Rep. 28, Oct. '43; A.C.5058.

Postulated as precursor of PCX.

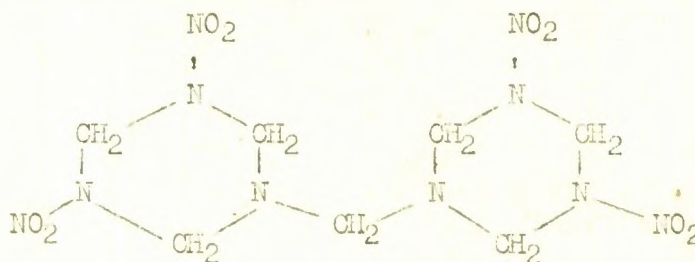
See also Bristol Res.Rep.120, April '44; A.C.6302;

A.R.D. Exp.Rep. 591/44, May '44; A.C.6455.

See Toronto X.R.16 Rep., 1 Sept. '44; SR7/44/3158.

Para. 103a

Methylene bis (1:3-dinitro-(6-ring)-5-)



Not purified yet.

Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/3153.



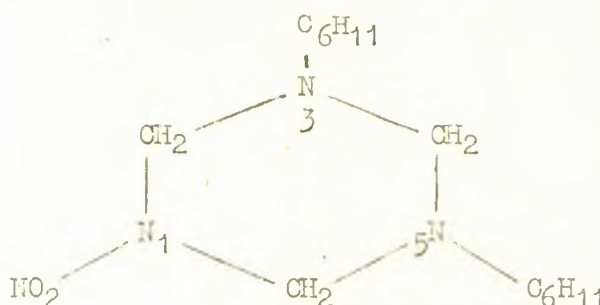
m.p. 154-162°  
(shrinkage at 79°)  
probably containing  
above compd.

EtOH  
EtOAc  
Acle  
"purif."

DPT + amorphous insoluble compd., m.p. 141°

Para. 104

1-Nitro-3:5-dicyclohexyl-(6-ring)



Cryst. from Acle(25° - 0°)

m.p. 99°.

Toronto, X.R.16 Rep. 31 Jan. '44; SR7/44/984.



Hexamine nitrolysis system: collect ppt. RDX:

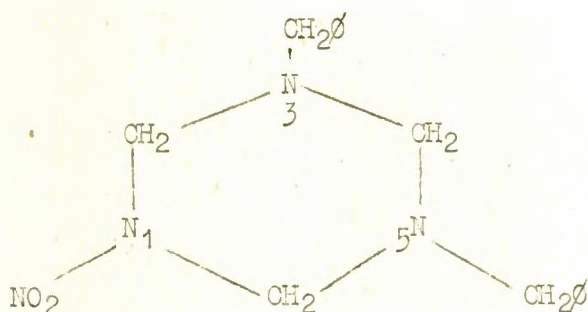
(Hex:HNO<sub>3</sub> = 1:4.5 by wt.)

adjust filtrate to pH 2: ether extract: ext. into H<sub>2</sub>O;

neutralise to pH 6.5 with C<sub>6</sub>H<sub>11</sub>NH<sub>2</sub>  $\longrightarrow$  1-Nitro-3:5-dicyclohexyl-6-ring.

## Para. 105

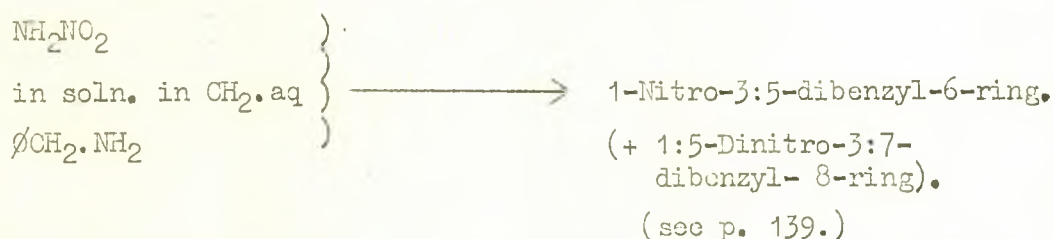
1-Nitro-3:5-dibenzyl-(6-ring)



Decomp. in hot solvents: ppt. from cold AcMe by H<sub>2</sub>O (see below).

m. p.  $109^{\circ}$ .

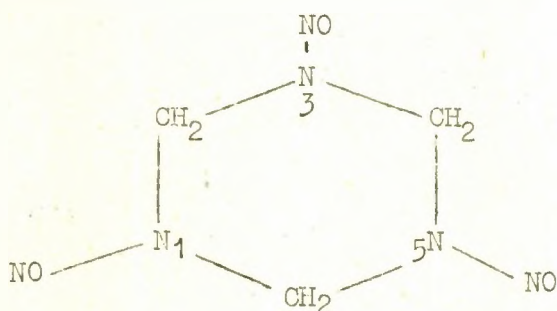
Toronto, X.R. 16 Rep., 31 Jan. '44; SR7/44/984.



Mixt. separated by dissolving in min. AdMe at 25°; cool to 0°. 8-ring compd. separates. 6-Ring compd. from filtrate by 1:1 H<sub>2</sub>O dilution.

Para. 106

1:3:5-Trinitroso-(6-ring)



(From EtOH or AcMe by H<sub>2</sub>O addition).

m. p. 105-106°.

Griess and Harrow. Ber., 1888, 21, 2737.

Mayor. Ber., 1888, 21, 2883.

Duden and Scharff, *Annalen*, 1895, 288, 218 et seq.

Hex. in very dilute HCl  $\xrightarrow{\text{NaNO}_2}$  trinitroso-(6-ring)

Michigan, Div. 8 Int. Rep. R.R.C. 13: Dec. '43-Jan. '44; SR7/44/915.

$\text{HNO}_2$  on Hex.  $\xrightarrow{\text{pH} = 1}$  trinitroso-6-ring.

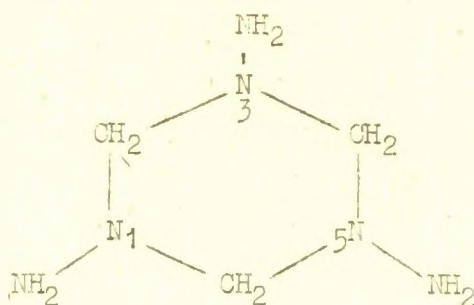
Knudsen, Ber., 1914, 47, 2700.

$$\text{CH}_2(\overset{+}{\text{NH}}_3) \left\{ \overset{-}{\text{Cl}} \right\}_2 \xrightarrow{\text{NaNO}_2} \text{trinitroso-6-ring.}$$

In preliminary work in Bristol in 1939, attempts to repeat this conversion failed.

Para. 107

1:3:5-Triamino-(6-ring)



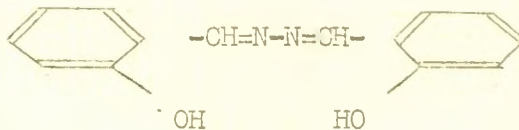
Not isolated.

Duden and Scharff, Annalen, 1895, 208, 218.

Trinitroso-(6-ring)  $\xrightarrow[\text{cold water}]{\text{Na/Hg}}$  triamino-(6-ring),  
isolated as tris(-c-hydroxybenzylidene)- derivative, m.p. 139-140°  
(from  $\text{CHCl}_3$  - ether).

Bristol, M.O.S. Paper, Dec. '39; A.C.14:

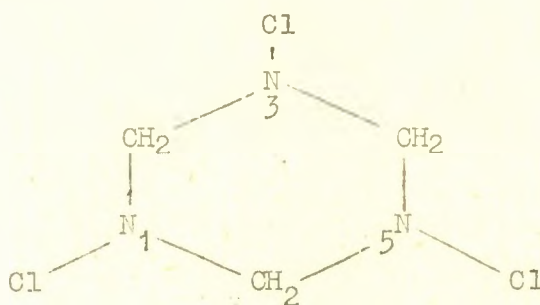
(a) repeated this Na/Hg reduction and (b) reduced RDX  
similarly. The only product isolated was the



o,o'-Dihydroxybenzalazine, from  $\text{CHCl}_3$ , m.p. 162°, of Curtius  
and Lublin, Ber., 1900, 33, 2463.

Para. 108

1:3:5-Trichloro-(6-ring)



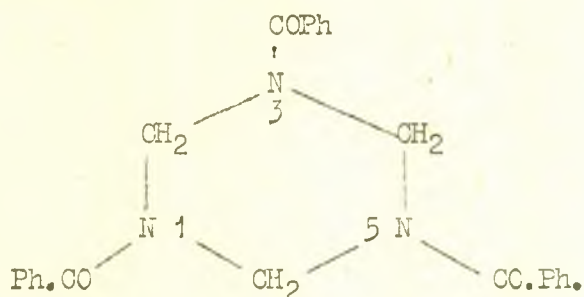
m.p. decomp. 75°.

Delépine: Bull.soc.Chim., 1911 (4), 9, 1025.

Dichloro-(P.T.) in HOAc  $\xrightarrow[\text{water}]{\text{dilute with}}$  Trichloro- (6-ring).  
(See p. 149).

Para. 109

1:3:5-Tribenzoyl-(6-ring)

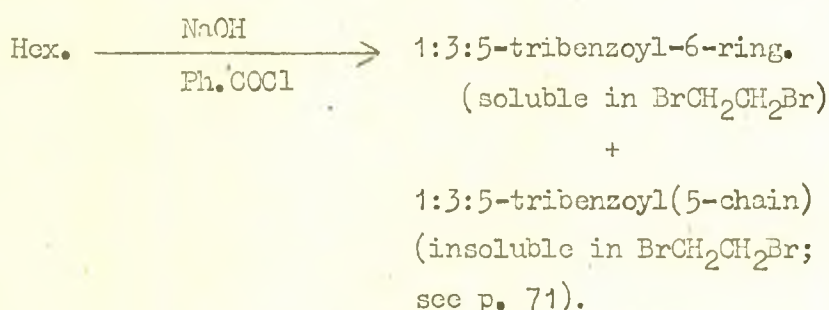


From Br.CH<sub>2</sub>CH<sub>2</sub>Br, or CHCl<sub>3</sub>

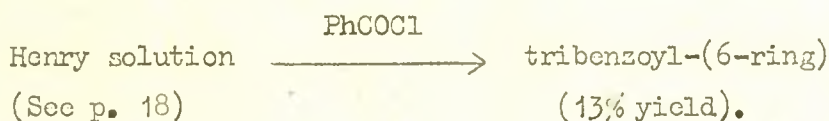
by ppt. + ether)

m.p. 220-221°.

Duden and Scharff, Annalen, 1895, 288, 248.

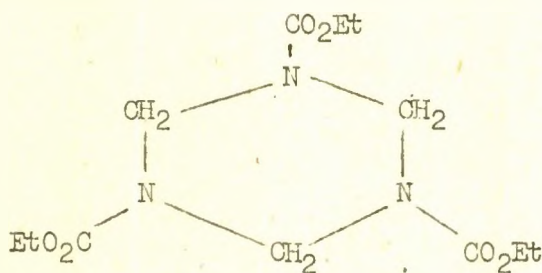


Toronto, X.R. 16 Rep., 31 Jan. '44; SR7/44/984.



Para. 110

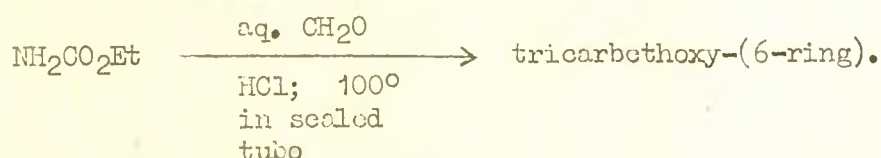
1:3:5-Tricarbethoxy-(6-ring)



m.p. 102°.

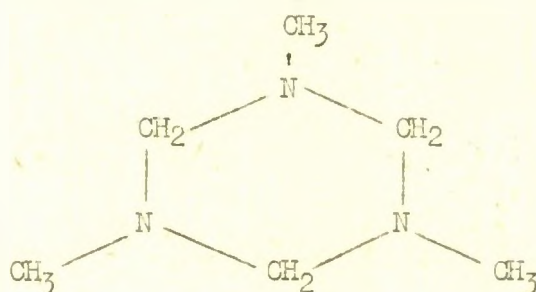
Bischoff and Reinfeld, Ber., 1903, 36, 39.

Conrad and Hock, Ber., 1903, 36, 2206.



Originally reported as (CH<sub>2</sub>-N-CO<sub>2</sub>Et)<sub>n</sub>, with n = 2. n = 3 much more likely and the compound actually is as above; private communication from Professor R. P. Linstead, F.R.S.

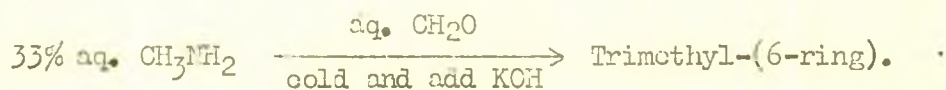
1:3:5-Trimethyl-(6-ring)



b.p./760 mm. 166°.

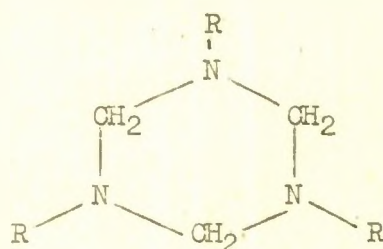
Henry, Bull Acad.roy.Belg., 1893, [3], 26, 200; ibid, 1895, [3], 28, 359.

Cambier and Brochet, Comptes rendus, 1895, 120, 450; Bull.soc.chim., 1895, [3], 13, 392.



Gives a picrate m.p. 127° (Duden and Scharff, Ber., 1895, 28, 936).

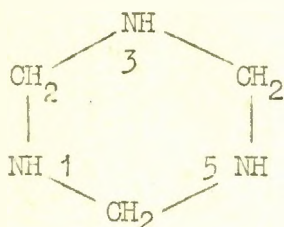
For other derivatives of the general type,



see Beilsteins Handbuch, 26, 1. System No. 3194-3196.

For R =  $\emptyset$  see Miller and Wagner, J.A.C.S., 1932, 54, 3698.

Para. 112 DERIVATIVES OF cyclo-2:4:6-TRIMETHYLENE-1:3:5-TRIAMINE

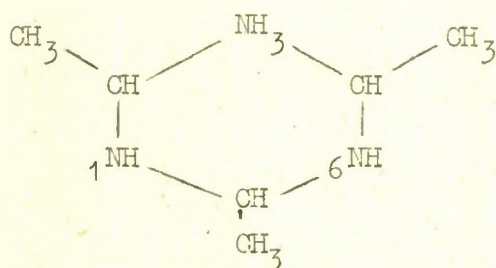


"6-Ring".

Section (B). Derivatives substituted on the C atoms.

Para. 113

2:4:6-Trimethyl-cyclo-2:4:6-trimethylene-1:3:5-triamine



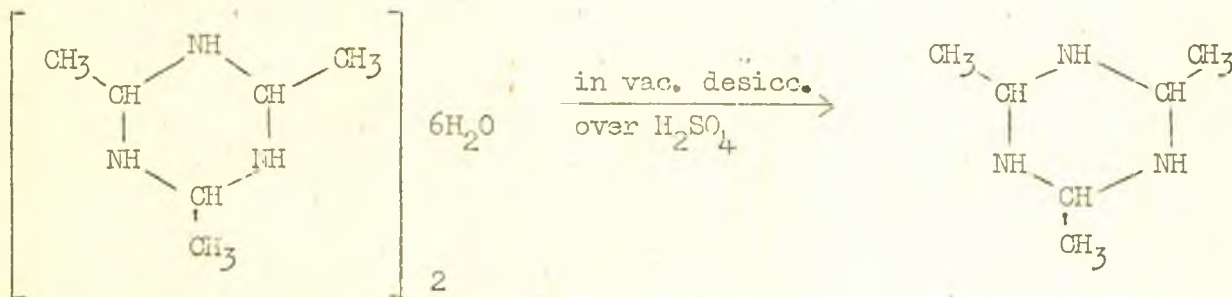
2:4:6-Trimethyl-(6-ring)

From  $\text{CHCl}_3$ .

m.p.  $85^\circ$ .

Delépine, Comptes rendus, 1897, 125, 952; ibid, 1899, 128, 105.

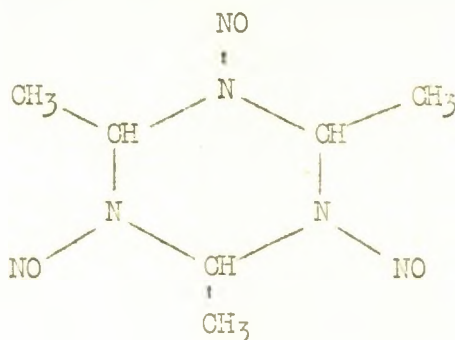
"Aldehyde Ammonia".



(See Moerman, Z.Krist., 1938, 98, 447, for structure of "aldehyde ammonia").

Para. 114

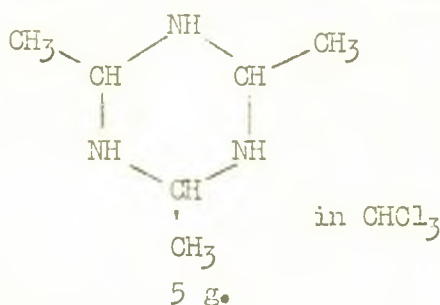
1:3:5-Trinitroso-2:4:6-trimethyl-(6-ring)



m.p. 161°

From EtOH, C<sub>6</sub>H<sub>6</sub> or CHCl<sub>3</sub>.

Delépine, Comptes rendus, 1907, 144, 853.



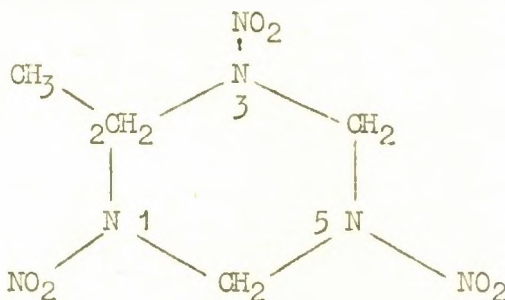
N<sub>2</sub>O<sub>3</sub> at -23°  
in CHCl<sub>3</sub>

1:3:5-Trinitroso-  
2:4:6-Trimethyl-  
6-Ring.

0.3 g.

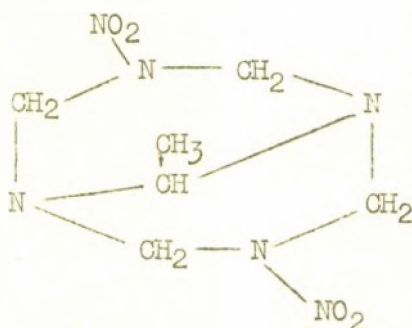
Para. 115

1:3:5-Trinitro-2-methyl-(6-ring)



m.p. 175-185°.

Toronto workers (U.S.A. - Canada RDX Committee Meeting, April '44; SR7/44/1594) suggest this may be the structure of the unstable by-product of the reaction,



HNO<sub>3</sub>

HMX

+

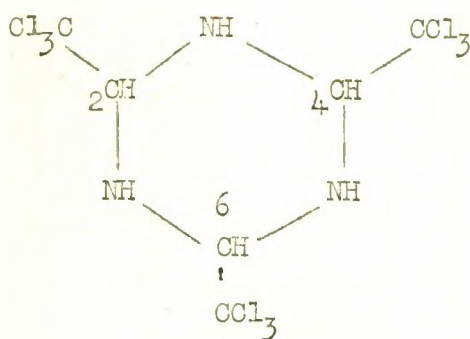
unstable  
compound

m.p. 175-185°.

(See p. 147)

See Toronto, X.R. 16 Rep., 1 Sept. '44; SR7/44/3158.

2:4:6-Tris(trichloromethyl)-(6-ring)



From  $\text{CHCl}_3$  or  $\text{NH}_2\text{CHO}$

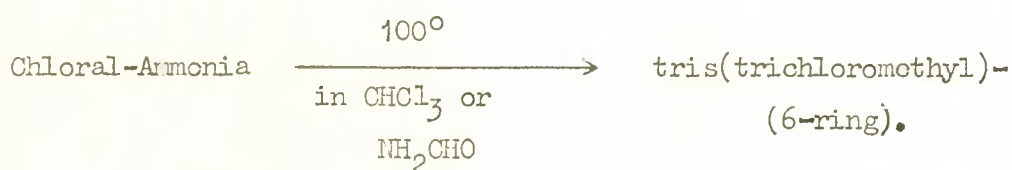
$\alpha$  stereoisomer, m.p.  $105-106^\circ$ .

$\beta$  stereoisomer, m.p.  $150-155^\circ$ .

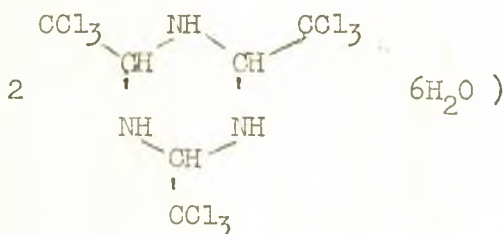
Meyer-Jacobson, Lehrbuch, I. 2, 873.

Delépine, Bull.Soc.chim., 1896, [3], 19, 171.

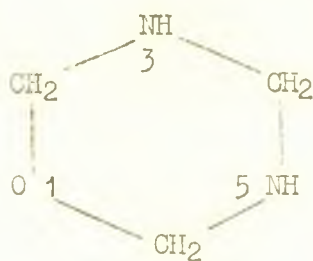
Orndorff and White, Amer.Chem.J., 1894, 16, 67.



(probably

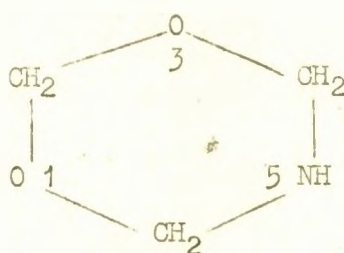


Para. 117 DERIVATIVES OF cyclo-1-oxo-2:4:6-trimethylene-3:5-diamine



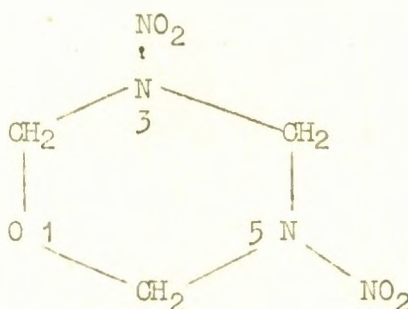
and

Cyclo-1:3-dioxo-2:4:6-trimethylene-5-amine,



Paras. 118, 119

"Cyclonite Oxide"



3:5-Dinitrocyclo-1-oxo-2:4:6-trimethylene-3:5-diamine.

From  $H_2O$ ,  $MeOH$ ,  $CHCl_3$  or  $C_6H_6$ , m.p.  $97-99^\circ$ .

A.R.D. RDX Rep. 2.

Hex. nitrolysis + fume off; mother liquor evaporated to  
small bulk  $\longrightarrow$  "Cyclonite Oxide"

in very small yield.

Para. 118 (Continued)

"Cyclonite Oxide" (Continued)

Toronto; C.E.12 Prog.Rep., Jan. '41; SR7/72: C.E.12 Prog.Rep.,  
30 Nov. '41; SR7/1173.

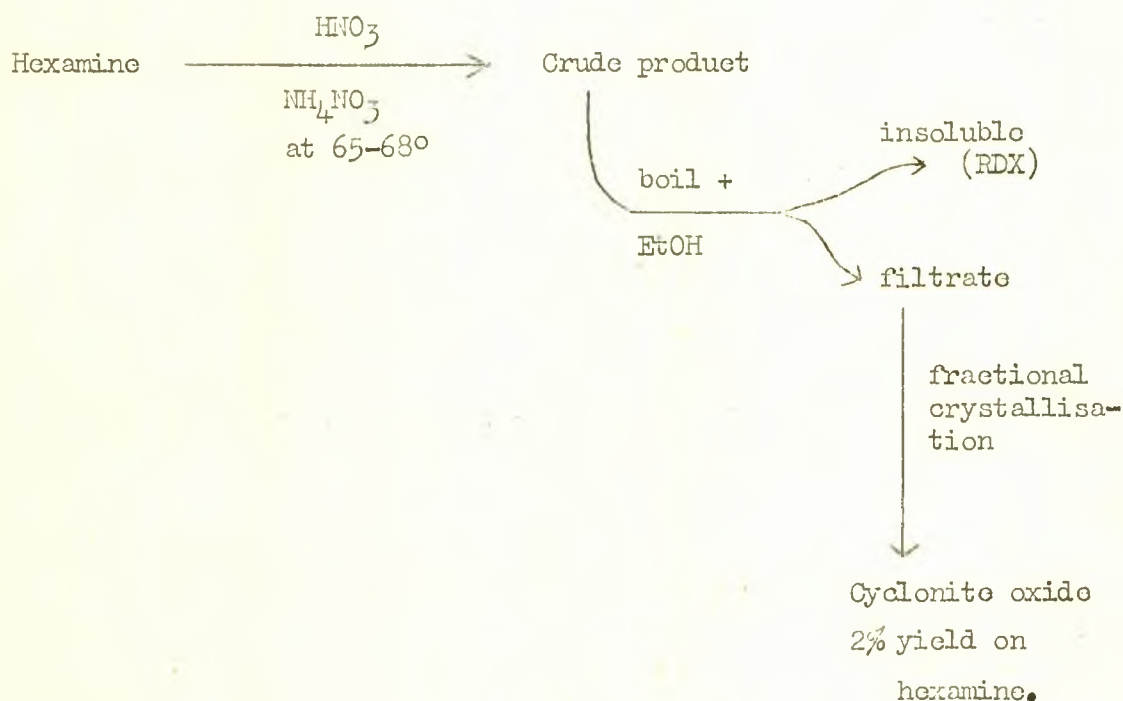
Isolated cyclonite oxide from hexamine recovered from  
Toronto modification of ARD process. ( $\text{CH}_2\text{O}$  recovery as  
hexamine). This hexamine contains 5% "cyclonite oxide",  
separated by flotation with  $\text{CHCl}_3$ .

ARD, Prep. RDX(B) Prog.Rep.5, Exp.Rep.28/4/42, April '42,  
isolated cyclonite oxide from mother liquors from  
Combination Process using "slurry technique" (i.e. add  
slurry of (Hex. +  $\text{NH}_4\text{NO}_3$ :  $2\text{HNO}_3$ ) to  $\text{Ac}_2\text{O}$ ). Not found in  
mother liquors from Combination Process using "Liquid Feed  
Technique" (i.e. (Hex. in  $\text{H}_2\text{O}$ ) + ( $\text{NH}_4\text{NO}_3$ :  $2\text{HNO}_3$ ) + ( $\text{Ac}_2\text{O}$ )).

See also ARD, Prep.RDX(B) Prog.Rep. 9, Exp.Rep.293/43, July '43, A.C.4628.

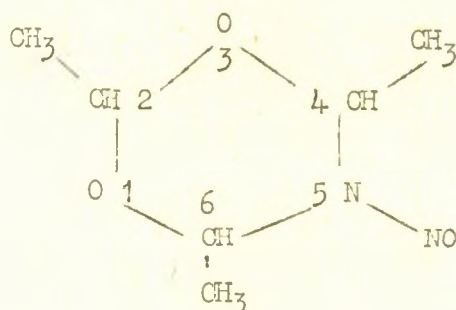
Para. 119

Toronto, X.R.16 Prog. Rep., 15 Jan. '43; SR7/3721.



See Cal. Tech., Div. 8 Int.Rep.R.R.C.21, Aug.-Sept. '44; SR7/44/3207; for  
chromatographic purification of crude cyclonite oxide.

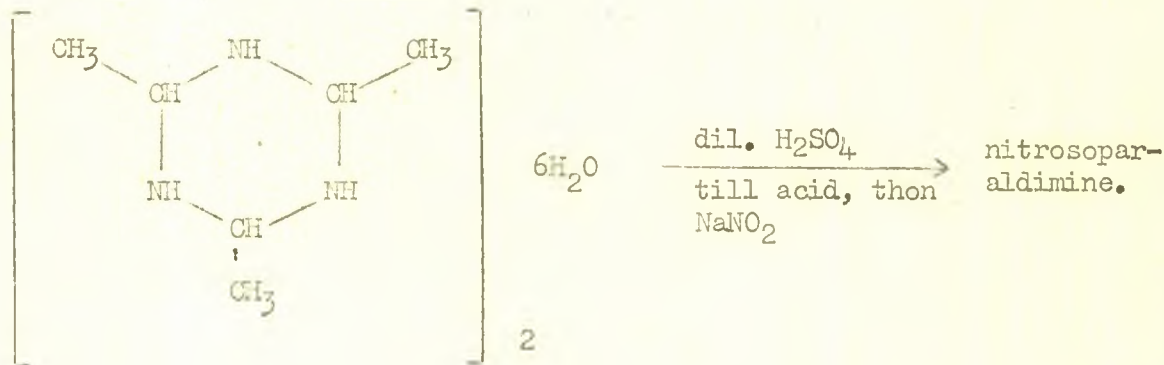
Nitrosoparaldehyde



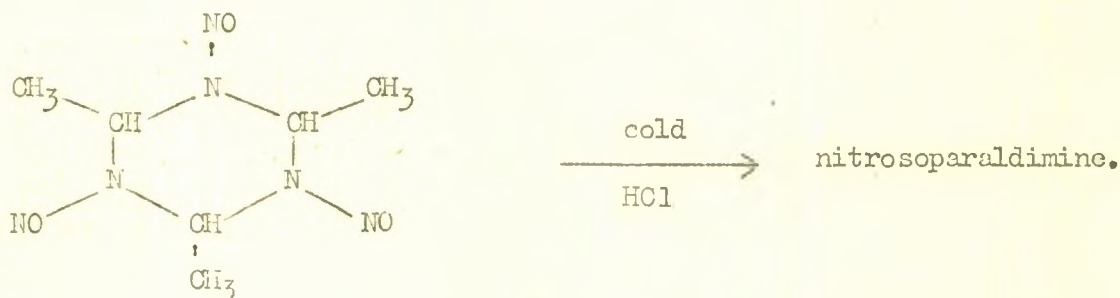
5-Nitroso-2:4:6-trimethylcyclo-1:3-dioxo-2:4:6-trimethylene-5-amine.

Yellow oil, b.p. 95°/35 mm.

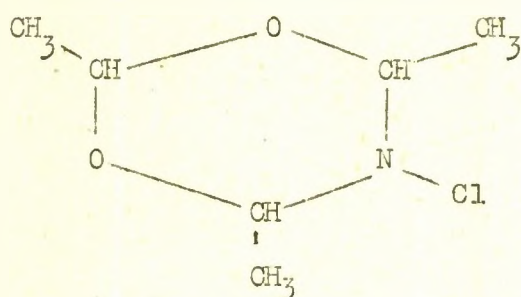
Curtius and Jay, Ber., 1890, 23, 744.



Delépine, Comptes rendus, 1907, 144, 853.



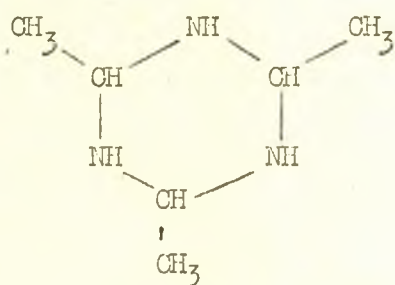
5-Chloro-2:4:6-trimethylcyclo-1:3-dioxo-2:4:6-trimethylene-5-amino



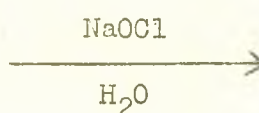
Very unstable.

Deflagrates on drying.

Delépine, Comptes rendus, 1899, 128, 105.

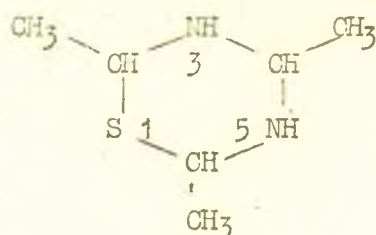


in HOAc



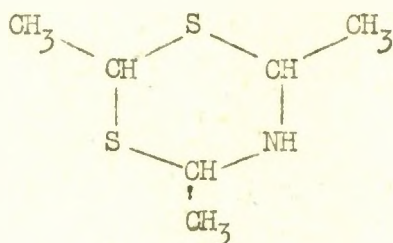
above N - Cl  
compound.

2:4:6-Trimethyl-cyclo-1-thio-2:4:6-trimethylene-3:5-diamine,



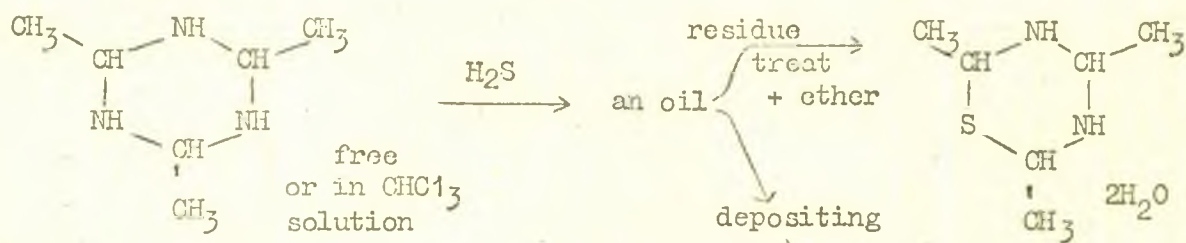
(m.p. of hydrate,  
+ 2H<sub>2</sub>O, 70°).

and 2:4:6-Trimethyl-cyclo-1:3-dithio-2:4:6-trimethylene-5-amine (thialdine)



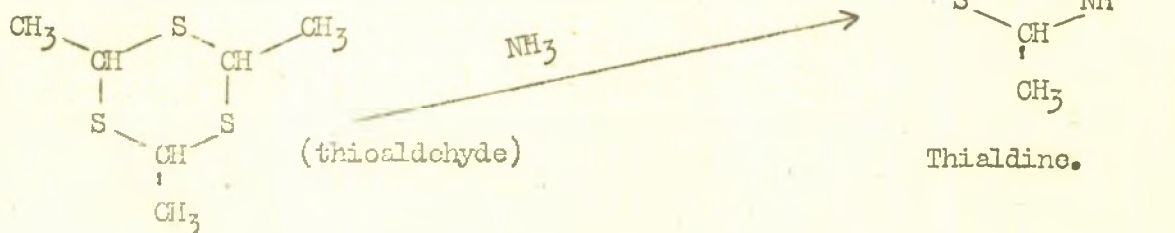
are known.

Delépine, Comptes rendus, 1899, 128, 105.



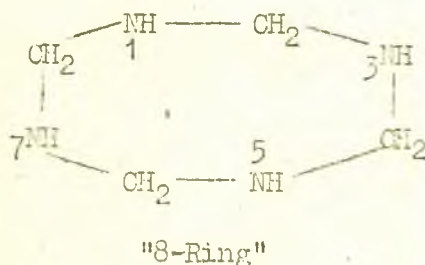
dehydrated  
"aldehyde ammonia"

Markwald, Ber., 1896, 19, 1827.



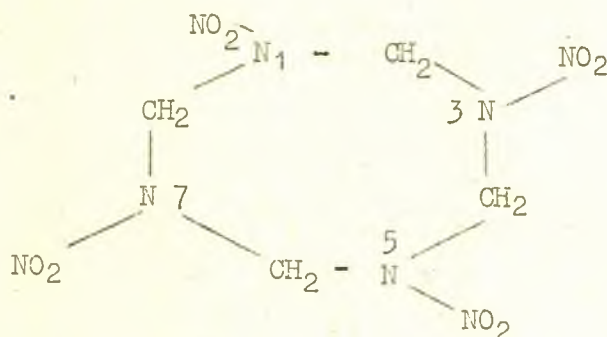
Thialdine.

Para. 123. DERIVATIVES OF Cyclo -2:4:6:8-TETRAMETHYLENE-1:3:5:7-TETRAMINE



Para. 124

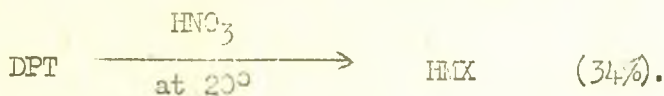
HMX



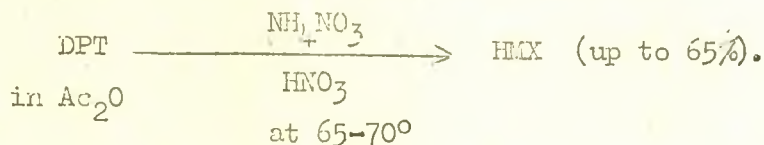
1:3:5:7-Tetranitro - (8-ring).

From AcMe, HOAc, dil.  $\text{HNO}_3$ ,  $\text{CH}_3\text{NO}_2$ ; m.p.  $281-282^\circ$ .

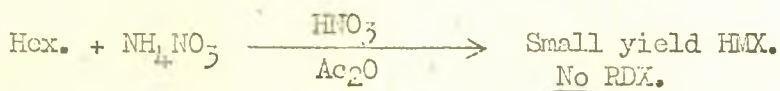
Toronto, C.E.12 Prog. Rep., Jan. '41; SR7/72.



Toronto, C.E.12 Prog. Rep., Nov. '41; SR7/1172.



Toronto, C.E.12 Prog. Rep., Aug. '41; SR7/643.



Toronto, C.E.12 Prog. Rep., Aug. '41; SR7/643:

C.E.12 Prog. Rep., Sept. '41; SR7/689.

Michigan, N.D.R.C. Prog. Rep., Oct. '41; SR7/874.

HMX is present in RDX(B) (up to 10%, usually about 3%).

Separated by (a) difficult fractional crystallisation;

(b) fractional hydrolysis in alkali (RDX decomposed,

HMX stable). See O.S.R.D. Rep. 1711, August '43, SR7/43/450, for a review of the methods of analysing HMX-RDX mixtures.

Para. 124 (Continued)

HMX (Continued)

Toronto, C.E.12 Prog.Rep., Sept. '41; SR7/689.

Ross reaction RDX contains some HMX.

Para. 125

Michigan Div.8 Int.Reps., R.R.C.3, March '43; SR7/4179.

Int.Reps., R.R.C.4, April '43; SR7/4180.

Int.Reps., R.R.C.6, June '43; SR7/4879.

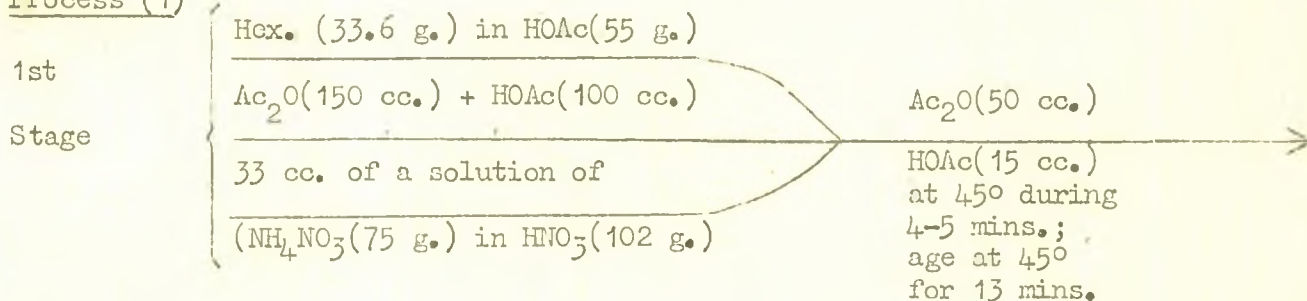
Int.Reps., R.R.C.7, July '43; SR7/43/197.

Int.Reps., R.R.C.9, Sept. '43; SR7/43/924.

Modifications of Bachmann Combination RDX(B) process to give product containing high percentage of HMX. For example (from above reps.

R.R.C.3 and 4),

Process (1)



2nd Stage

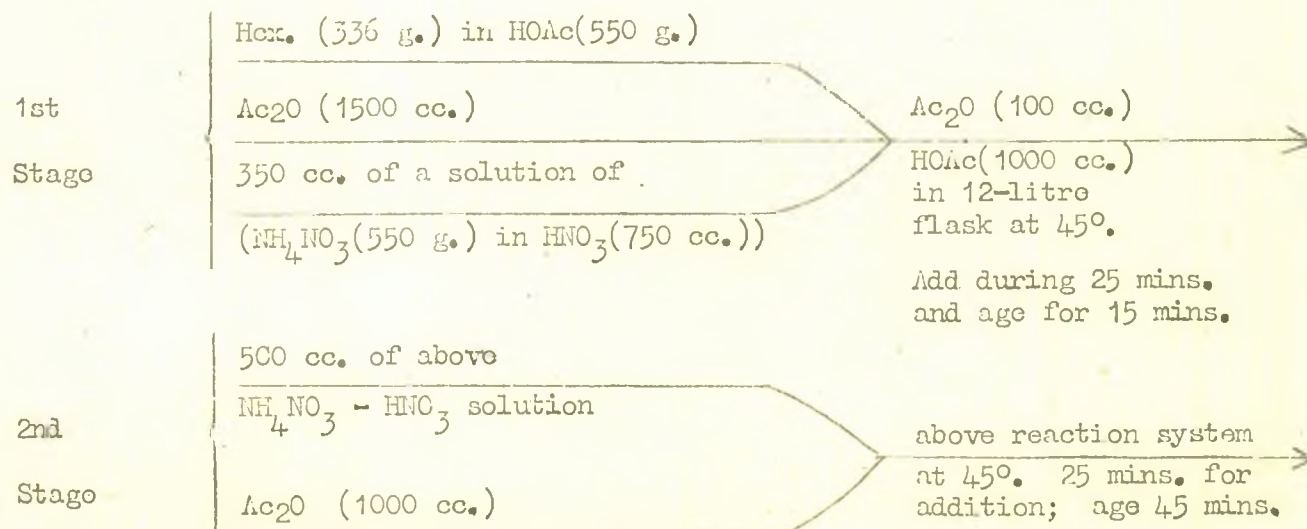
Then heat fast to 65° and add remaining 50 cc. of  
(NH<sub>4</sub>NO<sub>3</sub>(75 g.) in HNO<sub>3</sub>(102 g.)) fast, cooling to keep  
at 65-70°.

Cool, add 500 cc. H<sub>2</sub>O: simmer 4-5 hrs. Destroy RDX by boiling  
with pH 9 borax buffer.

Yield, 30-40% pure HMX.

(Crude product usually contains 50-60% HMX).

Process (2) (Above Ref. R.R.C.6).

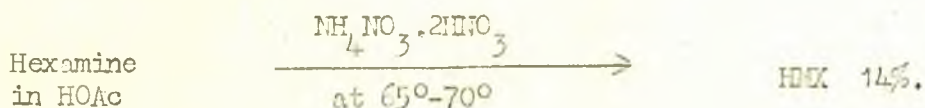


Para. 125 (Continued)

HMX (Continued)

Pour into 22-litre flask containing 6 litres of water and simmer overnight. Cool, collect, wash and dry at 65° overnight. Product, 511 g., contains 85% HMX (61% overall yield of HMX on hexamino).

A.R.D. Prep. RDX(B) Prog.Reps. 3, Exp.Rep. 4490/41; and 4, Exp. Rep. 107/42, Jan. '42.



Para. 125a

Toronto, X.R.16 Rep., May '43; SR7/4436.

Bristol, Br. Rep. 23, May '43; A.C.4237.

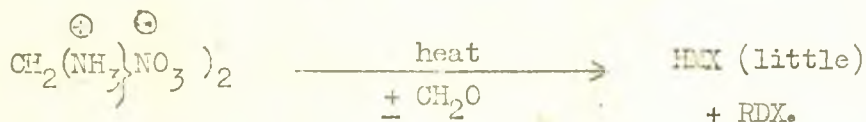
ARD, Exp.Rep. 256/43, Aug. '43; A.C.4629.

RDX from Hexamine nitrolysis contains traces of HMX. HMX isolated from mother liquors of the hexamine nitrolysis process

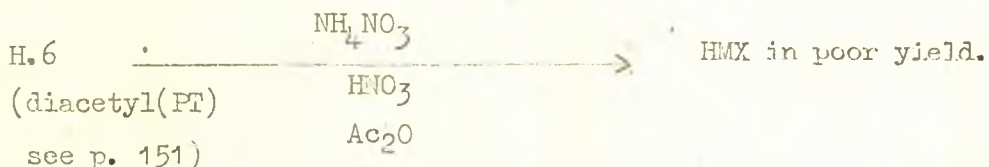
(HMX:RDX in process = 1:3000).

(ARD; Exp.Rep. 183/43, May '43; A.C.4231).

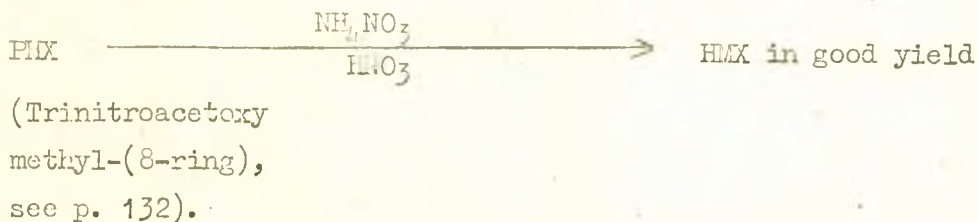
McGill, C.E.53, Prog.Rep., 1 Jan. '42; SR7/1436.



Harvard N.D.R.C.Rep., Oct. '42; SR7/3263.



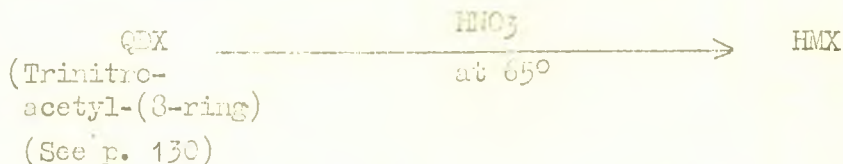
Michigan, Div.8 Int.Rep. R.R.C. 1, Jan. '43, SR7/3748.



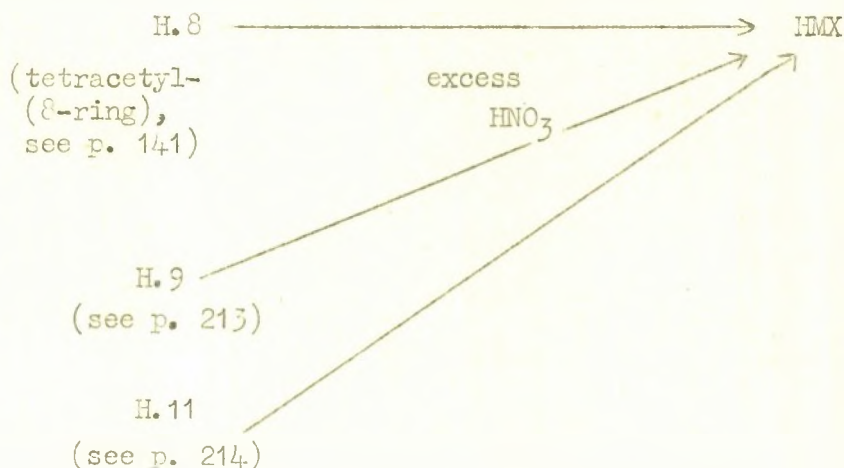
HMX (Continued)

Toronto X.R.16. Prog.Rep. 15 April '43; SR7/4313.

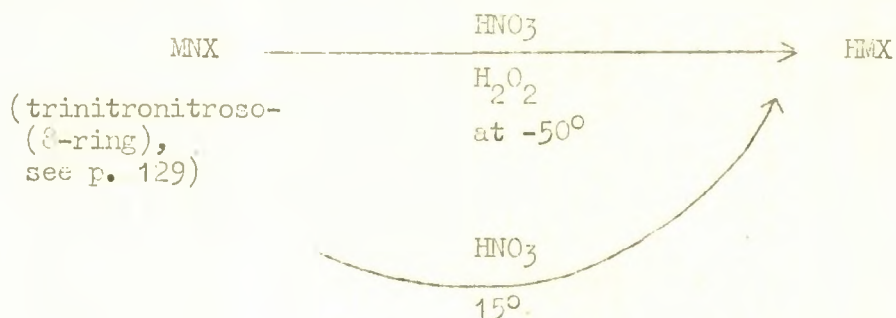
X.R.16. Prog.Rep. July '43; SR7/43/303.



Univ. Penn., O.S.R.D. Rep. 1733, July '43; SR7/43/448.



Michigan, Div.8 Int. Rep., R.R.C.13, Jan. '44; SR7/44/915.

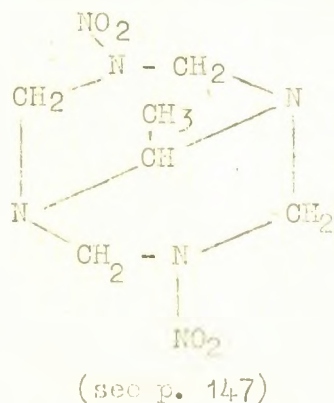


Bristol Res.Rep.117;

March '44; A.C.6046.

Toronto, U.S.A., Canada RDX Committee Meeting, April '44; SR7/44/1594;

X.R.16 Rep., 1 Sept. '44; SR7/44/3158.



(see p. 147)



22% yield  
+ unstable compound  
which may be 1:3:5-  
trinitro-2-methyl-  
(6-ring).

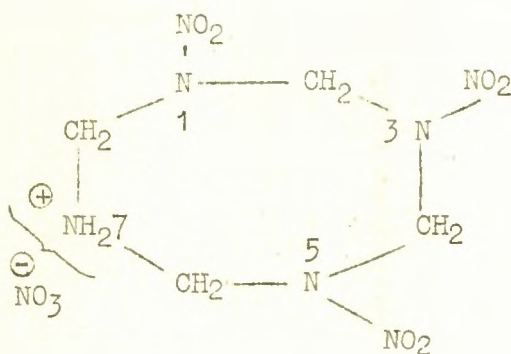
For the complicated polymorphism of HMX see Cornell, O.S.R.D., Rep. 1227:

Feb. '43; SR7/3858: O.S.R.D. Rep. 3014, Aug. '44; SR7/44/2863.

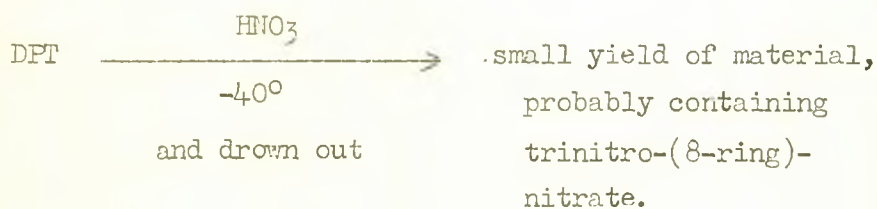
ARD. S.A.C. Paper, March '43; A.C.3714.

Para. 128

1:3:5-Trinitro-(8-ring)-7-nitrate



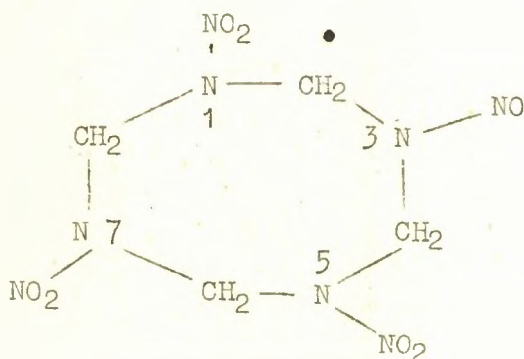
Bristol Res. Rep. 128, June '44; A.C.6477.



Para. 129

MX (Michigan)

Nitroso-HMX (Bristol)



1:5:7-Trinitro-3-nitroso-8-ring.

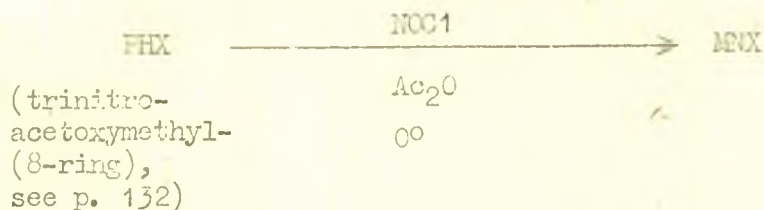
From AcMe + EtOH.

m.p. 236° (up to 243°).

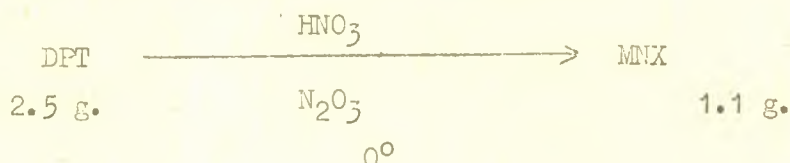
Para. 129 (Continued)

MX (Continued)

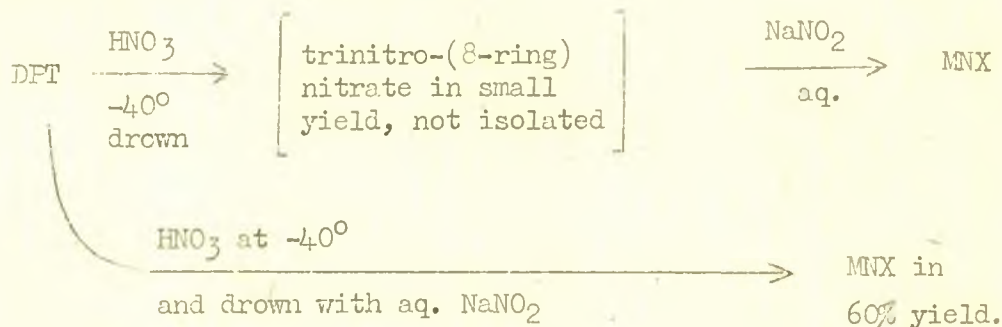
Michigan, Div. 8 Int.Rep. R.R.C.13, Jan. '44; SR7/44/915.



Bristol Res. Rep. 117, March '44; A.C.6046.



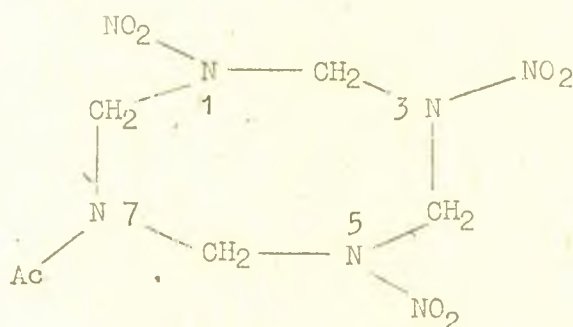
Bristol Res. Rep. 128, June '44; A.C.6477.



Paras. 130, 131

QDX (Toronto)

SEX (Penn. State).



1:3:5-Trinitro-7-acetyl-(8-ring).

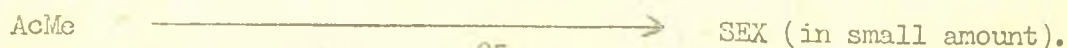
From AcMe and  $\text{CH}_3\text{NO}_2$

m.p. 224-225°.

Penn. State, N.D.R.C., Prog.Reps., Sept. '42; SR7/3046:

Dec. '42; SR7/3673.

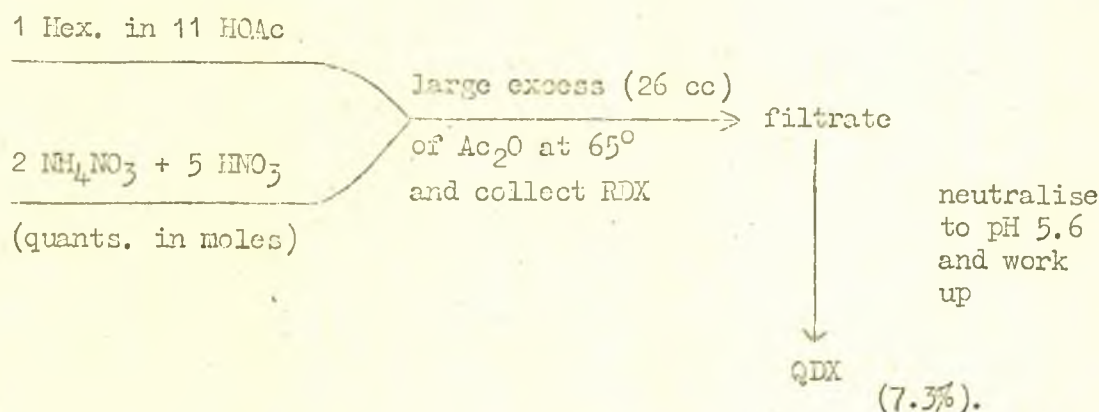
Filtrate from RDX(B), Bachmann Combination run, treat with  $\text{NH}_3$  to pH 2 and work up by fraction crystallisation from



Para. 130 (Continued)

QDX (Continued)

Toronto, X.R.16 Prog.Rep., April '43; SR7/4313.



ARD Prep.PDX(B) Prog.Rep.8, Exp.Rep.173/43, May '43, A.C.4293 and Prog.Rep.9, Exp.Rep.239/43, July '43, A.C.4628, isolated and identified QDX from RDX(B), Bachmann Combination run, by dilution, neutralisation and fractional precipitation and crystallisation.

Para. 131

Toronto, X.R.16 Prog.Rep., May '43: SR7/4549.

Add 1 mole  $\text{NH}_2\text{Ac}$  per mole Hexamine to Hex - HOAc solution and do normal Bachmann Combination run: crude solid product contains RDX, HMX, QDX and TAX. QDX isolated in yield 8%.

Penn. State. Div.8 Int.Rep., R.R.C.2, Feb. '43; SR7/3867; and

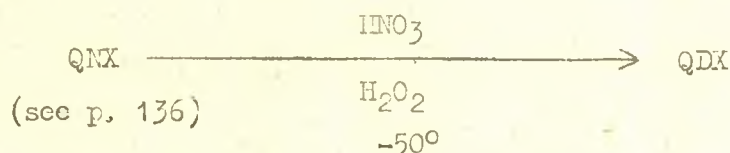
Cornell O.S.R.D.Rep.1227, Feb. '43; SR7/3858,

show by mixed m.p. and crystallography that QDX is identical with SEX.

Toronto X.R.16 Prog.Rep., July '43; SR7/43/303.

ARD, Prep.RDX(B) Prog.Rep.9, Exp.Rep.239/43, July 43; A.C.4628 showed constitution of QDX.

Michigan, Div.8 Int.Rep. R.R.C13, Jan. '44; SR7/44/915.

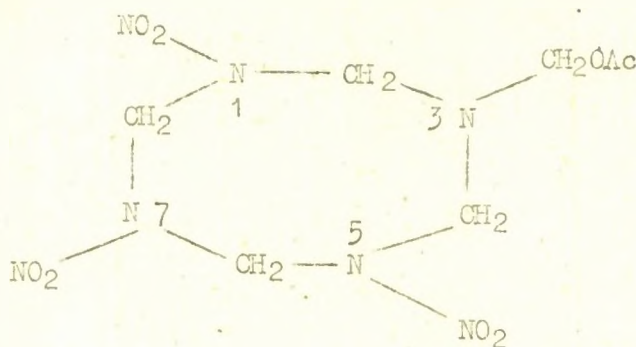


Toronto, X.R.16 Rep. 1 Sept. '44; SR7/44/3158.

Ross Reaction filtrates  $\longrightarrow$  QDX (2.8%).

Para. 132

PHX



1:5:7-Trinitro-3-acetoxymethyl-(8-ring).

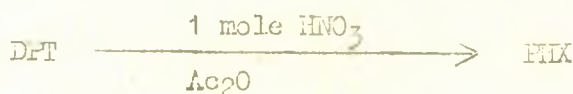
From reaction mixture  
(slowly decomposed by  
organic solvents).

m.p. 156-157°.

Michigan, M.D.R.C., Prog.Rep. B.M.372, Dec. '42; SR7/3676:

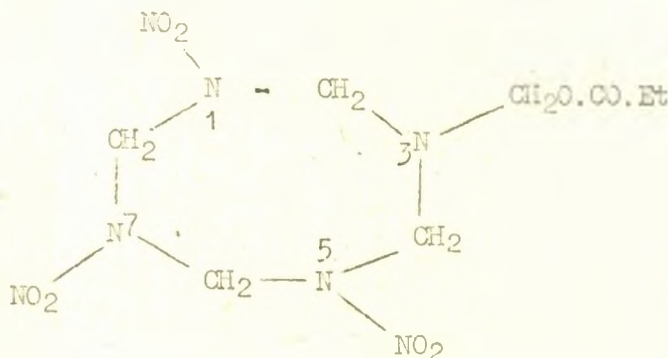
Div.8 Int.Rep.R.R.C.1, Jan. '43; SR7/3748.

Div.8 Int.Rep.R.R.C.2, Feb. '43; SR7/3867.



Para. 132a

PZHX



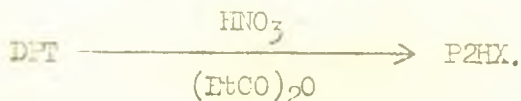
1:5:7-Trinitro-3-propionoxymethyl-(8-ring)

m.p. 120°.

Preparation indicated on diagrammatic representation of Hex, RDX, etc.  
interactions:- "Compounds related to RDX, derived from Hexamine".

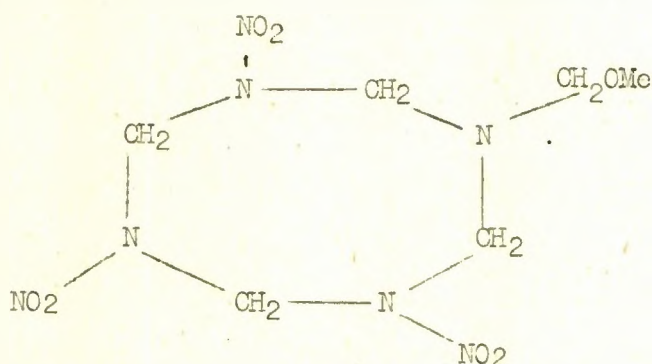
"Revision of 2-10-44" (received London O.S.R.D. office, 25 Feb. '44).

No solvents or conditions.



Para. 133

MeHX



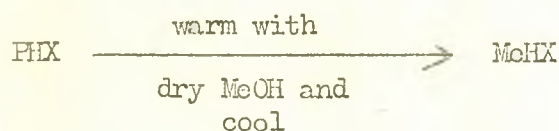
1:5:7-Trinitro-3-methoxymethyl-(8-ring).

From MeOH.

m.p. 138-139°.

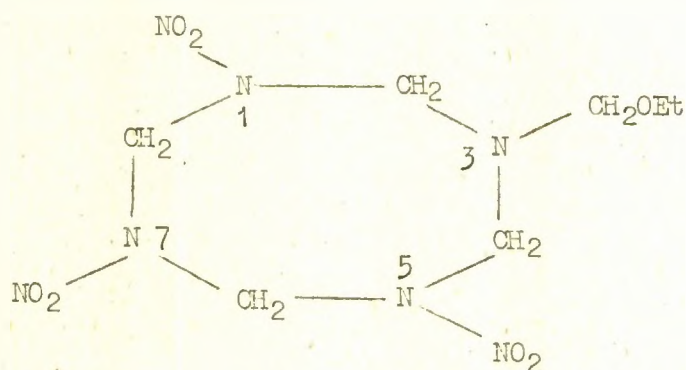
Michigan, Div.8 Int.Rep., R.R.C.2, Feb. '43; SR7/3867.

(Checked by Cornell, Div.8 Int.Rep., R.R.C.4, April '43; SR7/4180).



Para. 134

EtHX



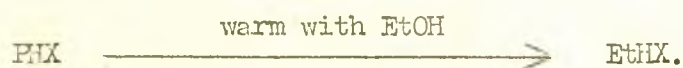
1:5:7-Trinitro-3-ethoxymethyl-(8-ring).

From EtOH

m.p. 115°.

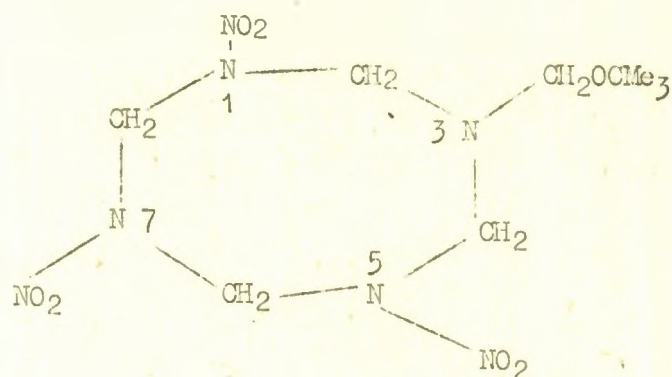
Michigan, Div.8 Int.Rep.R.R.C.2, Feb. '43; SR7/3869.

Checked by Cornell, Div.8 Int.Rep. R.R.C.4, April '43; SR7/4180.



Para. 135

Tertiary Butyl HX

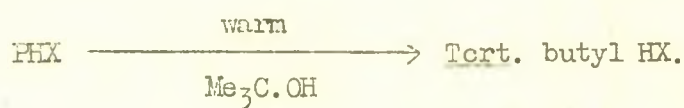


1:5:7-Trinitro-3-tert.nitroxymethyl-(8-ring).

From Me<sub>3</sub>C.OH

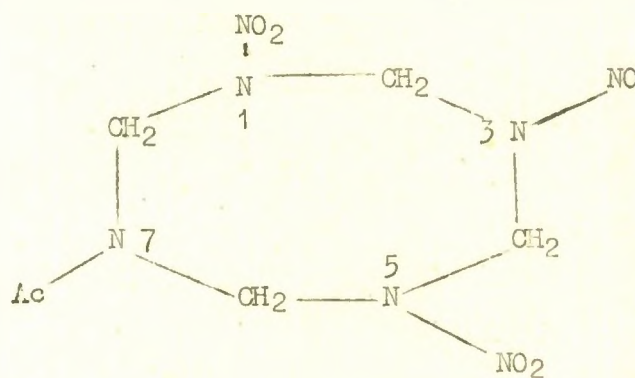
m.p. 129°.

Michigan, Div.8 Int.Rep.R.R.C.2, Feb. '43; SR7/3867.



Para. 136

QNX

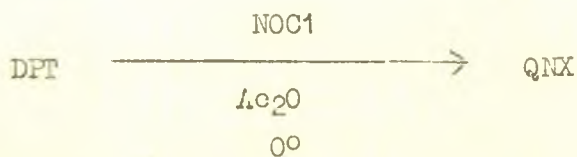


1:5:Dinitro-3-nitroso-7-acetyl-(8-ring).

From AcMc by pptn. with EtOH

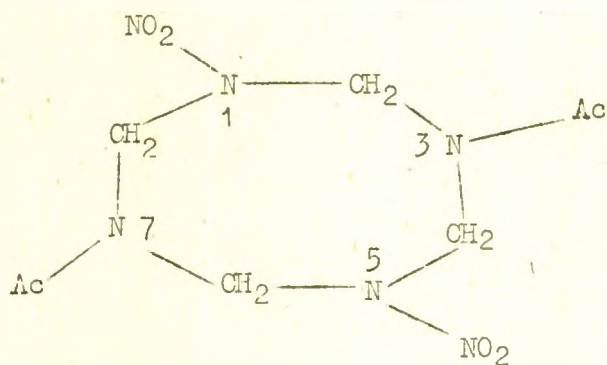
m.p. 181°.

Michigan Div.8 Int.Rep.R.R.C.13, Jan. '44; SR7/44/915.



Para. 137

H.12

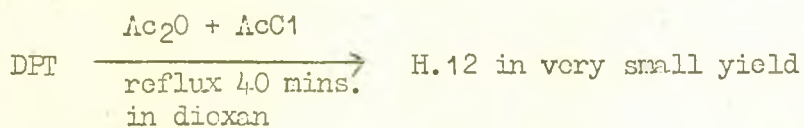


1:5-Dinitro-3:7-diacetyl (8-ring).

From  $\text{CH}_3\text{NO}_2$

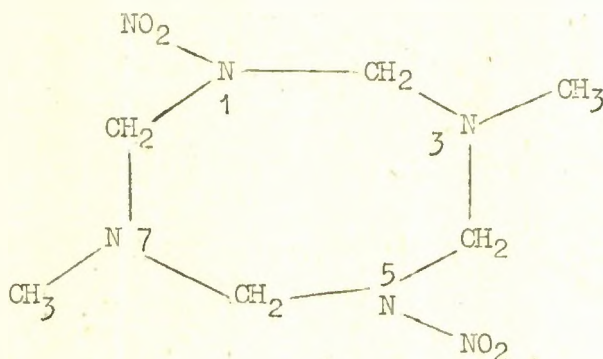
m.p.  $257^\circ$ .

Univ. Penn., O.S.R.D. 1733 Rep., July '43; SR7/43/448.



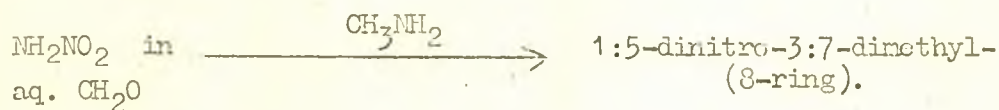
Para. 138

1:5-Dinitro-3:7-dimethyl-(8-ring)



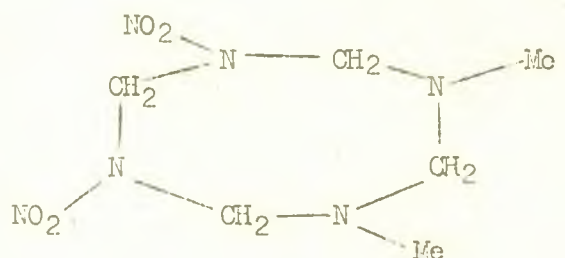
Unstable in hot solvents: cryst. from AcMe, ( $25^\circ$  to  $-40^\circ$ ).  
m.p.  $124^\circ$

Toronto, X.R.16 Rep., 31 Jan. '44; SR7/44/984.



Para. 138A

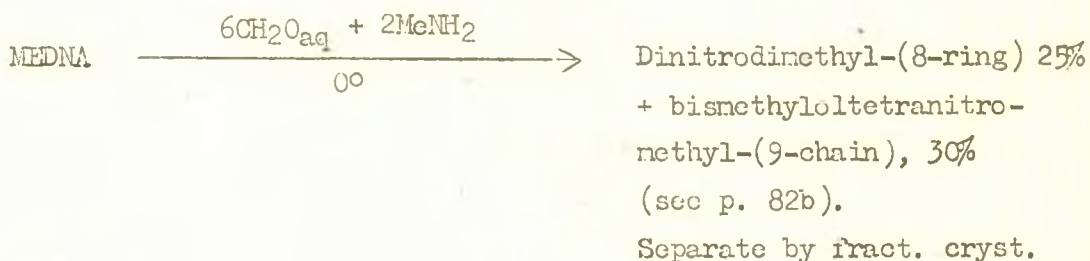
1:7-Dinitro-3:5-dimethyl-(8-ring)



Fract. cryst. from EtOH-AcMe

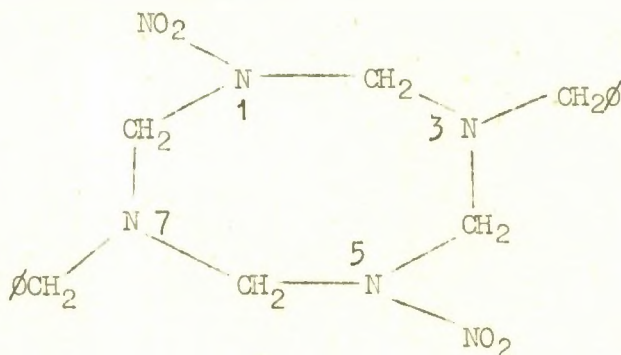
m.p. 108°.

Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/3158.



Para. 139

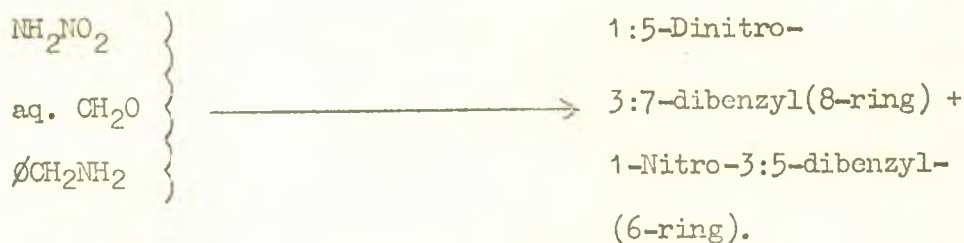
1:5-Dinitro-3:7-dibenzyl-(8-ring)



m.p. 150.5°.

Unstable in hot solvents: cryst. from cold AcMe.

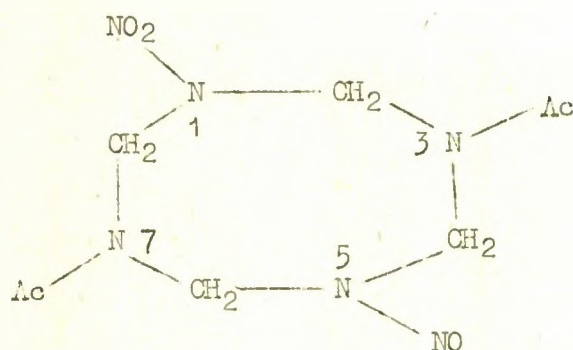
Toronto X.R.16 Rep., 31 Jan. '44; SR7/44/984.



Separated by AcMe solution; see p. 105.

Para. 140

"Nitroso-H.6"

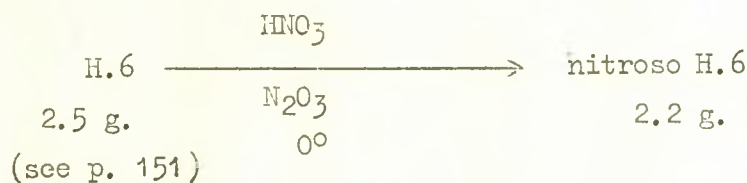


1-Nitro-5-nitroso-3:7-diacetyl-(8-ring).

From CH<sub>3</sub>NO<sub>2</sub>;

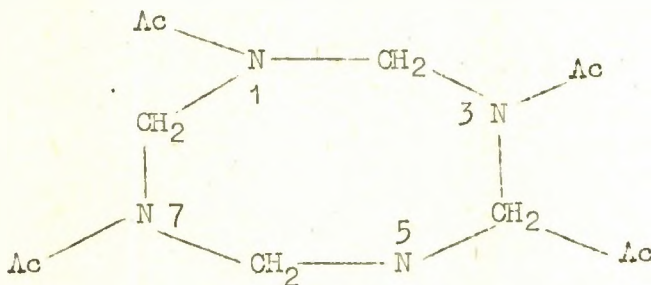
m.p. 224°.

Bristol Res.Rep.117, March '44; A.C.6046.



Para. 141

H.8

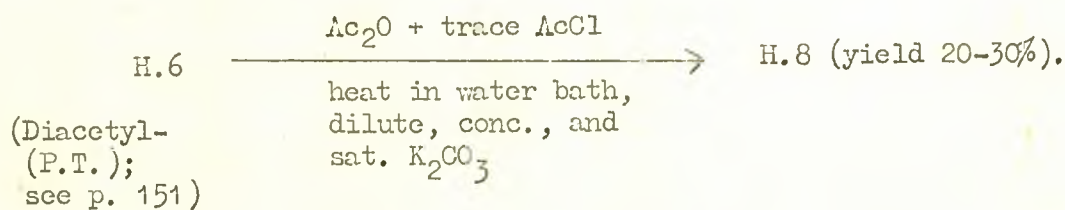


1:3:5:7-Tetracetyl-(8-ring).

From EtOH.

m.p. 157°.

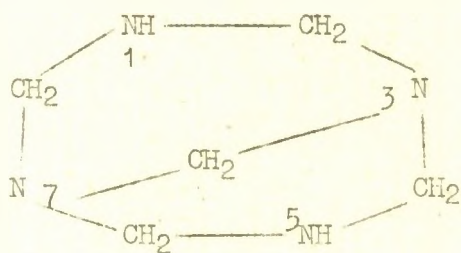
Harvard, N.D.R.C. Rep., Oct. '42; SR7/3263.



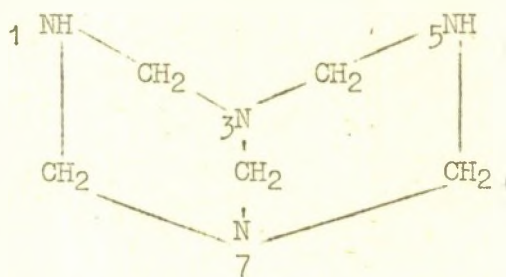
Goes better in CHCl<sub>3</sub> solution.

## DERIVATIVES OF 3:7-ENDOMETHYLENEcyclo-2:4:6:8-TETRAMETHYLENE-

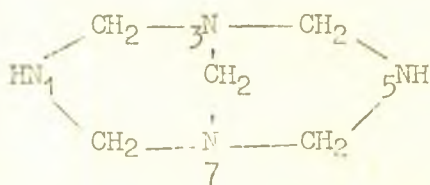
1:3:5:7-TETRAMINE, ("PENTAMETHYLENETETRAMINE"; "PT")



Also drawn in the projections:-



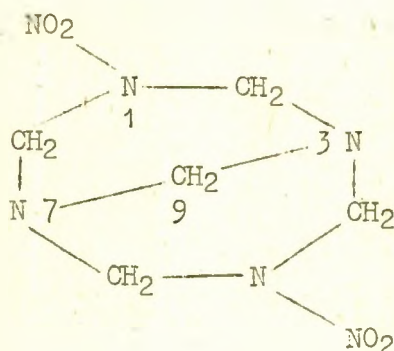
and



Para. 143

DPT (Toronto)

DNPT



1:5-Dinitro-(PT).

From AcMe, AcEt, CH<sub>3</sub>NO<sub>2</sub> or dioxan, usual m.p. 203-206°

(Compound dimorphous: α m.p. 223-224°. (Stable at low temp.)

β m.p. 200°

(Cornell, Div.8 Int.Rep.  
R.R.C.1, Jan. '43;  
SR7/3748)

Toronto, C.E.12 Prog.Rep., Feb. '41.

Prog.Rep., Nov. '41; SR7/1173.

Hexamine nitrolysis, collect RDX and neutralise mother liquor to pH 5.6

(first used ammonia for neutralisation, but any alkali will do)

—————→ DPT  
(up to 20%)

Toronto, C.E.12 Prog.Rep., 31 Dec. '41; SR7/1438:

X.R.16 Prog.Rep., 15 Jan. '43; SR7/3721.

|                                 |                                    |                                     |            |
|---------------------------------|------------------------------------|-------------------------------------|------------|
| NH <sub>2</sub> NO <sub>2</sub> | dissolved in aq. CH <sub>2</sub> O | neut. with<br>NH <sub>3</sub> to pH | DPT        |
| (1 mole)                        | (CH <sub>2</sub> O, 6 moles)       | 5.6                                 | up to 73%. |

Toronto C.E.12 Prog.Rep. Nov. '41; SR7/1173.

|                |                   |        |     |
|----------------|-------------------|--------|-----|
| HADN           | Ac <sub>2</sub> O | —————→ | DPT |
| (Hex.dinitrate | 4 days ca 30°     |        | 30% |
|                | watch temp.       |        |     |
|                | because may get   |        |     |
|                | out of hand.      |        |     |

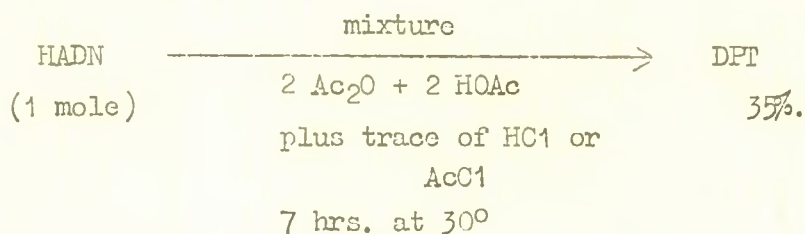
(Checked by Penn.State, N.D.R.C.Rep.274, June '42; SR7/2440).

DFT (Continued)

McGill, C.E.53 Prog.Rep. 1 Jan. '42; SR7/1436.

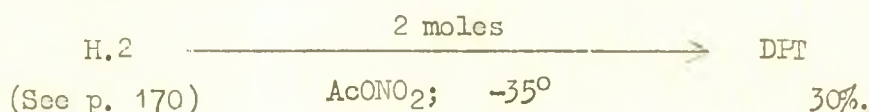


Harvard, N.D.R.C. Prog.Reps. Aug. '42 and Oct. '42; SR7/3263.

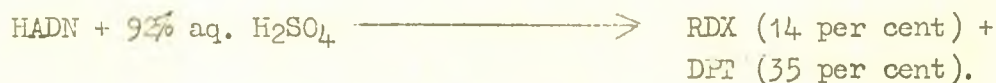
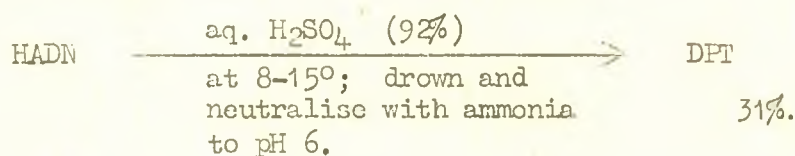


(See also Univ.Penn. C.S.R.D.Rep. 1733, July '43; SR7/43/448).

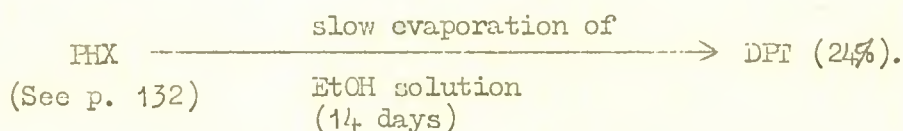
Harvard, N.D.R.C.Prog.Rep., Nov. '42; SR7/3342.



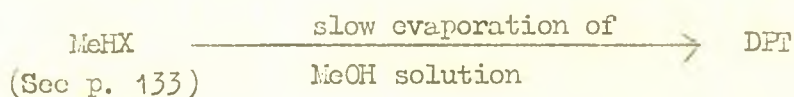
Toronto, X.R.16 Prog.Rep., 15 Jan. '43; SR7/3721.

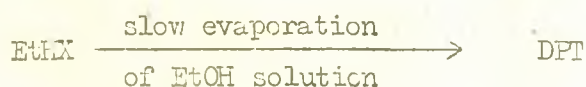


Cornell, Div.8 Int.Rep. R.R.C.3, March '43; SR7/4179.

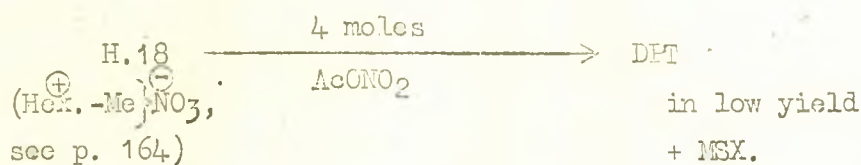


Cornell, Div.8 Int.Rop., R.R.C.4, April '43; SR7/4180.

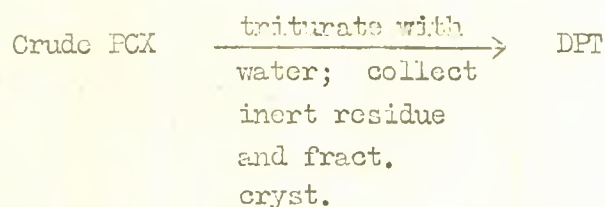


DPT (Continued)

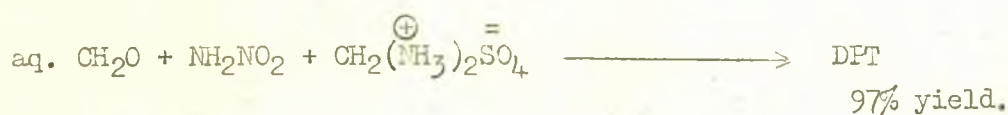
Univ. Penn., Div. 8 Int. Rep., R.R.C.5, May '43; SR7/4766.



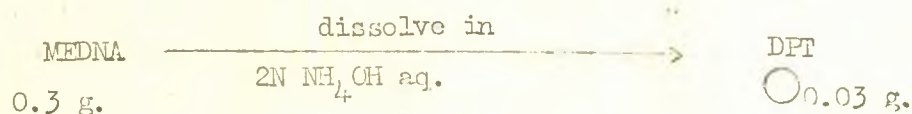
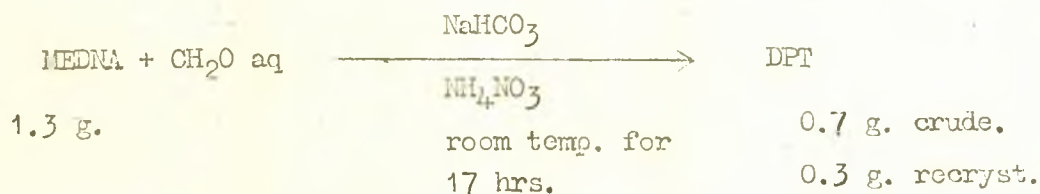
Bristol Br. Rep. 28, Oct. '43; A.C.5058.



Toronto, X.R.16 Rep., 31 Jan. '44; SR7/44/984.



Sheffield Rep. 44, March '44; A.C.6045.



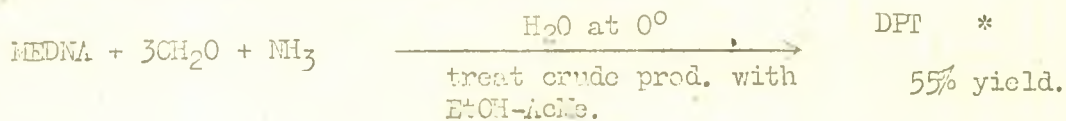
Crude PCX (1.3 g.), shake with H<sub>2</sub>O and filter;



Para. 14.6

DPT (Continued)

Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/3158.

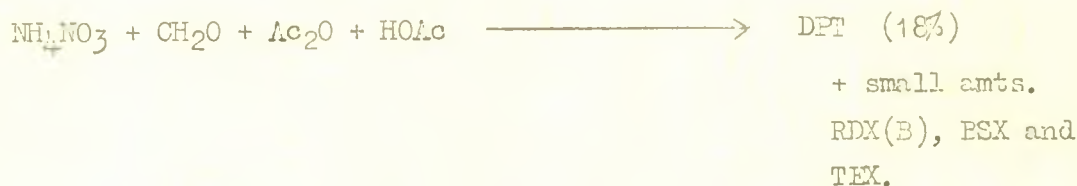


(Done independently by Sheffield workers: see Sheffield Rep. 44).

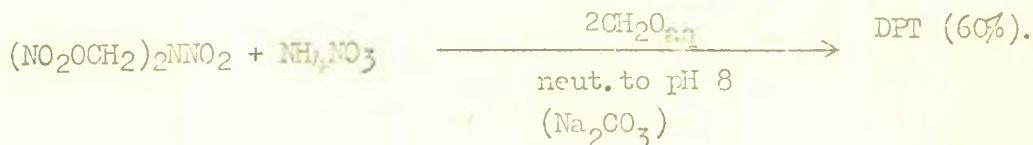
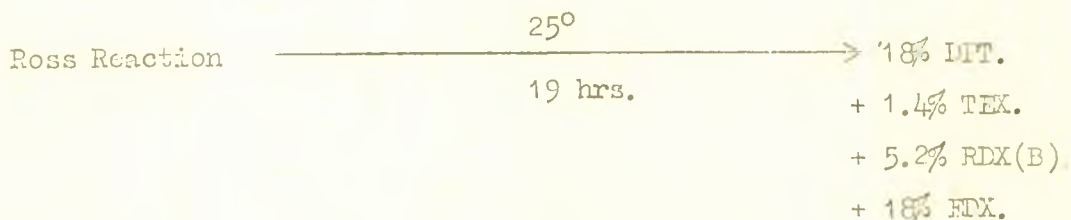
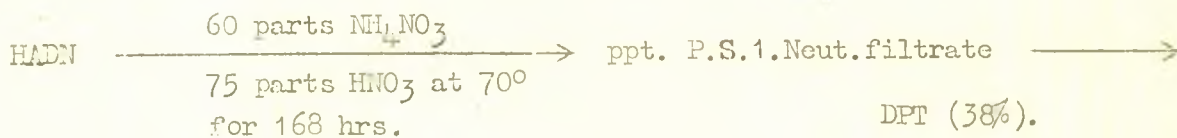


(see Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/3158).

Toronto, X.R.16, Canadian Exp.Res.Extram.Summary, April '44; SR7/44/1747.



Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/3158.



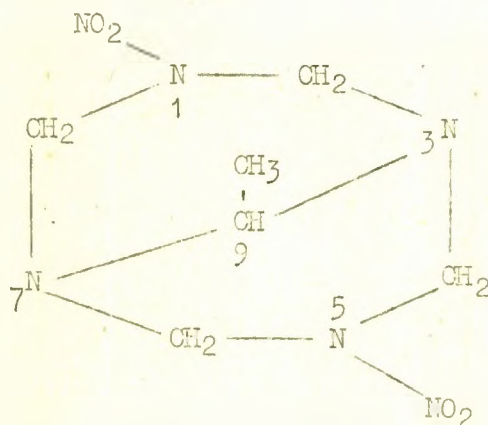
Cal.Tech., Div.8 Int.Rep.R.R.C. 22, Oct. '44; SR7/44/3502.

Chromatography of DPT.

\* Crude product probably contains methylene bis (3:5-dinitro-(6-ring)-1-). Treated with EtOH-AcMe  $\longrightarrow$  conversion to DPT and leaves amorphous residue, m.p.  $141^\circ$  (see p. 103a).

Para. 147

1:5-Dinitro-3:7-endoethylidene-(8-ring)



1:5-Dinitro-9-methyl-(P.T.)

From EtOAc, m.p. 175°.

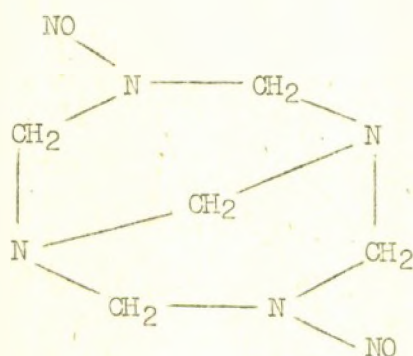
(residue remains at 245°).

Toronto, X.R.16 Repts., 31 Jan. '44; SR7/44/984: 1 Sept. '44; SR7/44/3158.



Para. 148

1:5-Dinitroso-(P.T.)



m.p. 207°.

Griess and Harrow. Ber., 1888, 21, 2737.

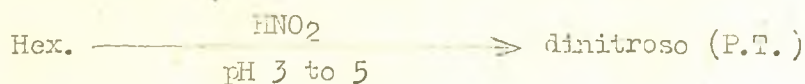
Mayer. Ber., 1888, 21, 2883.

Duden and Scharff. Annalen, 1895, 288, 218 et seq.

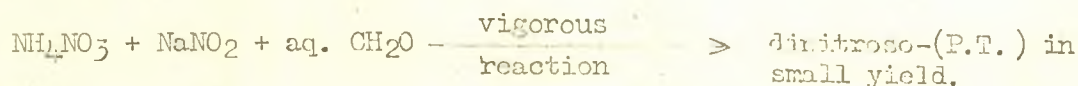
Duden and Scharff.

Add excess  $\text{NH}_3$  aq. to  $\text{CH}_2\text{O}$  aq. and treat with 2 moles  $\text{NaNO}_2$  and  $\text{HOAc}$ .

Michigan, Div.8 Int.Rep., R.R.C.13, Jan. '44; SR7/44/915.

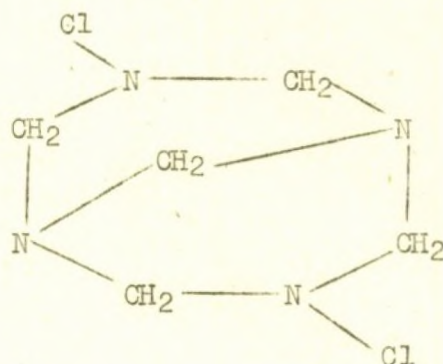


Bristol Res.Rep.129, June '44; A.C.6486.



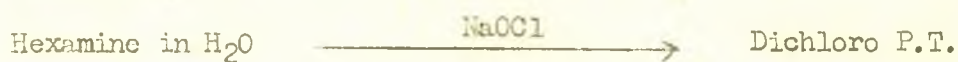
Para. 149

1:5-Dichloro-(P.T.)



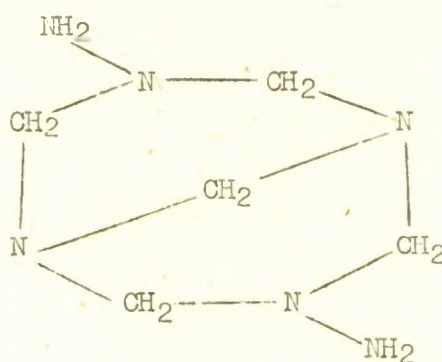
From H<sub>2</sub>O and ether, m.p. 78°.

Delepine: Bull. soc. chim., 1911, (4), 9, 1025.



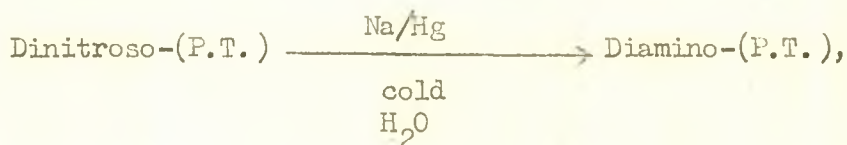
Para. 150

1:5-Diamino-(P.T.)



Not isolated.

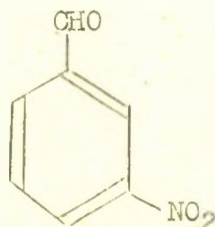
Duden and Scharff, Annalen, 1895, 288, 218.



isolated as (a) dibenzylidene derivative, from EtOH. m.p. 226-7°;

(b) bis-o-hydroxybenzylidene derivative, from CHCl<sub>3</sub>-ether. m.p. 213°.

Also made derivatives from



From EtOH, m.p. 134°.

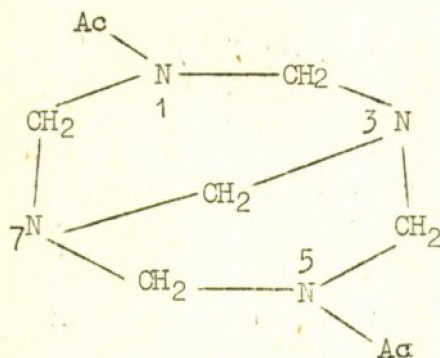
and  $\phi\text{-CH=CH-CH=O}$ .

From EtOH, m.p. 207°.

Para. 151

H.6

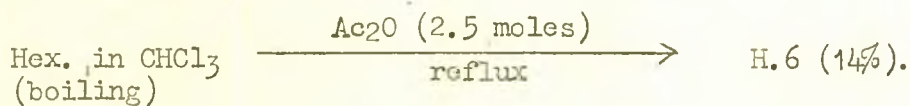
(DAFT)



1:5-Diacetyl - (P.T.).

From EtOH, m.p. 191°.

Harvard, N.D.R.C.Rep., Oct. '42; SR7/3263.

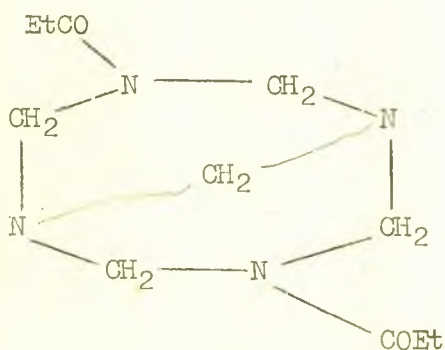


Hex. in 2 parts Ac<sub>2</sub>O, 2 hrs. standing, then add 5 vols. ether. Lower oily layer deposits H.6 (10%).

Compound prepared by Dominikiewicz (Chem.Abs., 1936, 30, 1029) by Ac<sub>2</sub>O on Hex. is probably H.6.

Para. 152

H.17



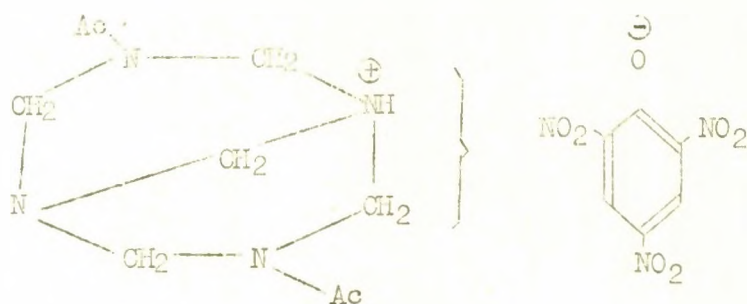
1:5-Dipropionyl-(P.T.).

m.p. 133°.

Univ.Penn., Div.8 Int.Rep., R.R.C.8, Aug. '43; SR7/43/391, refer to this compound, which presumably was made earlier, probably by a method analogous to H.6 preparation (p. 151).

H.17 does not yield a picrate.

H.6 Picrate

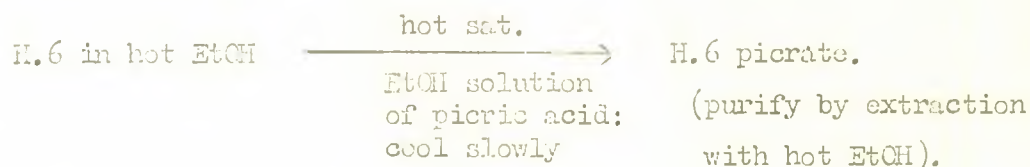


1:5-Diacetyl-(P.T.)-3-picrate.

From reaction mixture and washed with hot EtOH.

m.p. 135°.

Bristol (private communication from Messrs. T. H. Bevan, M. E. Foss, N. H. Woodbury), Oct. '44.



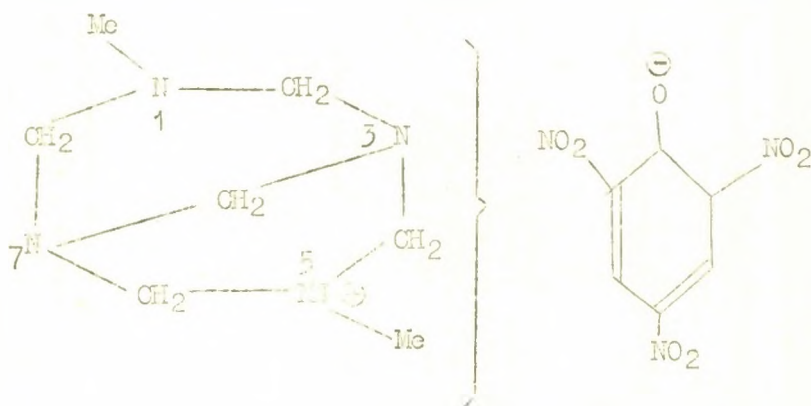
Found: C, 40.4; H, 4.27; N, 21.0.

C<sub>15</sub>H<sub>19</sub>N<sub>7</sub>O<sub>9</sub> requires: C, 40.7; H, 4.31; N, 22.2%.

See p. 216 for other products from H.6 and picric acid reaction.

Para. 153

1:5-Dimethyl-(P.T.) picrate



From AcOH,

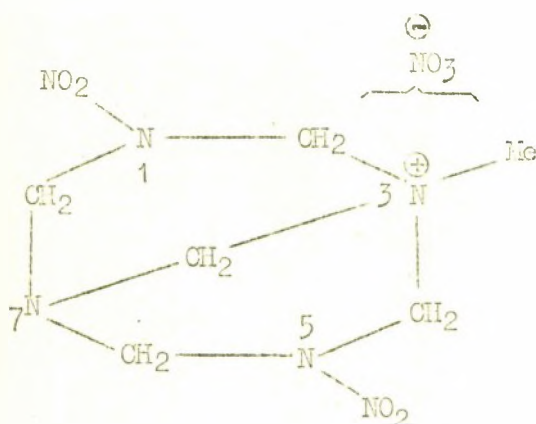
m.p. 195°.

Knudsen, Ber., 1914, 47, 2694.



Para. 154

H.19



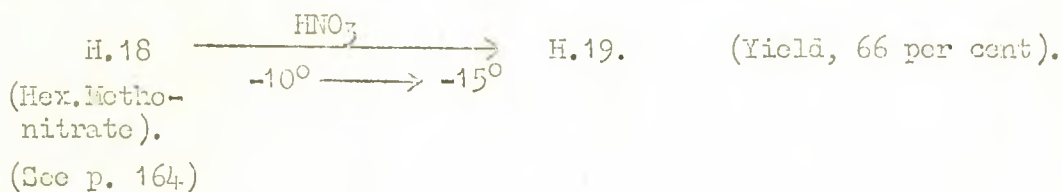
1:5-Dinitro-3-methyl-(P.T.)-3-nitrate.

Washed with water, EtOH, ether.

m.p. 142-143°.

Univ. Penn., Div. 8 Int. Rep., R.R.C.5, May '43; SR7/4766.

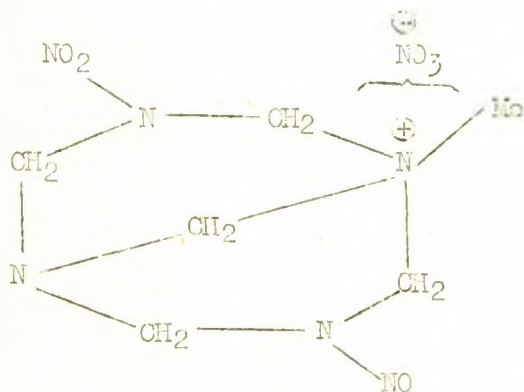
U.S.A.-Canada RDX Committee Meeting, June '43; SR7/4956.



See also, Univ. Penn. O.S.R.D. 1733 Rep., July '43; SR7/43/448.

Para. 155

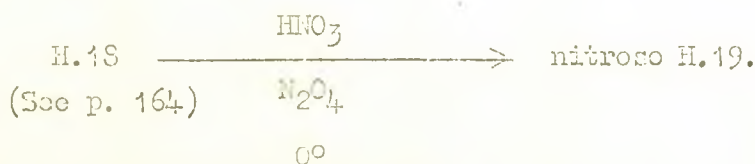
Nitroso-H.19



1-Nitro-5-nitroso-3-methyl-(P.T.)-3-nitrate.

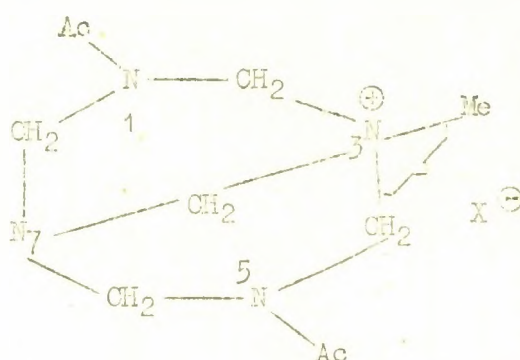
(not recryst., wash + H<sub>2</sub>O, MeOH and ether, m.p. 128-130°).

Bristol Res. Rep. 117, March '44; A.C.6046.



Para. 155A

H.6 Metho-salts



1:5-Diacetyl-5-methyl-(P.T.)-3-salts.

Bristol, (private communication from Messrs. T. H. Bevan, M. E. Foss, N. H. Woodbury), Oct. '44.

X = I.

From MeOH

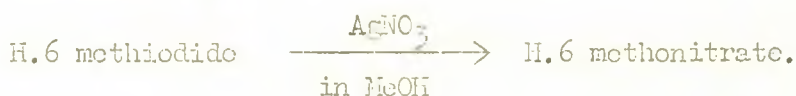
m.p. 180-1°.



X = NO<sub>3</sub>

From MeOH

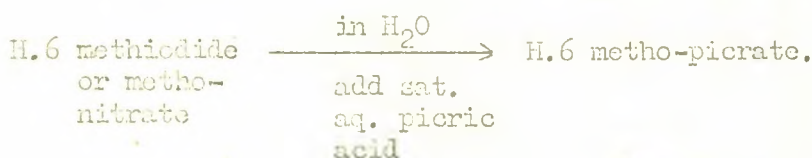
m.p. 181-2°.



X = picrate.

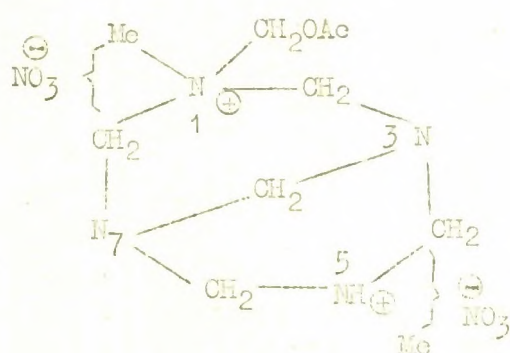
From H<sub>2</sub>O

m.p. 199°.

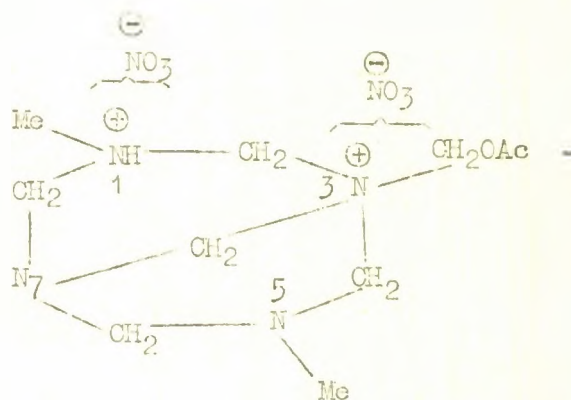


Para. 156

H.23



or



1:5-Dimethyl-1-acetoxymethyl-(P.T.)-1:5-dinitrate  
or 1:5-Dimethyl-3-acetoxymethyl-(P.T.)-1:3-dinitrate.

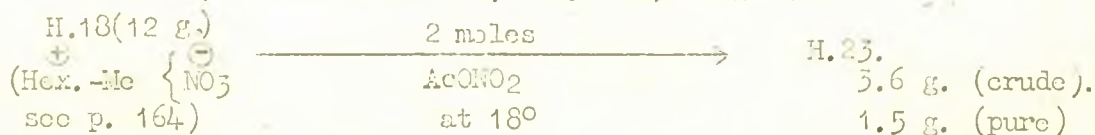
Dissolve in H<sub>2</sub>O and ppt. with HOAc.

m.p. 192°.

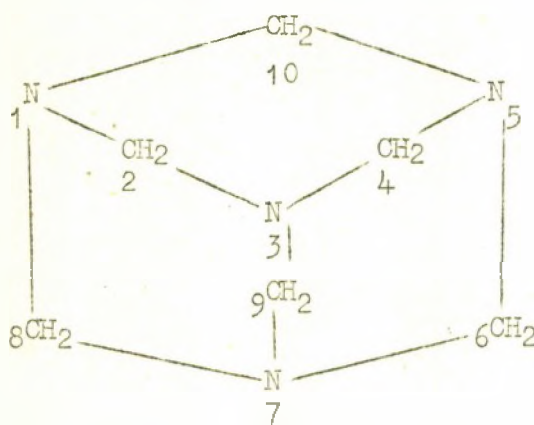
Univ. Penn., Div.8 Int.Rep.R.R.C.5, May '43; SR7/4766, and

Univ. Penn., Div.8 Int.Rep.R.R.C.6, June '43; SR7/4879.

See also Univ. Penn., O.S.R.D.Rep.1733, July '43; SR7/43/44.8.



DERIVATIVES OF HEXAMETHYLENE TETRAMINE



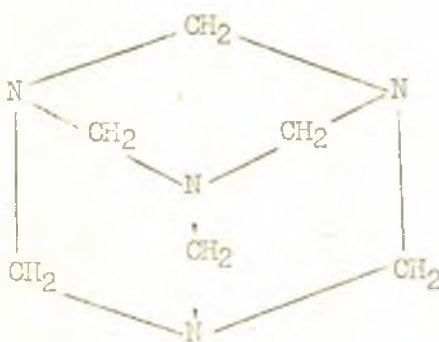
"Hex."

Para. 158

"Hexamethylene tetramine"

"(Hexamine)"

"Hex."



Sublimes with partial decomp.  
on heating.

From water or ethyl alcohol.

Beilsteins Handbuch, I, 584.

See particularly Duden and Scharff, Annalen, 1895, 288, 218 for chemistry.

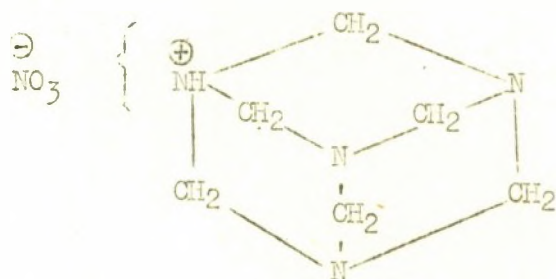


Dickinson and Raymond, J.A.C.S., 1923, 45, 22 and Wyckoff and Corey, Zeit.Krist., 1934, 89, 462 for X-ray crystal analysis giving proof of structure.

Para. 159

HAMN.

Hexamine mononitrate



Hex-1-nitrate

m.p. 158-168°, according  
to rate of heating.

Cambier and Brochet, Bull.soc.chim., 1895, (3), 13, 392.

Harvard, N.D.R.C.Rep., Oct. '42; SR7/3263.

Hex. in water  $\xrightarrow[\text{cold}]{1 \text{ equiv. } 70\% \text{ HNO}_3}$  HAMN.

(1st. Harvard prep. in May '42).

Michigan, Div.8 Int.Rep. R.R.C.12, Dec. '43; SR7/44/508.

Hex. +  $\text{NH}_4\text{NO}_3$   $\xrightarrow[\text{HOAc and cool}]{\text{diss. in warm}}$  HAMN  
14 g.      8 g.      1.8 g.

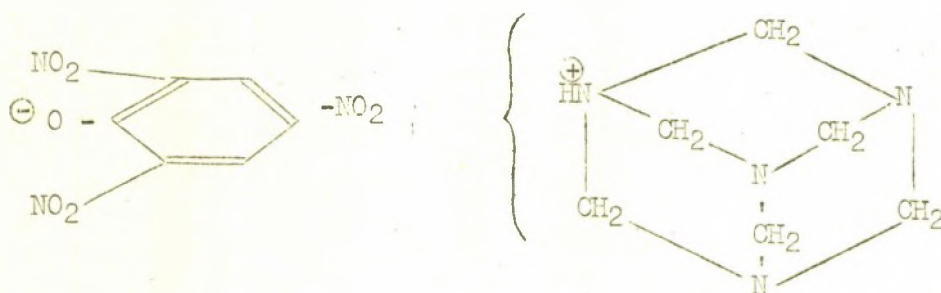
Bristol Res.Rep.113, Jan. '44; A.C.5739.

Hex.  $\xrightarrow[\text{CHCl}_3]{\text{H}_2\text{O}_3}$  HAMN  
14% yield

(probably not a primary product)

Para. 160

Hexamine Picrate

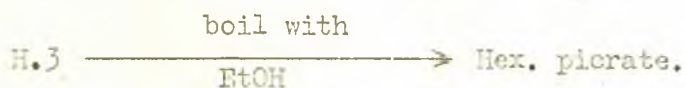


m.p. 178-179°

Moschatos and Tollens, Annalen, 1893, 272, 285.

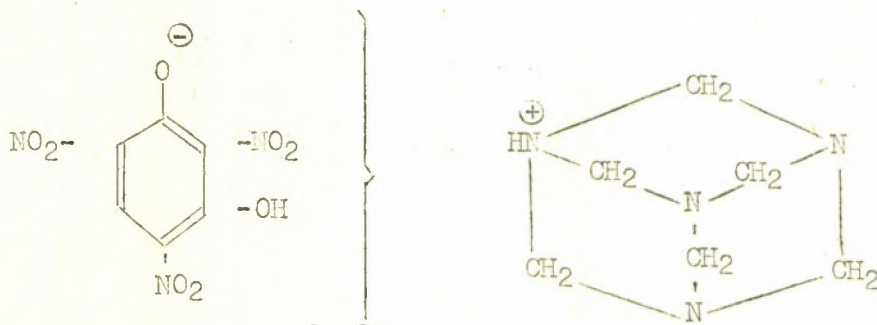


Harvard, N.D.R.C. Rep., Oct. '42; SR7/3263.



Para. 161

Hexamine Styphnate



From  $\text{CH}_3\text{NO}_2$

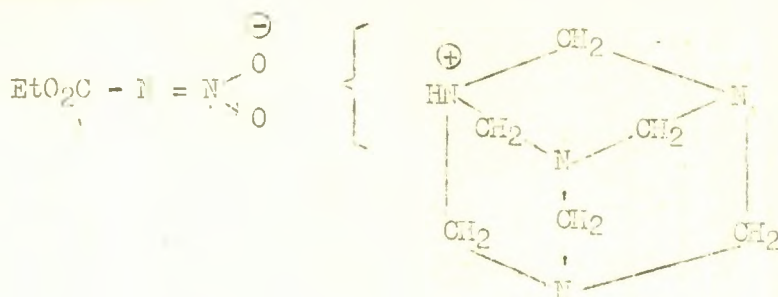
m.p. 197°

Toronto, X.R.16 Rep., 31 Jan. '44; SR7/44/984.



Para. 162

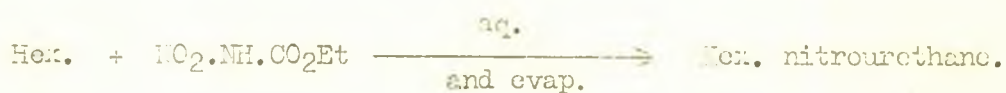
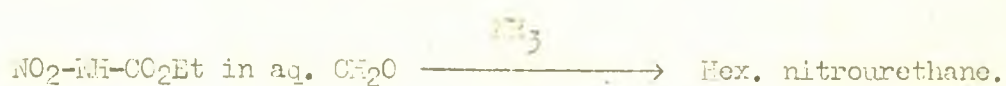
Hexamine Nitrourethane



From EtOH.

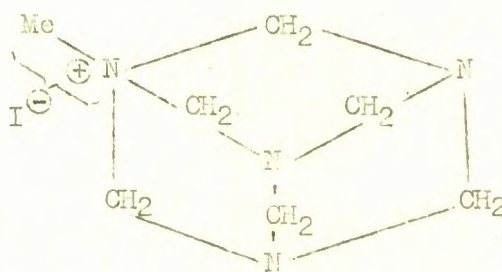
m.p. 136-138°

Bristol Br. Rep. 29, Oct. '43; A.C.5039.



Para. 163

Hexamine Methiodide



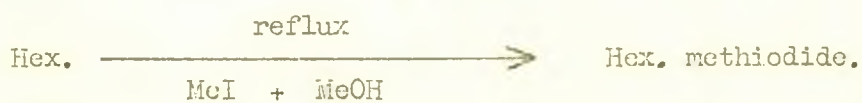
1-Methyl-(Hex.)-1-iodide.

From EtOH

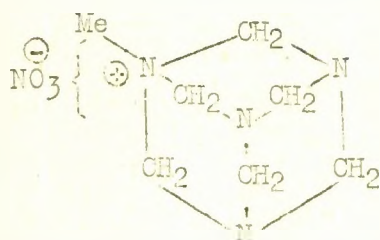
m.p. 190°

Wohl, Ber., 1886, 19, 1843.

Univ. Penn. Div. 8 Int. Rep. R.R.C.5, May '43; SR7/4766.



H.18, (H.20), (H.1)



1-Methyl-(Hex.)-1-nitrate

"Hex-methonitrate"

From EtOH.

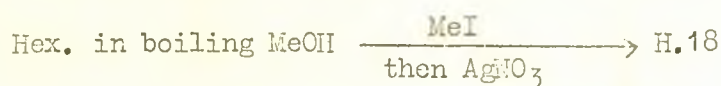
m.p. 190°

Hahn and Walter, Ber., 1921, 54, 1531.

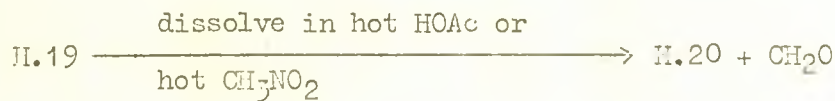
Univ.Penn., Div.8 Int.Rep.R.R.C.4, April '43; SR7/4180.



Univ.Penn., Div.8 Int.Rep.R.R.C.5, May '43; SR7/4766.



(Best laboratory preparation).



H.20 forms a picrate, m.p. 205°.

Mixed m.p. H.20 - H.18, no depression.

Mixed m.p. H.20 picrate - P.S.2, no depression.

H.20 is H.18. (U.S.A., Canada RDX Committee Meeting, June '43, SR7/4956).

(See also Univ.Penn.Rep. O.S.R.D. 1733, July '43, SR7/43/448).

Cornell, Prog.Rep. O.S.R.D. 1803, Sept. '43, SR7/43/876.



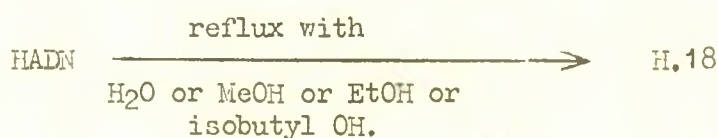
Para. 165

H.18 (H.20, H.1) (Continued)

Bristol Prog.Rep. Sept. '43.

Bristol Br. Rep. 36, Jan. '44; AC.5725.

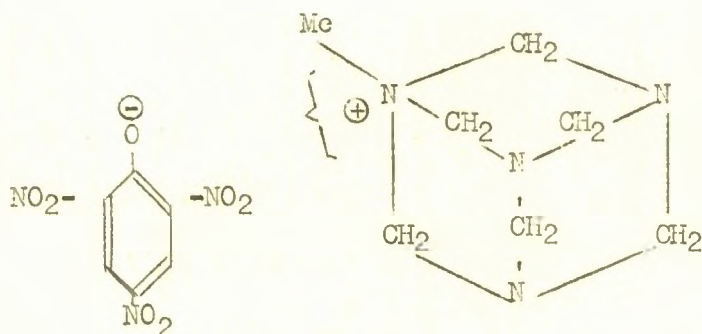
Bristol Res. Rep. 129, June '44; AC.6486.



Univ. Penn. Rep. O.S.R.D. 1733, July 1943; SR7/43/448.

Para. 166

P.S.2

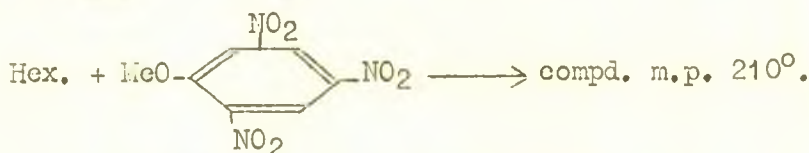


1-Methyl-(Hex)-1-picrate.

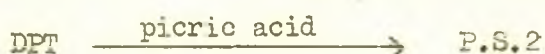
"Hex.-methopicrate"

m.p. 210-215°

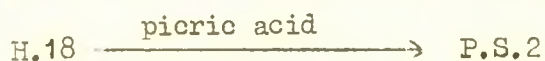
Hahn and Walter, Ber. 1886, 19, 1510



Penn. State, Div.8 Int.Rep.R.R.C.2, Feb. '43; SR7/3867.



Univ.Penn., Div.8 Int.Rep.R.R.C.4, April '43; SR7/4180.

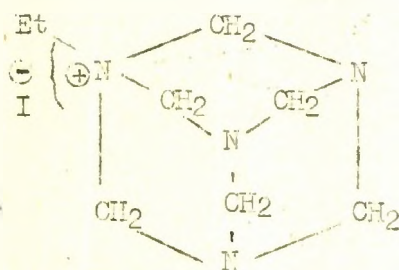


Univ.Penn., O.S.R.D.Rep. 1733, July '43; SR7/43/448.

P.S.2 is Hex-methopicrate.

Para. 167

Hexamine Ethiodide



1-Ethyl-(Hex.)-1-iodide.

m.p. 141-143°

Wohl, Ber., 1886, 19, 1344 gives m.p. 133°

Delépine, Bull. soc. chim., [3], 13, 350 gives m.p. 146°

Univ. Penn., Div. 8 Int. Rep. R.R.C. 10, Oct. '43; SR7/43/925.

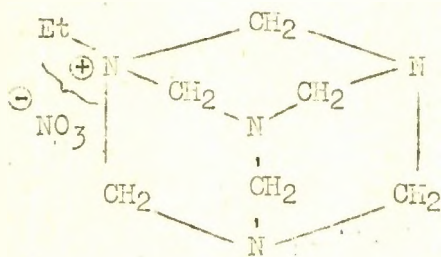


Second crop  $\longrightarrow$  m.p. 154-156°

and is different compound,  
not identified.

Para. 168

H.29. "Hexamine Ethonitrate"

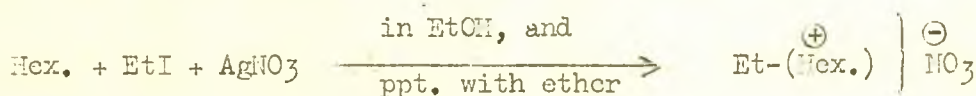


1-Ethyl-(Hex.)-1-nitrate

Usually just ether washed,  
but can be crystd. from  
MeOH.

m.p. 135°

Univ. Penn., Div. 8 Int. Rep. R.R.C. 9, Sept. '43; SR7/43/924.

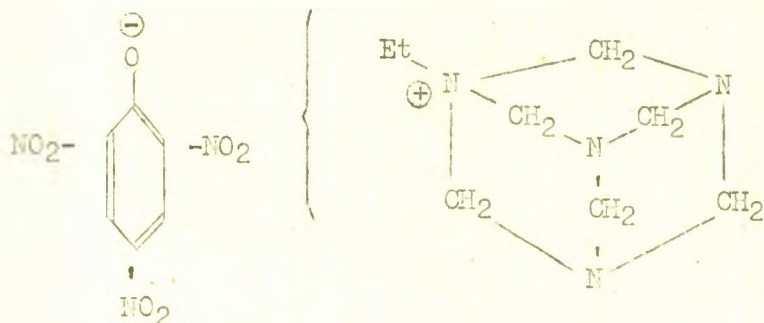


(as for H.18)

Para. 169

H.30

PS.2 (Et)



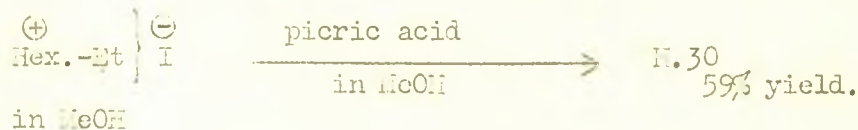
1-Ethyl-(Hex.)-1-picrate.

"Hexamine ethopicrate"

From MeOH m.p. 166-168°

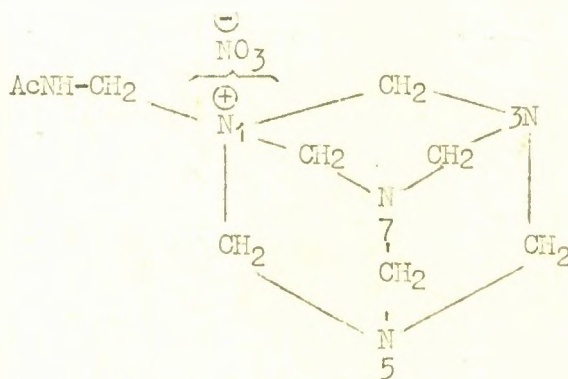
Univ. Penn., Div.8 Int.Rep.R.R.C.9, Sept. '43; SR7/43/924.

Div.8 Int.Rep.R.R.C.10; Oct. '43; SR7/43/925.



Paras. 170, 171

H.2



1-Acetamidomethyl-(Hex.)-1-nitrate.

Diss. in equal weight of H<sub>2</sub>O and add

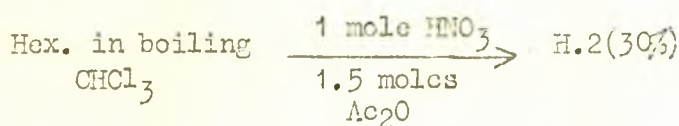
4 vols. of EtOH  $\longrightarrow$  cryst. m.p. 168-183°  
according to  
rate of heating

Para. 170

H.2 (Continued)

Harvard N.D.R.C.Rep. May '42;

N.D.R.C.Rep. Oct. '42; SR7/3263.



Michigan, Div.8 Int.Rep.R.R.C.3, March '43; SR7/4179.



(\* or Hex. in HOAc and add 70% aq. HNO<sub>3</sub> in HOAc)



(\* presumably acting as source of CH<sub>2</sub>O).



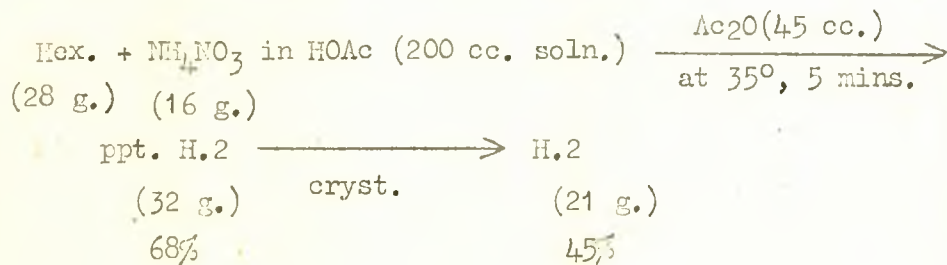
Univ.Penn. Div.8 Int.Rep.R.R.C.3, March '43; SR7/4179



(See Univ.Penn., O.S.R.D.Rep.1733, July '43; SR7/43/448, for review).

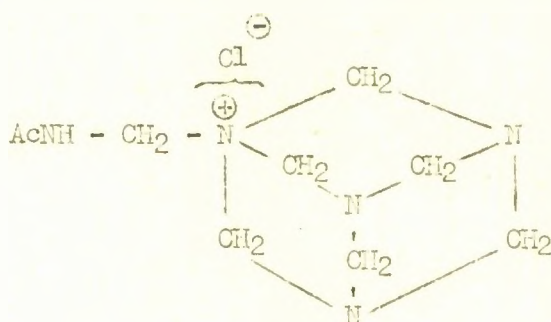
Para. 171

Michigan, Div.8 Int.Rep.R.R.C.12, Dec. '43; SR7/44/508.



Para. 172

H.2 Cl



1-Acetamidomethyl-(Hex)-1-chloride.

From EtOH

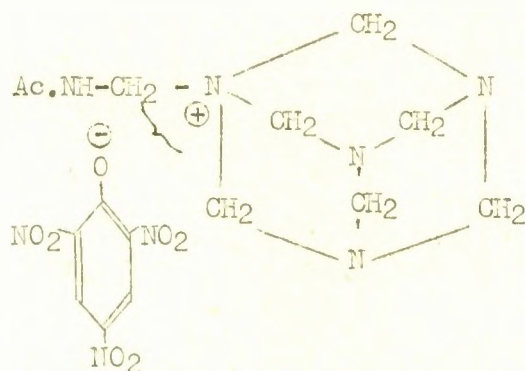
m.p. 188-189°

Michigan, Div.8 Int.Rep.R.R.C.3, March '43; SR7/4179.



Para. 173

H.3



1-Acetamidomethyl-(Hex)-1-picrate.

m.p. 190°

(Cannot be recrystallised because



Harvard, N.D.R.C.Rep., Oct. '42; SR7/3263.

Michigan, Div.8 Int.Rep.R.R.C.3, March '43; SR7/4179.



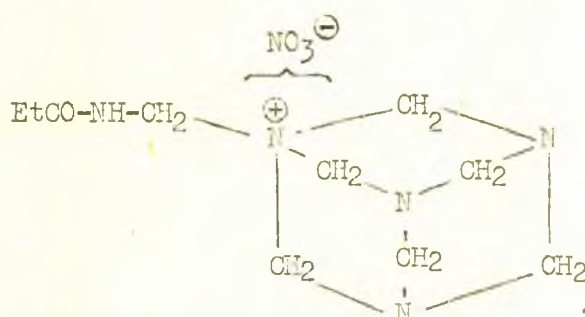
Univ.Penn., Div.8 Int.Rep.R.R.C.3, March '43; SR7/4179.



Para. 174

H.5 (Harvard)

Propionic H.2 (Michigan)



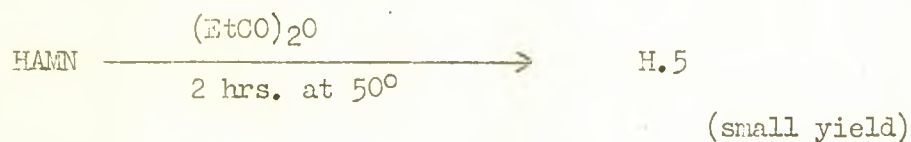
1-Propionamidomethyl-(HCl)-1-nitrate.

From EtOH.

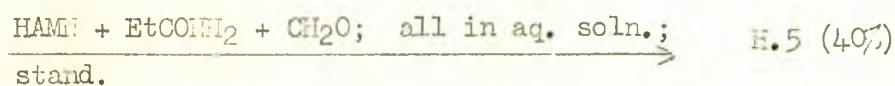
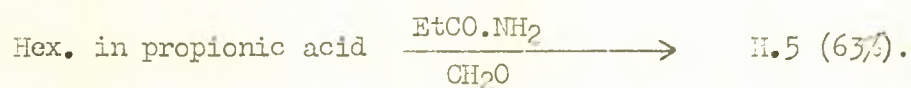
m.p. 160° (1st prep.  
Harvard)

"180° or higher"  
(Michigan prep.).

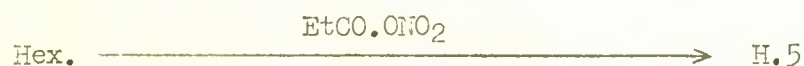
Harvard, N.D.R.C.Rep., Oct. '42; SR7/3263.



Michigan, Div.8 Int.Rep., R.R.C.3, March '43; SR7/4179.

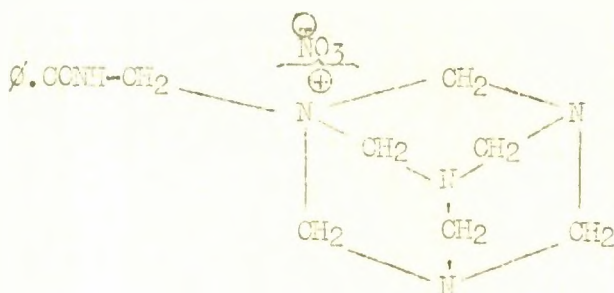


Univ.Penn., O.S.R.D.Rep. 1733, July '43; SR7/43/448.



Para. 175

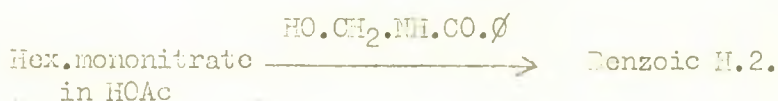
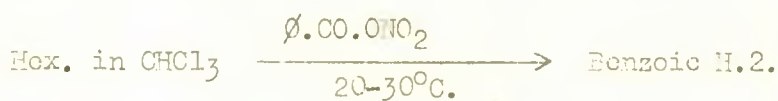
Benzoic H.2



1-Benzamidomethyl-(Hex)-1-nitrate.

From 90% aq. EtOH, m.p. 158-159°.

Bristol Res.Rep.96, June '43; A.C.454C.

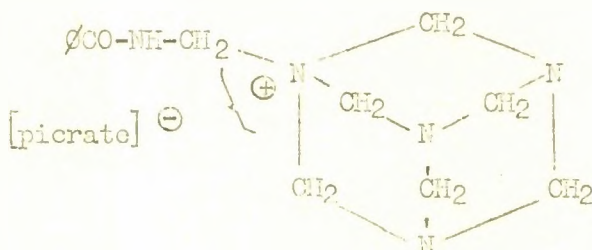


Univ.Penn., Div.3 Int.Rep., P.R.C.15, March '44; SR7/44/1236.

In first method of preparation, the yield of Benzoic - H.2 was dependent on EtOH content of CHCl<sub>3</sub>.

Para. 176

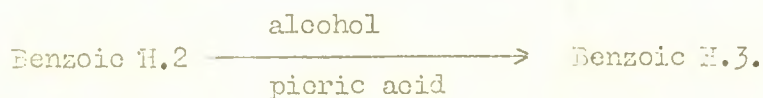
Benzoic H.3



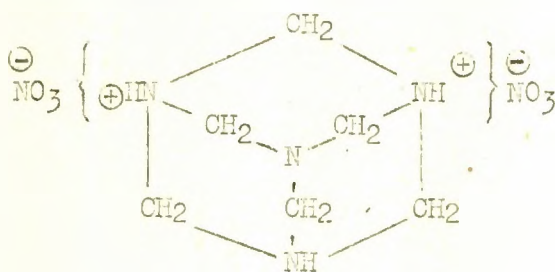
1-Benzamidomethyl-(Hex)-1-picrate.

From EtOH, m.p. 157-158°.

Bristol, Res.Rep. 96, June '43, A.C.454O.



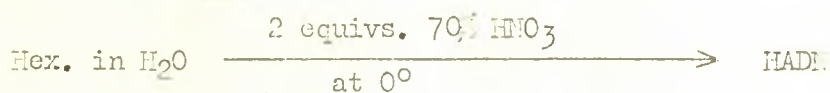
HADN



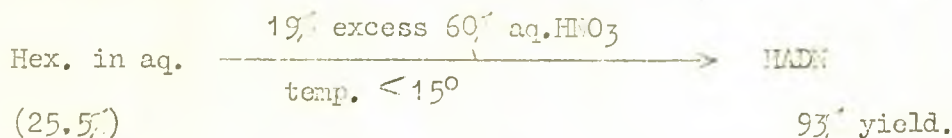
Hex.-1:5-dinitrate.

m.p. 162°

Hale, J.A.C.S., 1925, 47, 2754,



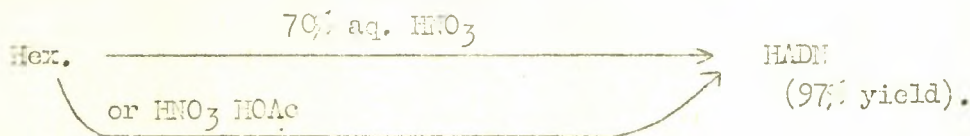
Michigan, O.S.R.D.Rep. 820, 15 Aug. '42; SR7/2982.



McGill, X.R.6 Prog.Rep., May '43; SR7/4435.



Bristol, Br.Rep. 36, Jan. '44; A.C.5725.

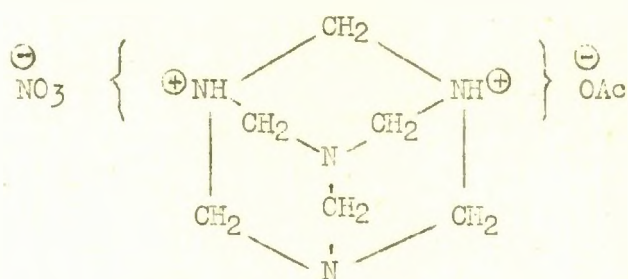


Bristol, Res.Rep. 129, June '44, A.C.6486.



Para. 178

Hexamine nitrate acetate

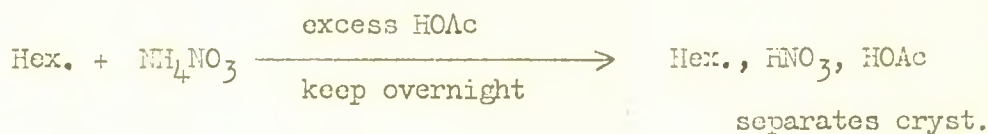


Hex-1-nitrate-5-acetate.

Dry at room temp.

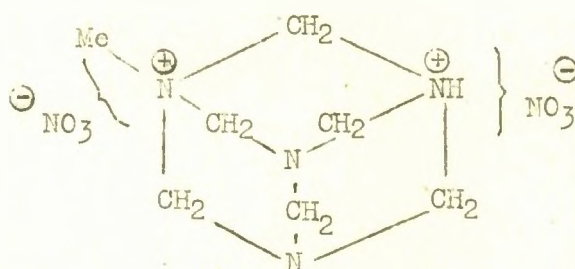
Warming  $\longrightarrow$  loss of HOAc  $\longrightarrow$  HAN.

Michigan, Div.8 Int.Rep. R.R.C.12, Dec. '43; SR7/44/508.



Para. 179

H.26

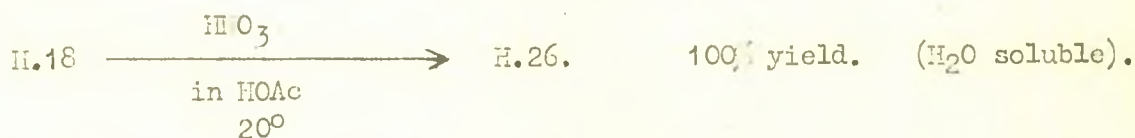


1-Methyl-(Hex.)-1:5-dinitrate.

Product washed with HOAc and ether but not recryst.

m.p. 150°

Univ.Penn., Div.8 Int.Rep.R.R.C.5, May '43; SR7/4766.



(See Univ.Penn., O.S.R.D.Rep. 1733, July '43; SR7/43/448).

ppt. from 70%  $\text{HNO}_3$  aq +  $\text{MeOH}$ , m.p.  $193^\circ$  (Bristol)  
m.p.  $188-189^\circ$  (McGill)

Hex. + MeNH<sub>3</sub><sup>+</sup> NO<sub>3</sub><sup>-</sup> in HOAc. Add (EtCO)<sub>2</sub>O, then HNO<sub>3</sub>.

(10 g. from 14 g. Hex.).

C, H, and N analysis, and suggest structure.

Methylolamine Nitrate  $\xrightarrow[\text{MeOH}]{\text{ppt. with}}$  "Stabiliser compound"

1:3:5-Trimethyl-(6-ring)  $\xrightarrow[\text{NH}_4\text{NO}_3]{\text{CH}_2\text{O}}$  "Stabiliser compound"  
28%  
Then add 70% aq.  
HNO<sub>3</sub>

Formula  $\left[ \text{CH}_3(\text{CH}_2)_3 \overset{+}{\text{N}}_2 \overset{-}{\text{NO}}_3 \right]_x$  suggested from C, H, N and  $\text{NO}_3^-$  analysis.

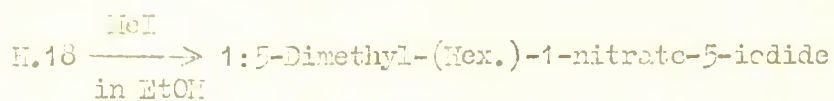
Compound gives a picrate, m.p. 211-213° (1:5-Dimethyl-(Hex.)-1:5-dipicrate)

H.18 +  $\text{MeNH}_3\text{NO}_3$   $\xrightarrow[10 \text{ cc. HOAc}]{20 \text{ cc. (EtCO)}_2\text{O}}$  BCX  
1 g.      0.5 g.      at 45-50° for 45 mins.      82%

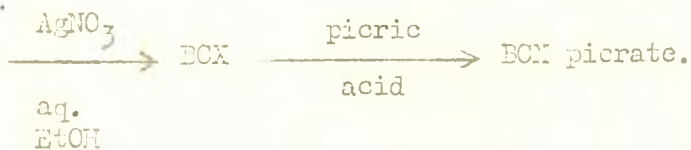
Para. 189A

PCX (Continued)

X.R.4 Proj., C.E.R. Extramural Summary 21, June-Aug. '44; SR7/44/3156.



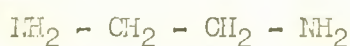
(m.p. 197-202°).



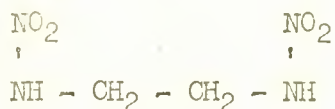
(These reactions are under independent investigation  
in Bristol).

McGill, X.R.4 Prog.Rep., 1 Sept. '44; SR7/44/3596

The picrates made by the 3 methods are identical (X Rays).

DERIVATIVES OF ETHYLENEDIAMINE

## Para. 182

EDNA

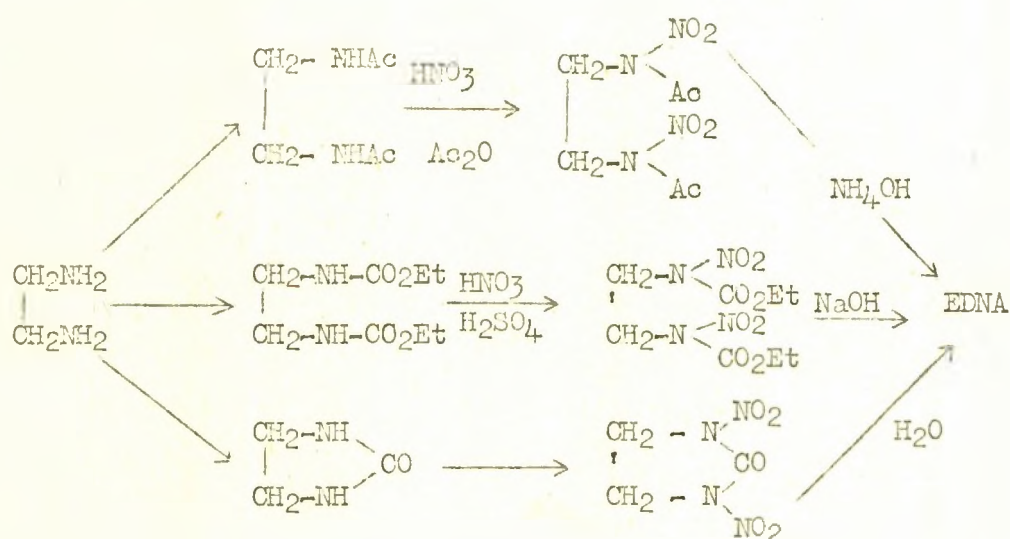
N:N'-Dinitroethylenediamine.

Ethylenedinitramine.

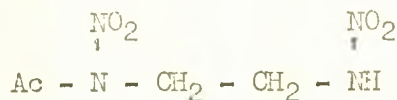
m.p. 177-179°

A review of the very extensive and specialised literature devoted to EDNA is outside the scope of this work.

Three methods of preparation from ethylene diamine are indicated by Haworth, Lambertson and Woodcock in their review (A.C.5053), Sheffield, Oct.'43.



## Para. 183

N-Acetyl EDNA

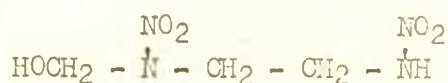
Toronto, X.R.16, Canadian Exp. Res. Extramur. Summary, April '44;

SR7/44/1747.



Para. 184

N-Hydroxymethyl-EDNA



N-methylol-N:N'-dinitroethylenediamine.

N-Methylol-EDNA.

Cryst. from reaction mixt.

m.p. 127-129°

(Hot organic solvents  $\longrightarrow$  EDNA)

Can cryst. from AcMe-petrol.

Michigan, O.S.R.D. Rep. 820, 15 Aug. '42; SR7/2982.

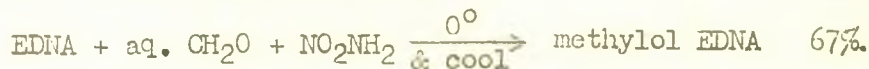
Sheffield, Rep. 41, Feb. '44; A.C.5995.



(Characterised in Sheffield as morpholine derivative).

(From EtOAc, m.p. 128-130°).

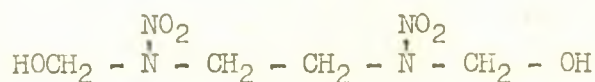
Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/3158.



(The  $\text{NH}_2\text{NO}_2$  is not necessary for this preparation).

Para. 185

N:N'-Bismethylol-EDNA



Sheffield Rep. 41, Feb. '44, A.C.5995.

Not isolated from EDNA +  $\text{CH}_2\text{O}$  aq. but:-

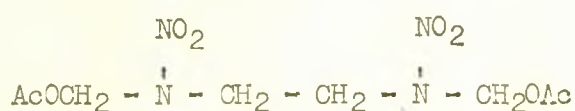
Dimorpholine derivative isolated; m.p. 170-171°(from EtOAc).

Toronto, X.R.16 Rep., 31 Jan. '44; SR7/44/984, considers this compound as an intermediate in the preparations on pp. 186 to 190.

e.g. the preparation of Homo RDX.

Para.186

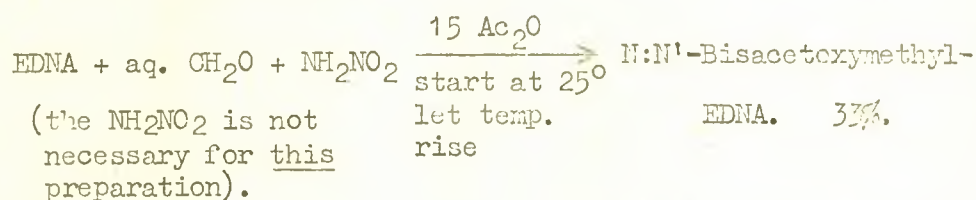
N:N'-Bis(acetoxymethyl)-EDNA



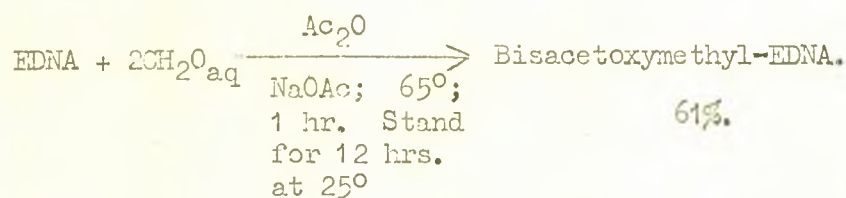
From EtOH - Petrol.

m.p. 83°.

Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/5158.

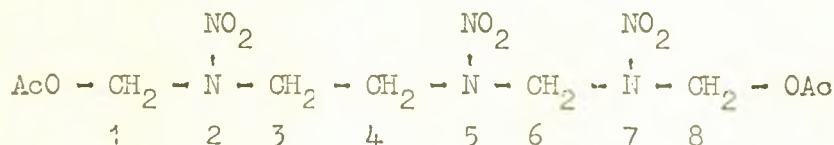


(Called "bisacetoxymethylene EDNA" in Canadian Rep.).



Para.187

1:3-Diacetoxy-2:5:7-trinitro-2:5:7-triazaoctane

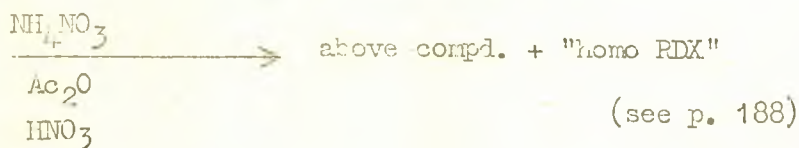


m.p. 98°

Ppt. from AcMe by Petrol.

Toronto, X.R.16 Rep., 31 Jan. '44; SR7/44/984.

Methylene-bis-(3:6-dinitro-1:3:6-triazacycloheptane) (sup. 190)

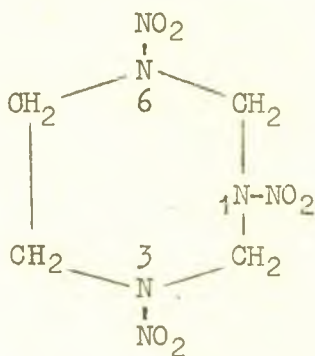


Separation by fractional pptn.

Para.188

Homo-RDX

Hepta-RDX



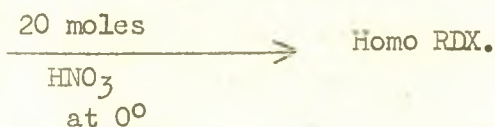
1:3:6-Trinitrocyclo-1:5:6-triazaheptane.

Ppt. from AcMe + petrol

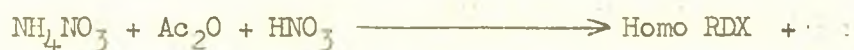
m.p. 165°

Toronto, X.R.16 Rep., 31 Jan. '44, SR7/44/984.

Methylene-bis-(3:6-dinitrocyclo-1:3:6-triazaheptane) (see p. 190)



Also from same starting material, using

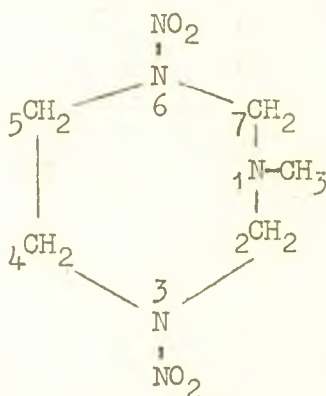


1:8-Diacetoxy-2:5:7-trinitro-2:5:7-triazaoctane

(see p. 187)

Para.189

3:6-Dinitro-1-methylcyclo-1:3:6-triazaheptane



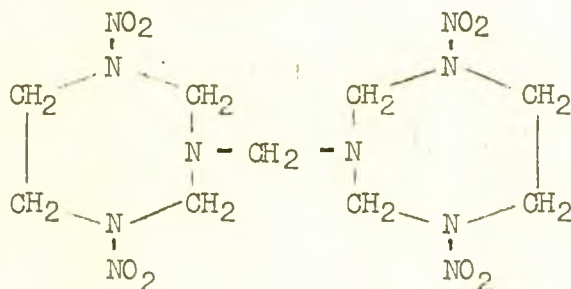
From EtOAc, m.p. 159°

Toronto, X.R.16 Rep., 31 Jan. '44; SR7/44/984.



Para.190

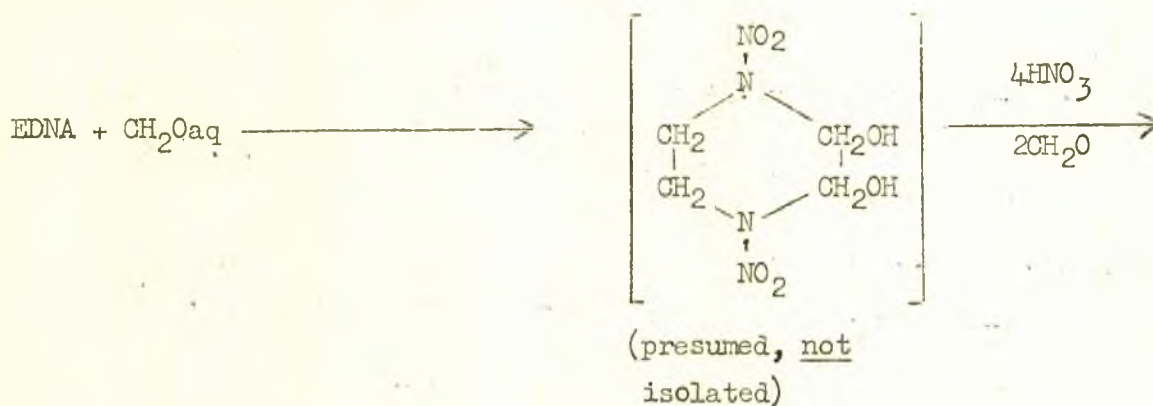
Methylene-bis-(3:6-dinitrocyclo-1:3:6-triazaheptane)



m.p. 205°

Ppt. from AcMe by petrol.

Toronto, X.R.16 Rep., 31 Jan. '44, SR7/44/984.



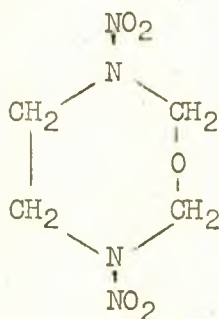
methylene-bis-(3:6-dinitrocyclo-1:3:6-triazaheptane)

63 per cent yield on EDNA.

Para.190A

3:6-Dinitrocyclo-1-oxa-3:6-diazaheptane

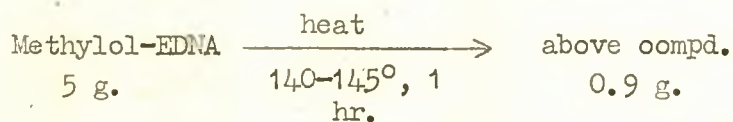
Homo-Cyclonite Oxide



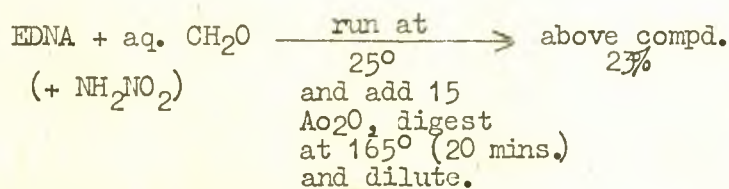
From AcMe - petrol.

m.p. 154-155°

Sheffield, Rep. 41, Feb. '44; A.C.5995.

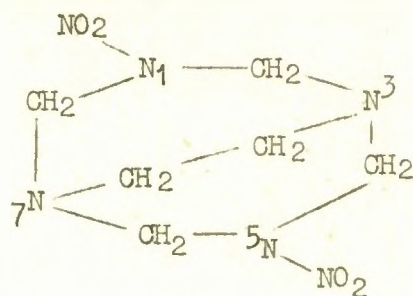


Toronto, X.R.16 Rep., 1 Sept. '44; SR7/44/3158.



Para. 191

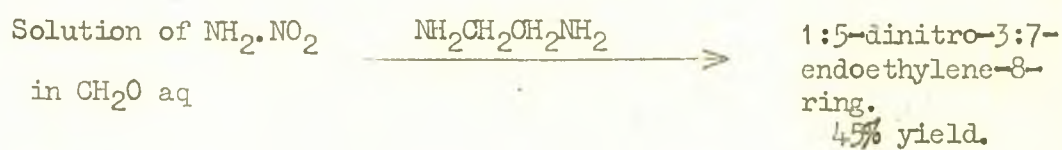
1:5-Dinitro-3:7-endoethylene-(8-ring)



m.p. 140°

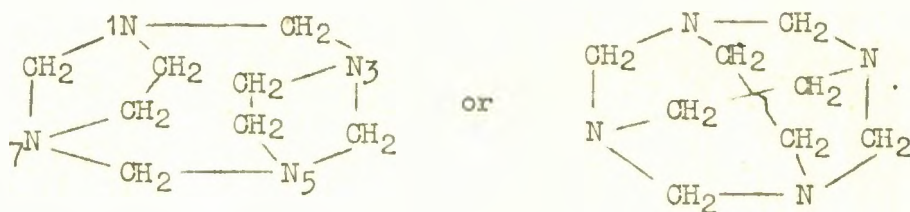
From AcMe.

Toronto, X.R.16 Rep., 31 Jan. '44; SR7/44/984



Para. 192

OMTA



"Octamethylene tetramine"

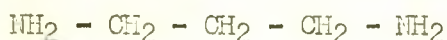
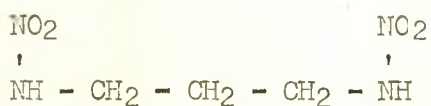
(1:7)-(3:5)-or (1:5)-(3:7) - Bisendoethylene-(8-ring).

m.p. 196°

Bischoff, Ber., 1898, 31, 3254.

Cornell, Div.8 Int.Rep.R.R.C.16, April '44; SR7/44/1543.



Para. 193DERIVATIVES OF TRIMETHYLENE DIAMINEPara. 194TMDNA

Trimethylene dinitramine.

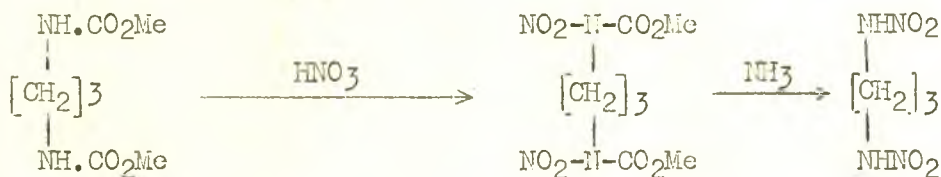
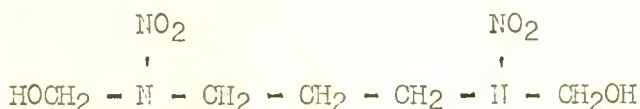
N:N'-Dinitrotrimethylenediamine.

Cryst. from H<sub>2</sub>O or (ether + MeOH + m.p. 67°  
petrol)

Franchimont and Klobbie, Rec.Trav.chim., 1888, 7, 347.

Michigan, O.S.R.D. Rep. 820; 15 Aug. '42; SR7/2982.

Sheffield, Rep. 41, Feb. '44, A.C.5995.

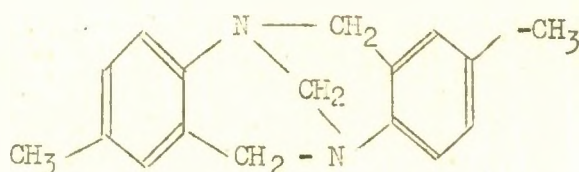
Para. 195N:N'-Bismethylol-TMDNA

Cryst. from reaction mixture. m.p. 88-92°.

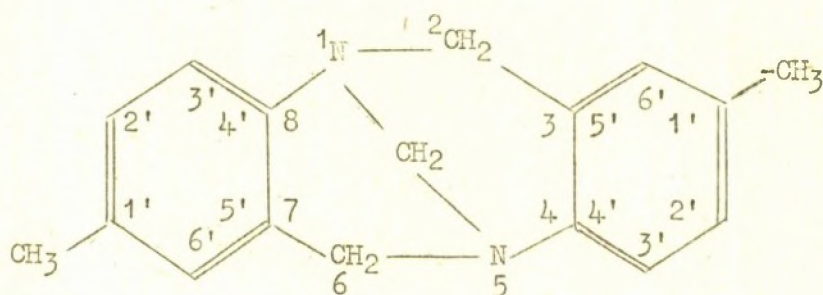
Sheffield, Rep. 41, Feb. '44; A.C.5995.



Dimorpholine derivative (from EtOAc), m.p. 130-132°.

DERIVATIVES OF TROGER'S BASE

Para. 197

Troger's Base

From aq. EtOH

m.p. 135-136°

Troger, J.prakt.Chem., 1887, [2] 36, 227.Spielman, J.A.C.S., 1935, 57, 583.

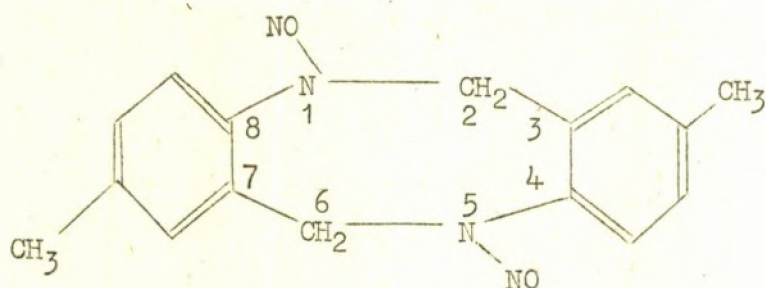
aq. CH<sub>2</sub>O, aq. HCl,  
 20 days room temp.  
 Then made alkaline  
 with NH<sub>3</sub> and steam  
 distilled.

Troger's Base

Troger's Base gives a picrate (from EtOH), m.p. 188-9°.

Para. 198

"Dinitroso - Tröger's Base"



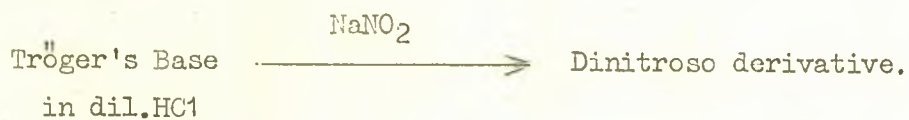
1:5-Dinitroso-(3:4)-(7:8)-Bis(1'-methylbenzo-4':5')cyclo-  
1:5-diazaoctane.

From HOAc or  $\phi\text{CH}_3$

m.p. 254-5°

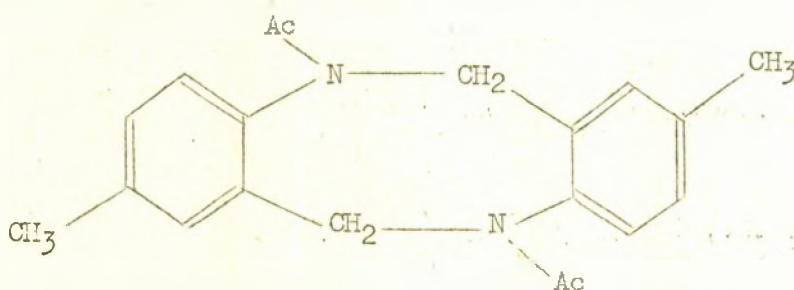
Tröger, loc. cit. see p. 197

Spielman, loc. cit. see p. 197



Para. 199

"Diacetyl-Tröger's Base"



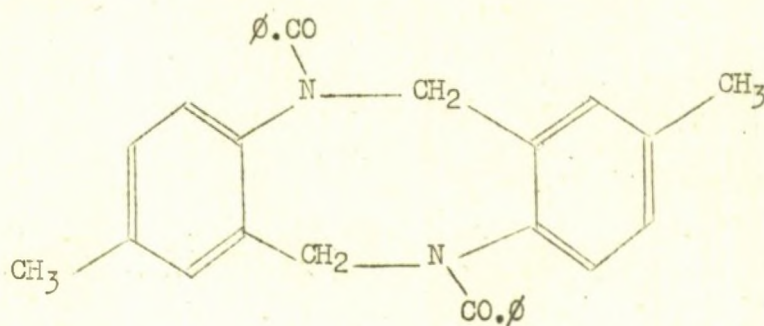
ppt. from HOAc by H<sub>2</sub>O. m.p. 286-8°

Tröger, loc.cit. see p. 197

Spielman, loc.cit. see p. 197



"Dibenzoyl-Tröger's Base"



From  $\phi\text{CH}_3$  - EtOH,

m.p. 290-1°

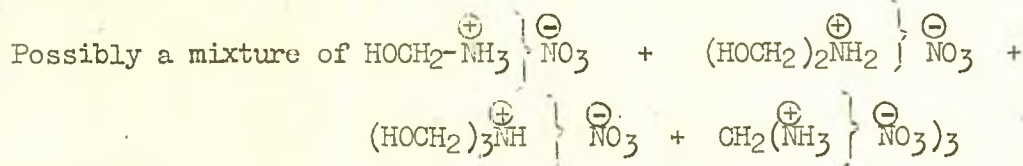
Tröger, loc.cit. see p. 197

Spielman, loc.cit. see p. 197

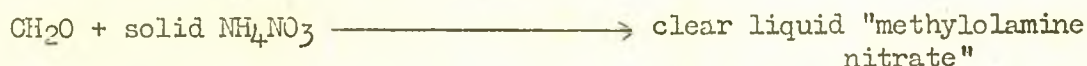


MISCELLANEOUS SUBSTANCES OF UNCERTAIN CONSTITUTION

Para. 202

"Methylolamine nitrate"

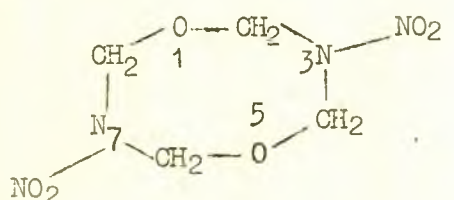
Bristol, Res.Rep.129, June '44; A.C.6486.



Paras. 203, 204

F.S.1

Probably



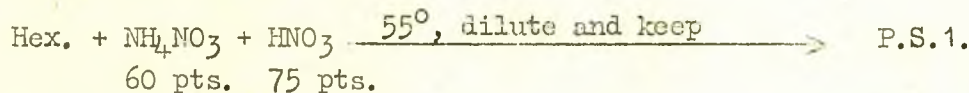
3:7-Dinitrocyclo-1:5-dioxo-2:4:6:8-tetramethylene-3:7-diamine

m.p. 259-264° (Penn.State).

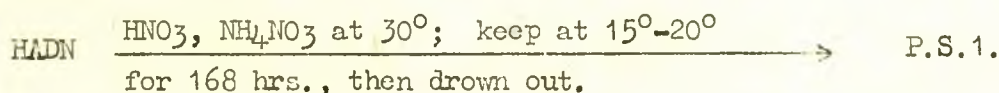
From AcMe

263-264° (Toronto).

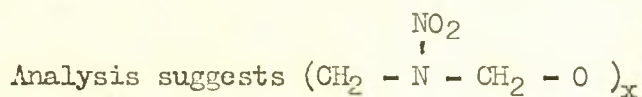
Penn.State, Div.8 Int.Rep.R.R.C.4, April '43; SR7/4180.



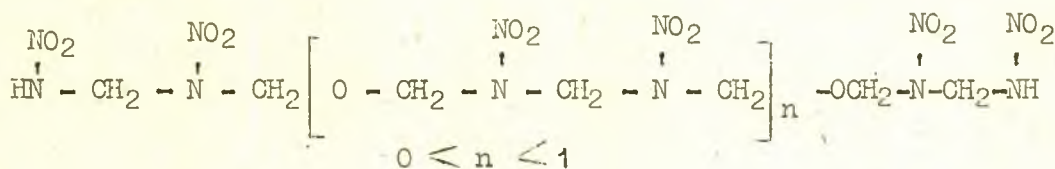
Penn.State, Div.8 Int.Rep.R.R.C.11, Nov. '43; SR7/44/70.



14.5 g./m.Hex.



Toronto; U.S.A.-Canada-RDX Committee Meeting, April '44; SR7/44/1594.



Toronto, X.R.16 Project, Canadian Exp.Res.Extram.Summary 20, May-June '44, SR7/44/2426.

Regard (1) Above compound  $\equiv$  P.S.1 and

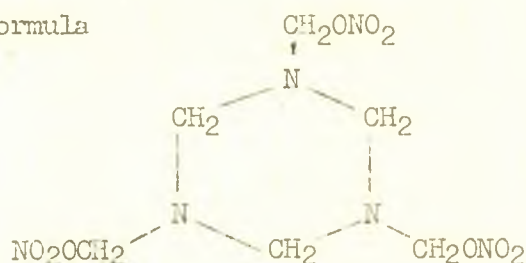
(2) above constitution as wrong.

Para. 204

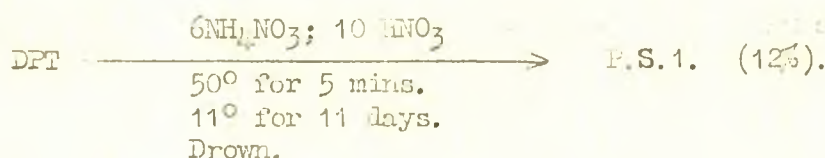
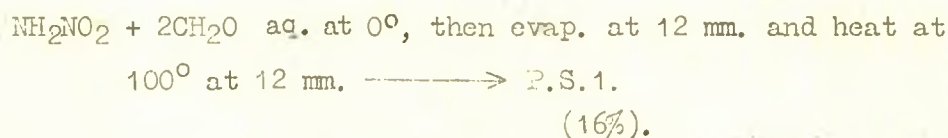
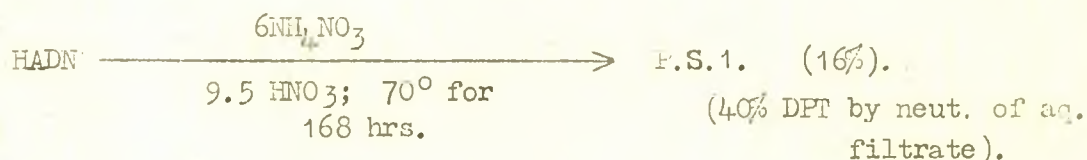
P.S.I. (Continued)

Toronto, X.16 Proj., RDX Committee (U.S.A. and Canada) Meeting 26 May, '44;  
SR7/44/2801.

Suggest formula



Toronto, X.R.16 Prog.Rep., 1 Sept. '44; SR7/44/3158, abandon above and suggest much more likely structure, 3:7-Dinitrocyclo-1:5-dioxo-2:4:6:8-tetramethylene-3:5-diamine.

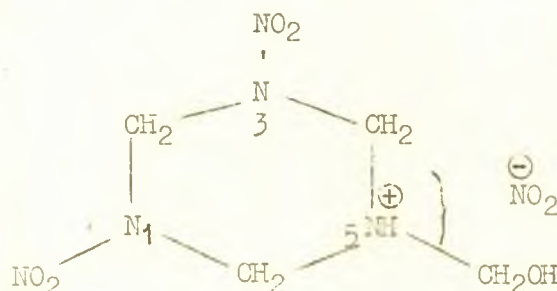


Para. 205

$\text{C}_4\text{H}_{10}\text{N}_6\text{O}_7$

"Methylol-PCX-nitrite"

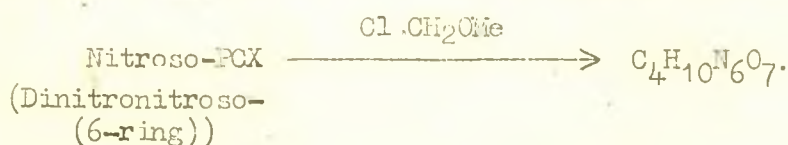
Probably



1:3-Dinitro-5-methylol-(6-ring)-5-nitrite.

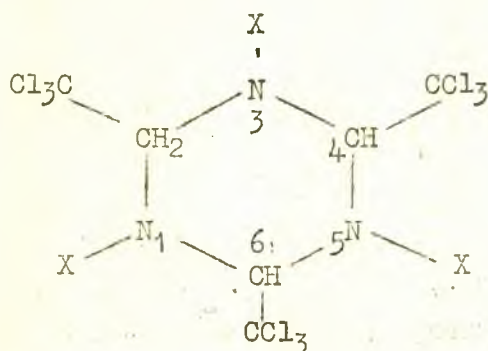
From reaction mixture. m.p.  $168^\circ$ .

Bristol, June '44, Dr. J. K. N. Jones, private communication.



Para. 206

1:3:5-Tri(X)-2:4:6-Tris(trichloromethyl)-(6-ring)



X = CO<sub>2</sub>Et, m.p. 143°.

X = CHO, m.p. 193°.

X = Ac, m.p. 207°.

X = COϕ, m.p. 142°.

The compounds prepared by Moscheles, Ber., 1891, 24, 1803, from "chloral-ammonia" and recorded as Cl<sub>3</sub>C-CH-N-X probably have the above constitution.

Para. 207

"Bristol Chloro-Compound"

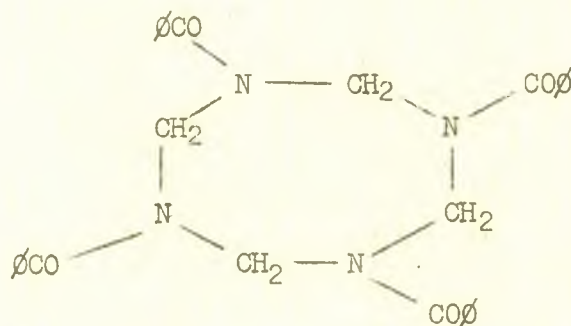
From HOAc.

m.p. 218°.

Bristol, July '44 (Dr. J. K. N. Jones, private communication).

ϕCOCl on Hex., pH 1.5 → compd. (ϕCO-N-CH<sub>2</sub>)<sub>x</sub>  
(sol. in MeOH)  
+ Cl containing  
compd. (insol. in MeOH).

1:3:5:7-Tetrabenzoyl-(8-ring) ?



From MeOH.

m.p. 225°.

Bristol, July '44 (Dr. J. K. N. Jones, private communication).

$\phi\text{COCl}$  on Hex. at pH 1.5  $\longrightarrow$  above compd. +  
chlorocompd. sepd.  
by MeOH extrac-  
tion, which  
dissolves above  
compd.

Not tri $\phi\text{CO}$ -(6-ring).

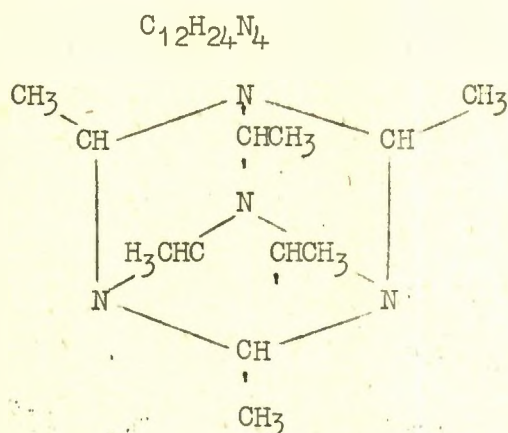
Certainly analysis fits  $(\phi\text{CO-N-CH}_2)_x$ .

From M.W. in camphor,  $x = 2$ .

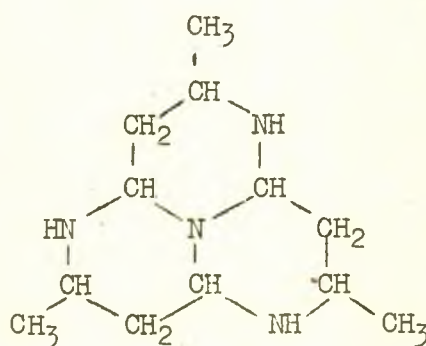
Para. 209

"Hexaethylidenetetramine"

or Tricrotonylidenetetramine



or, more  
probably



(Kudernatsch, Monatsh., 1900,  
21, 137).

Cryst. from  $H_2O$  (+  $3H_2O$ )

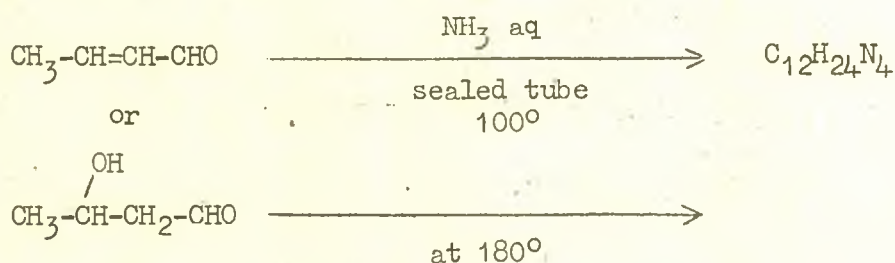
m.p.  $96^\circ$

(Delépine, Comptes rendus,  
1907, 144, 855: Bull.

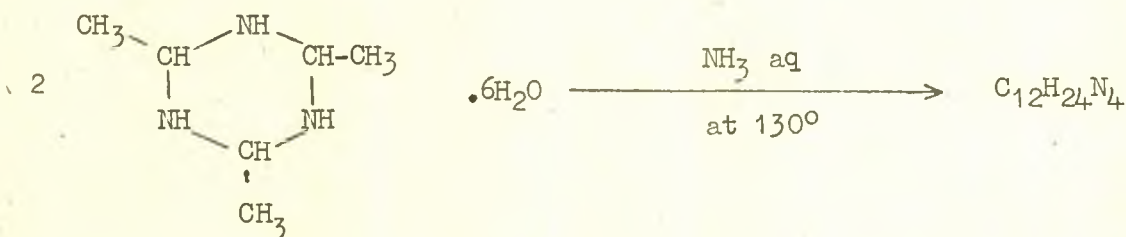
Soc.chim., [4], 1, 594.)

Loses  $3H_2O$  and solidifies  
at  $100^\circ$ . m.p. (anhydrous)  
 $102^\circ$ .

Wurtz., Comptes rendus, 1879, 88, 1154: Bull.Soc.chim., [2], 34, 486.

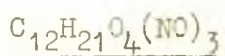


Kudernatsch, loc.cit.

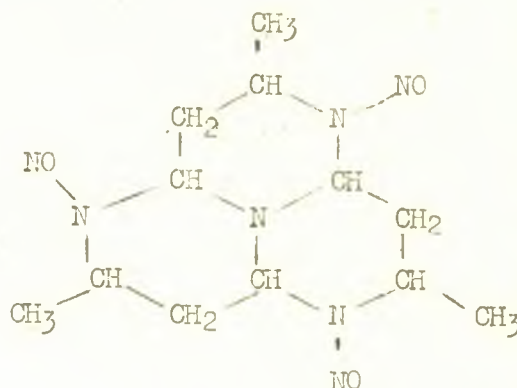


(See Bristol Res. Rep. 134, Aug. '44; A.C.6871).

Para. 210



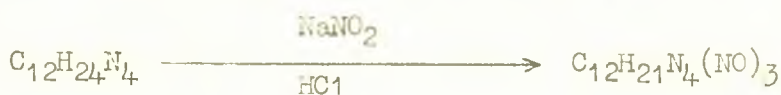
Probably



m.p. 210-212°.

Kudernatsch, Monatsh., 1900, 21, 137.

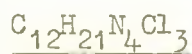
Delépine, Comptes rendus, 1907, 144, 855.



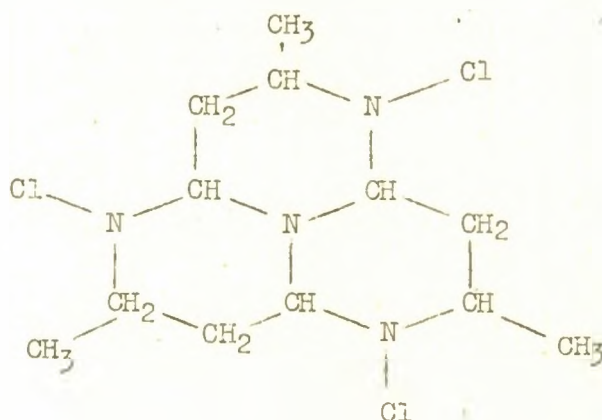
(either by Wurtz  
or Kudernatsch prepn)

Bristol, Res. Rep. 134, Aug. '44; A.C.6871: checked preparation and analysis.

Para. 211

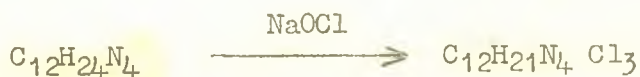


Probably



Detonates at 70°.

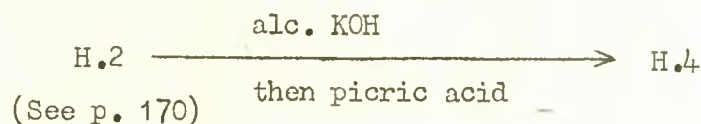
Delépine, Comptes rendus, 1907, 144, 855.



Para. 212

H.4

See Univ.Penn., O.S.R.D.Rep.1733, July '43; SR7/43/448.



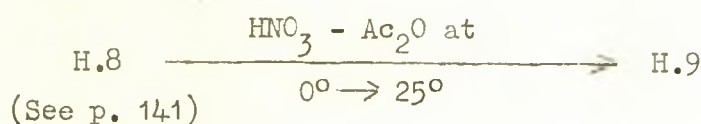
H.4 is probably a mixture of H.3 (See p. 173) and potassium picrate.

Para. 213

H.9

m.p. 233-238°.

Harvard, N.D.R.C.Rep., Oct. '42; SR7/3263.



H.9 is very probably a mixture of intermediates in the exchange of 4 Ac of H.8 for the 4 NO<sub>2</sub> of HMX. (Univ.Penn.O.S.R.D.1733 Rep., July '43; SR7/43/448).

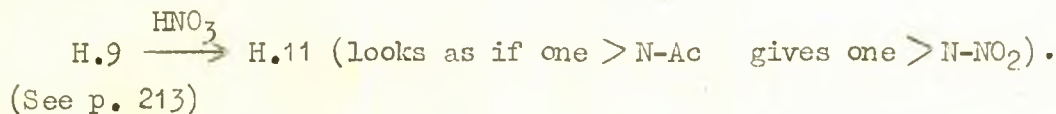
Para. 214

H.11

m.p. 225-244°.

'not identical with H.9'.

Harvard, N.D.R.C.Rep., Oct. '42; SR7/3263.



H.11 is probably a mixture like H.9, but richer in NO<sub>2</sub> groups.  
(Univ.Penn.O.S.R.D.Rep.1733, July '43; SR7/43/448).

Para. 215

H.13

'an intractable oil'.

See Univ.Penn.O.S.R.D.1733 Rep., July '43; SR7/43/448.

H.6 in  $\xrightarrow[\text{CHCl}_3]{\text{AcONO}_2; \text{ reflux and drawn with ether}}$  H.13  
(See p. 151)

H.13  $\longrightarrow$  a picrate similar to H.3 (p. 173) but probably not identical with H.3.

Para. 216

H.14

H.6 P.

m.p. 164-165°.

Univ.Penn., O.S.R.D., Rep.1733, July '43; SR7/43/448.

H.6  $\xrightarrow[\text{picric acid}]{\text{EtOH}}$  H.14  
(See p. 151)

C and H analysis indicates that the compound is not a simple picrate of H.6, but is derived from fragments of H.6 plus picric acid: Found, C, 35.5; H, 3.5; picryl, 74.6; Ac, 11.2%.

(Compare

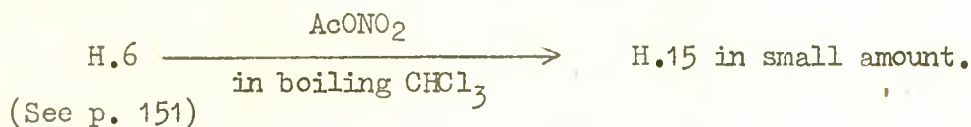
DNPT  $\xrightarrow{\text{picric acid}}$  P.S.2  
(See p. 166).  $\left. \begin{array}{l} \text{(Me - (Hex)}^{\oplus} \end{array} \right\} \text{picrate}^{\ominus}$

Para. 217

H.15

'a solid'.

See Univ.Penn. O.S.R.D.1733 Rep. July '43; SR7/43/448.



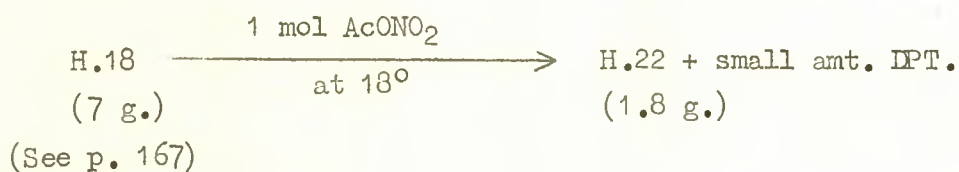
Might be a nitrate analogue of H.13. (p. 215). Not investigated.

Para. 218

H.22

From HOAc, m.p. 181-182°.

Univ.Penn., Div.8 Int.Rep., R.R.C.5, May '43; SR7/4766.



Structure still unknown, Univ.Penn., O.S.R.D.Rep.1733, July '43; SR7/43/448.

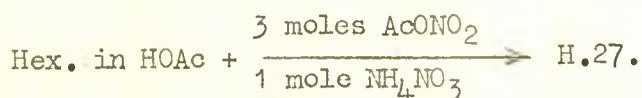
Para. 219

H.27

Ppt. by H<sub>2</sub>O from reaction mixture.

m.p. ca 140°.

Univ.Penn.Div.8 Int.Rep.R.R.C.8, August '43; SR7/43/391.



Not stable and not yet purified.

Constitution still unknown, Univ.Penn., Div.8 Int.Rep.  
R.R.C.11, Nov. '43; SR7/44/70.

Para. 220

L.M.X.

McGill X.R.4 Prog.Report, June '43; SR7/4908.

Repeat BCX preparation (p. 180) using  $\text{NH}_4\text{NO}_3$  for  $\text{MeNH}_3\text{NO}_3$   $\longrightarrow$   
unstable low melting material, soluble in AcMe, called L.M.X.  
(9 g. from 14 g. hex.).

Para. 221

I.S.X.

m.p. 156-158°.

McGill X.R.4 Prog.Rep. June '43; SR7/4908.

L.M.X.(5.5. g.)  $\xrightarrow[\text{solution}]{\text{boil acetone}}$   $\text{CH}_2\text{O} + \text{I.S.X.}$   
(2.5 g.).

I.S.X. insoluble in AcMe, Ph.H, ether, dioxan, MeOH, EtOH,  $\text{CHCl}_3$ .

Para. 222

McGill compound

Wash with ether.

Yellow viscous oil.

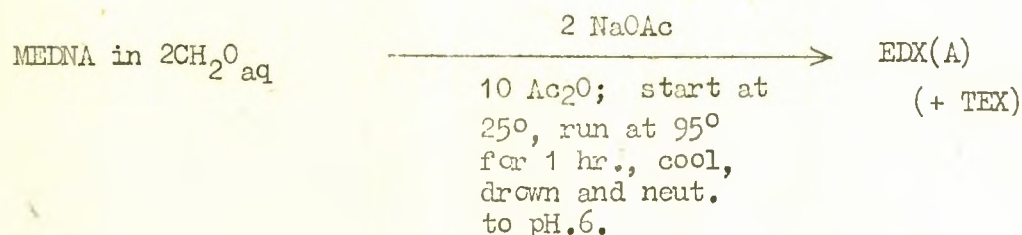
McGill, X.R.6 Rep.; 1 Feb. '44; SR7/44/578.

PCX  $\xrightarrow[\text{filter at } < 0^\circ]{\text{pyridine, add at } 20^\circ \text{ and cool to } -40^\circ}$  filtrate = yellow oil.

## EDX

m.p.  $225^{\circ}$ .

(Toronto, X.R.16 Rep. 1 Sept. '44; SR7/44/3158).



## Hex. Ethiodide By-Product

m.p. 154-156°.

$$\text{Hex.} + \text{EtI} \xrightarrow[\text{MeOH}]{\text{boiling}} \text{Et} - (\text{Hex})^{\oplus} \text{I}^{\ominus} \text{ m.p. } 141-3^{\circ}.$$

second crop m.p.  $154-6^{\circ}$ .

62015-1

## MELTING POINT IDENTIFICATION LIST

The "melting-points" recorded for many of the compounds in the Hexamine - RDX series are decomposition points and are, to some extent, functions of the rate of heating. Moreover, it is not always clear whether reported m.p.'s are corrected or not\*. Nevertheless, the melting point of a member of the series, determined in the usual way, is often a very useful guide to the identification of the compound.

A list is, therefore, given of the compounds treated in this review, in order of rising melting point. The arrangement is in three columns and is such that one may read off the m.p., the description of the compound, and the paragraph of the review dealing with the compound.

Melting points listed with large ranges, and marked with an asterisk, indicate that the given substance melts (or decomposes) fairly sharply at some specific temperature within the range, this temperature being a function of the rate of heating.

Melting points listed with short ranges (and not marked by an asterisk) indicate that the substance melts over the range in question.

The following compounds are liquids at room temperatures.

| Boiling point<br>(°C) | Designation of Compound    | Para. |
|-----------------------|----------------------------|-------|
| 48°/15 mm.            | P.1                        | 8     |
| 85°/760 mm.           | Tetranethyl-(3-chain)      | 45a   |
| 89°/9 mm.             | P.2                        | 9     |
| 95°/35 mm.            | Nitrosoparalaldimine       | 120   |
| 115°/15 mm.           | Methylene bis piperidine   | 45a   |
| 153-156°/12 mm.       | Bisacetoxymethylnitramine  | 15b   |
| 166°/760 mm.          | 1:3:5-Trimethyl-(6-ring)   | 111   |
| 166-169°/760 mm.      | TEMED                      | 40a   |
| _____                 | N:N'-Bisethoxymethyl-MEDNA | 34    |
| _____                 | Dimethylether of MEDNA     | 29    |
| _____                 | H.13                       | 215   |
| _____                 | LMX                        | 220   |
| _____                 | Methylolamine nitrate      | 202   |
| _____                 | McGill compound            | 223   |

\* It is obviously desirable that recorded melting points should be corrected by standardisation of the thermometer and for "emergent column error". The use of the Thiele-Hershberg m.p. apparatus (Ind. Eng. Chem. (Anal.), 1936, 8, 307) with short range, Anschutz type, thermometers, is to be recommended.

Solids at room temperaturesA. Melting points up to 100°

| Melting point<br>(°C) | Designation of Compound                                                    | Para. |
|-----------------------|----------------------------------------------------------------------------|-------|
| 38                    | Methyl nitramine                                                           | 12    |
| 43                    | Thialdine                                                                  | 122   |
| 51-2                  | DINA                                                                       | 16    |
| 54                    | Methylolacetamide                                                          | 19    |
| 57                    | Dimethylnitramine                                                          | 13    |
| 59-60                 | Bisnitroxymethylnitramine                                                  | 15a   |
| 63                    | Diacetyl-MEDNA                                                             | 29a   |
| 67                    | TMDNA                                                                      | 194   |
| 68-72                 | Bismethylol-MEDNA                                                          | 30    |
| 70                    | Trimethylcyclo-1-thio-2:4:6-trimethylene-<br>3:5-diamine:2H <sub>2</sub> O | 122   |
| 70<br>(detonation)    | C <sub>12</sub> H <sub>21</sub> N <sub>4</sub> O <sub>3</sub>              | 211   |
| 72-75                 | Nitramine                                                                  | 11    |
| 78                    | Dichloro-(P.T.)                                                            | 149   |
| 78                    | Trichloro-(6-ring)                                                         | 108   |
| 79-80                 | Bismethoxymethyl-MEDNA                                                     | 33    |
| 80                    | Bisethoxymethyltrinitro-(5-chain)                                          | 69    |
| 83                    | Bisacetoxymethyl-EDNA                                                      | 186   |
| 84-6                  | Morpholine derivative of methylmethylol-<br>nitramine                      | 14    |
| 85                    | 2:4:6-Trimethyl-(6-ring)                                                   | 113   |
| 87                    | H. 32                                                                      | 61    |
| 88-92                 | Bismethylol TMDNA                                                          | 195   |
| 94-96                 | H. 31                                                                      | 60    |
| 96                    | C <sub>12</sub> H <sub>24</sub> N <sub>4</sub> ·3H <sub>2</sub> O          | 209   |
| 97-9                  | Cyclonite Oxide                                                            | 118   |
| 98                    | Diacetoxytrinitrotriazaoctane                                              | 187   |
| 98-99                 | PCX (HOK)                                                                  | 95    |
| 98-101                | COX                                                                        | 31    |
| 99                    | Nitrodicyclohexyl-(6-ring)                                                 | 104   |

(B) Melting points 100°-150°

| Melting point<br>(°C) | Designation of Compound                        | Para.   |
|-----------------------|------------------------------------------------|---------|
| 102                   | Tricarboethoxy-(6-ring)                        | 110     |
| 102                   | MSX-Me (H. 25) (Univ. Penn.)                   | 55      |
| 102                   | C <sub>12</sub> H <sub>24</sub> N <sub>4</sub> | 209     |
| 102                   | 2ATM:AcMe                                      | 66      |
| 103                   | MEDNA                                          | 25      |
| 103-4                 | TEX                                            | 32      |
| 104                   | "104"                                          | 67      |
| 105-6                 | -tris(trichloromethyl)-(6-ring)                | 116     |
| 105-6                 | Trinitroso-(6-ring)                            | 106     |
| 107                   | "107"                                          | 68      |
| 108                   | 1:7-Dinitro-3:5-dimethyl-(8-ring)              | 138a    |
| 108-110               | Methylolbenzamide                              | 20      |
| 109                   | Nitrodibenzyl-(6-ring)                         | 105     |
| 109-110               | BSX-Et (H. 24)                                 | 56      |
| 114                   | Dinitroethoxymethyl-(6-ring)                   | 102     |
| 114-115               | MSX-Me (H. 25) (A.R.D.)                        | 55      |
| 115                   | EtHX                                           | 134     |
| 116                   | Furfurylidenenitramine                         | 23      |
| 116-117               | H. 33                                          | 62      |
| 120                   | P. 2. HX                                       | 132a    |
| 124                   | Dinitrodimethyl-(8-ring)                       | 138     |
| 125                   | MSX + BSX mixture                              | 52 & 65 |
| oa 125                | Diammonium salt of MEDNA                       | 27      |
| 127-9                 | Methylol-EDNA                                  | 184     |
| 128                   | Dinitromethoxymethyl-(6-ring)                  | 101     |
| 128-130               | Morpholine deriv. of Methylol-EDNA             | 184     |
| 128-130               | Nitroso H. 19                                  | 155     |
| 129                   | Dinitro-(5-chain)nitrate                       | 47      |
| 129                   | <u>Tert.</u> butyl HX                          | 135     |
| 130-1                 | CMX                                            | 49      |
| 130-2                 | Dimorpholine deriv. of Bismethylol-TMDNA       | 195     |
| 131                   | Methylene bisurethane                          | 44      |

(B) Melting points 100°-150° (Contd.)

| Melting point<br>(°C) | Designation of Compound                                       | Para.      |
|-----------------------|---------------------------------------------------------------|------------|
| 133                   | H.17                                                          | 152        |
| 133-4                 | H.28                                                          | 58         |
| 134                   | Bis( <u>m</u> -nitrobenzylideneamino)-(P.T.)                  | 150        |
| 134-5                 | Bismethyloltetranitromethyl-(9-chain)                         | 82b        |
| 135                   | H.6 picrate                                                   | 152a       |
| 135                   | H.29                                                          | 168        |
| 135-6                 | Troger's Base                                                 | 197        |
| 136                   | Methylol-PCX (PCX(A))                                         | 100        |
| 136-8                 | Hex. nitrourethane                                            | 162        |
| 136-9                 | MSX nitrate                                                   | 54         |
| 138-9                 | MeHX                                                          | 133        |
| 139-140               | Tris(salicylideneamino)-(6-ring)                              | 107        |
| 140                   | Dinitroendoethylene-(8-ring)                                  | 191        |
| 140-2                 | OFX                                                           | 57         |
| <u>ca</u> 140         | H.27                                                          | 219        |
| 141-3                 | Hex. ethiodide                                                | 167        |
| 142                   | Methylene bisformamide                                        | 35         |
| 142                   | 1:3:5-Tribenzoyl-2:4:6-tris(trichloro-<br>methyl)-(6-ring)    | 206        |
| 142-3                 | H.19                                                          | 154        |
| 143                   | 1:3:5-Tricarbethoxy-2:4:6-Tris(trichloro-<br>methyl)-(6-ring) | 206        |
| 145-7                 | GSX                                                           | 70         |
| 147-152               | MSX + H.28 mixture                                            | 53, 58, 59 |

## (c) Melting points, 150-200°

| Melting point<br>(°C) | Designation of Compound                                  | Para.     |
|-----------------------|----------------------------------------------------------|-----------|
| 150                   | Chloralbenzamide                                         | 21        |
| 150                   | H. 26                                                    | 179       |
| 150-1                 | Dinitrodibenzyl-(8-ring)                                 | 139       |
| 150-5                 | β Tris(trichloromethyl)-(6-ring)                         | 116       |
| 154                   | ATX (NBSX)                                               | 66        |
| 154-5                 | Dinitrocyclooxodiazahptane                               | 190a      |
| 154-5                 | Unidentified by-product in Hex. ethiodide<br>preparation | 167 & 224 |
| 154-162               | Crude Methylene bis(dinitro-(6-ring))                    | 104a      |
| 155                   | MSX (H. 21)                                              | 51        |
| 155-6                 | BSX                                                      | 63        |
| 156                   | TAX                                                      | 98        |
| 156-7                 | PHX                                                      | 132       |
| 156-8                 | ISX                                                      | 221       |
| 157                   | H. 16 (WRX)                                              | 82        |
| 157                   | H. 8                                                     | 141       |
| 157-8                 | Benzoic H. 3                                             | 176       |
| 158-9                 | Benzoic H. 2                                             | 175       |
| 158-168*              | HAMN                                                     | 159       |
| 159                   | Dinitromethylcyclootriazaheptane                         | 189       |
| 160-180*              | H. 5                                                     | 174       |
| 161                   | Trinitrosotrimethyl-(6-ring)                             | 114       |
| 162                   | HADN                                                     | 177       |
| 164-5                 | H. 14 (H. 6 P)                                           | 216       |
| 165                   | Homo-PDX                                                 | 188       |
| 166-7                 | Bisethoxymethyltetranitro-(7-chain)                      | 81        |
| 166-8                 | Hex. ethopicate (P.S. 2(Et))                             | 169       |
| 168                   | Nitroso-PCX                                              | 96        |
| 168                   | Methylol-PCX nitrite                                     | 205       |
| 168-183*              | H. 2                                                     | 170       |
| 169                   | Ethylidene bisacetamide                                  | 38        |

(C) Melting points, 150-200° (Contd.)

| Melting point<br>(°C)   | Designation of compound                                        | Para. |
|-------------------------|----------------------------------------------------------------|-------|
| 170-1                   | Dimorpholine derivative of bismethylol-<br>EDNA                | 185   |
| 175<br>(leaves residue) | Dinitroendoethylidene-(8-ring)                                 | 147   |
| 175-185                 | Trinitromethyl-(6-ring)                                        | 115   |
| 177                     | Ø-urethane of methylolbenzamide                                | 20    |
| 177-9                   | EDNA                                                           | 182   |
| 178-9                   | Hex. picrate                                                   | 160   |
| 180-1                   | H.6 methiodide                                                 | 155a  |
| 181                     | QNX                                                            | 136   |
| 181-2                   | H.6 methonitrate                                               | 155a  |
| 181-2                   | H.22                                                           | 218   |
| 182-3                   | Bismethoxymethyltetranitro-(7-chain)                           | 80    |
| 182-3                   | Methyloldibenzoyl-(3-chain)                                    | 41    |
| 187                     | AcAn                                                           | 76    |
| 187                     | Tris(benzamidomethyl)amine                                     | 22    |
| 187-8                   | Ethylidene bisbenzamide (also given as<br>m.p. 202-4°)         | 42    |
| 188-9                   | H.201                                                          | 172   |
| 188-9                   | Troger's Base picrate                                          |       |
| 188-9                   | BCX (stabiliser compound) McGill m.p.<br>(Bristol m.p. 193°)   | 180   |
| 190                     | H.3                                                            | 173   |
| 190                     | H.18 (H.20) (H.1)                                              | 164   |
| 190                     | Hex. methiodide                                                | 163   |
| 190-200                 | Crude RDX(B)                                                   | 85    |
| 191                     | H.6 (DAPT)                                                     | 151   |
| 192                     | H.23                                                           | 156   |
| 193                     | Triformyltris(trichloromethyl)-(6-ring)                        | 206   |
| 193                     | BCX (stabiliser compound) Bristol m.p.<br>(McGill m.p. 188-9°) | 180   |
| 195                     | Dimethyl-(PT) picrate                                          | 153   |
| 196                     | OMTA                                                           | 192   |
| 197                     | H.7                                                            | 36    |
| 197                     | Hex. styphnate                                                 | 161   |
| 199                     | H.6 methopicrate                                               | 155a  |

(D) Melting points over 200°

| Melting point<br>(°C) | Designation of Compound                                | Para. |
|-----------------------|--------------------------------------------------------|-------|
| 200-3°                | Crude RDX                                              | 85    |
| 202-4                 | Ethylidene bisbenzamide (m.p. also given as<br>187-8°) | 42    |
| 203-6                 | DPT                                                    | 143   |
| 204-5                 | 106                                                    | 78    |
| 204-5                 | Pure RDX                                               | 85    |
| 205                   | Methylene-bis(dinitrocyclo <del>tri</del> azaheptane)  | 190   |
| 207                   | Bis(cinnamylideneamino)-(PT)                           | 150   |
| 207                   | Dinitroso-(P.T.)                                       | 148   |
| 207                   | Triacetyltris(trichloromethyl)-(6-ring)                | 206   |
| 210-2                 | $C_{12}H_{21}H_4(NO)_3$                                | 210   |
| 210-5                 | P.S. 2                                                 | 166   |
| 211-2                 | "Stabiliser compound" picrate (BCX picrate)            | 180   |
| 213                   | Bis(salicylideneamino)-(P.T.)                          | 150   |
| 218                   | "Bristol Chloro Compound"                              | 207   |
| 218-20                | H.10                                                   | 37    |
| 219-230               | MEDNA-CH <sub>2</sub> O polymer                        | 34a   |
| 220-1                 | Tribenzoyl-(6-ring)                                    | 109   |
| 220-230               | P.S.1 Toronto m.p. (Penn.State m.p. 259-64°)           | 203   |
| 224                   | Nitroso-H.6                                            | 140   |
| 224-5                 | QDX (SEX)                                              | 130   |
| 224-6                 | Methylene bisbenzamide                                 | 40    |
| 225                   | EDX                                                    | 223   |
| 225                   | Tetrabenzoyl-(8-ring) (?)                              | 208   |
| 225-44*               | H.11                                                   | 214   |
| 226-7                 | Bis(benzylideneamino)-(P.T.)                           | 150   |
| 232-4                 | EDX(B)                                                 | 223   |
| 233-8                 | H.9                                                    | 213   |
| 236-43*               | MX                                                     | 129   |
| 244                   | DMTN                                                   | 74    |

(D) Melting points over 200° (Contd.)

| Melting point<br>(°C) | Designation of Compound                        | Para. |
|-----------------------|------------------------------------------------|-------|
| 254-5                 | "Dinitroso-Tröger's Base"                      | 198   |
| 257                   | H.12                                           | 137   |
| 257                   | Trichloroethylidenebisbenzamide                | 43    |
| 259-64                | P.S.1. Penn. State m.p. (Toronto m.p. 220-30°) | 203   |
| 266-7                 | Tribenzoyl-(5-chain)                           | 71    |
| 281-2                 | HMX                                            | 124   |
| 281-296               | EDX(A)                                         | 223   |
| 286-8                 | "Diacetyl-Tröger's Base"                       | 199   |
| 290-1                 | "Dibenzoyl-Tröger's Base"                      | 200   |

The following solid compounds have been isolated, and are discussed in the review, but, for the reasons indicated, the melting point data have not yet been recorded.

| Compound                                        | Behaviour                                                           | Para. |
|-------------------------------------------------|---------------------------------------------------------------------|-------|
| Acetyl-EDNA                                     | No data yet                                                         | 183   |
| Bismethyloltetranitro-<br>(7-chain)             | Not yet specified; compd.<br>unstable                               | 75    |
| Chlorotrimethylcyclodioxo-<br>trimethyleneamine | Very unstable, deflagrates<br>on drying                             | 121   |
| Diacetyltrichloromethyl-<br>(3-chain)           | Sublimes                                                            | 39    |
| H.15                                            | No data yet                                                         | 217   |
| Hexamine                                        | Sublimes                                                            | 158   |
| Hex:nitrate:acetate                             | Decomps. on warming<br>——→ HAMN                                     | 178   |
| K <sub>2</sub> AcAn                             | No data recorded                                                    | 73    |
| K <sub>2</sub> BSX                              | No data recorded                                                    | 48    |
| K CHX                                           | No data recorded                                                    | 50    |
| MEDA salts                                      | Hygrosc. and decomp. by<br>H <sub>2</sub> O (dinitrate deflagrates) | 45    |
| Methylenebismorpholine                          | No data yet                                                         | 45a   |
| Trinitro-(8-ring)-nitrate                       | No data yet                                                         | 128   |

MONTHLY INTERIM REPORTS TO DIVISION 8, N.D.R.C. of O.S.R.D."Studies on RDX and Related Compounds"

These reports, covering the chemical work carried out in the U.S.A., have the (U.S.A.) designation R.R.C., followed by a serial number. The British "S.R.7" numbers are:-

| R.R.C. No. | Date                 | SR7/ No. |
|------------|----------------------|----------|
| 1          | Dec. '42 to Jan. '43 | 3748     |
| 2          | Jan. to Feb. '43     | 3867     |
| 3          | Feb. to March '43    | 4179     |
| 4          | March to April '43   | 4180     |
| 5          | April to May '43     | 4766     |
| 6          | May to June '43      | 4879     |
| 7          | June to July '43     | 43/197   |
| 8          | July to Aug. '43     | 43/391   |
| 9          | Aug. to Sept. '43    | 43/924   |
| 10         | Sept. to Oct. '43    | 43/925   |
| 11         | Oct. to Nov. '43     | 44/70    |
| 12         | Nov. to Dec. '43     | 44/508   |
| 13         | Dec. '43 to Jan. '44 | 44/915   |
| 14         | Jan. to Feb. '44     | 44/952   |
| 15         | Feb. to March '44    | 44/1236  |
| 16         | March to April '44   | 44/1543  |
| 17         | April to May '44     | 44/2047  |
| 18         | May to June '44      | 44/2254  |
| 19         | June to July '44     | 44/      |
| 20         | July to Aug. '44     | 44/2833  |
| 21         | Aug. to Sept. '44    | 44/3207  |
| 22         | Sept. to Oct. '44    | 44/3502  |

CANADIAN EXPLOSIVES RESEARCH EXTRAMURAL SUMMARIES

(Research Projects of the Research and Development Sub-committee, Associate Committee in Explosives, National Research Council, Canada).

These give a clear review of the Canadian work and though, in the text of this Index, reference has been made rather to the University Progress Reports, the Extramural Summaries are probably the best means of tracking down work for which the direct Progress Report reference is not available.

| Canadian Serial No. | Date                 | SR7/ No. |
|---------------------|----------------------|----------|
| 3                   | March to June '42    | 2349     |
| 4                   | June to Nov. '42     | 3608     |
| 5                   | Nov. to Dec. '42     | 3719     |
| 6                   | Dec. to Jan. '43     | 4309     |
| 7                   | Jan. to Feb. '43     | 4032     |
| 8                   | Feb. to March '43    | 4312     |
| 9                   | March to April '43   | 4546     |
| 10                  | April to May '43     | 4547     |
| 11                  | June to Sept. '43    | 43/774   |
| 12                  | Sept. to Oct. '43    | 43/848   |
| 13                  | Oct. to Nov. '43     | 43/1148  |
| 14                  | Nov. to Dec. '43     | 44/135   |
| 15                  | Dec. '43 to Jan. '44 | 44/      |
| 16                  | Jan. to Feb. '44     | 44/679   |
| 17                  | Feb. to March '44    | 44/1376  |
| 18                  | March to April '44   | 44/1747  |
| 19                  | April to May '44     | 44/2112  |
| 20                  | May to June '44      | 44/2426  |
| 21                  | June to August '44   | 44/3156  |

U.S.A. and Canada RDM Committee Meetings

The dates of the meetings since September 1942 and the SR7/numbers of the reports covering the meetings are

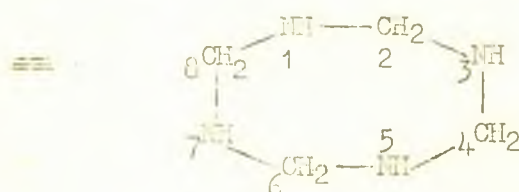
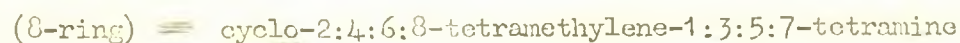
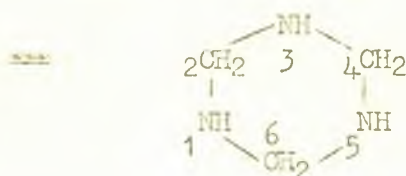
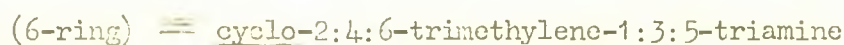
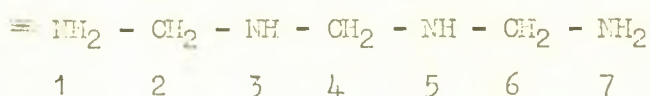
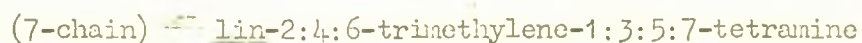
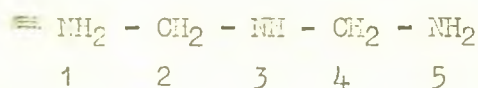
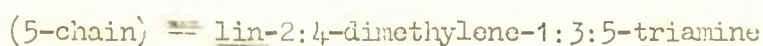
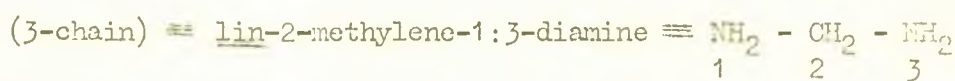
| Date of meeting | SR7/number |
|-----------------|------------|
| 4 Sept. '42     | 3319       |
| 1 Nov. '42      | 3440       |
| 19 Dec. '42     | 3665       |
| 10 April '43    | 4306       |
| 3 June '43      | 4956       |
| 7 Aug. '43      | 43/210     |
| 30 Sept. '43    | 43/1059    |
| 4 Dec. '43      | 44/299     |
| 5 Feb. '44      | 44/765     |
| 1 April '44     | 44/1594    |
| 26 May '44      | 44/2801    |
| 9 Sept. '44     | 44/        |

INDEX

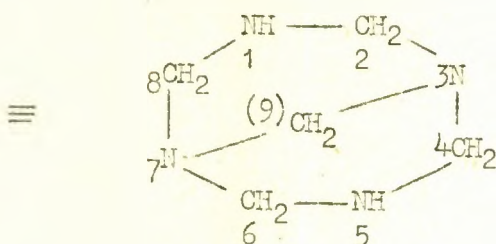
This is a "Subject-Index". Each compound is listed under

- (a) its "initial-designation";
- (b) its popular or trivial name;
- (c) its short systematic name.

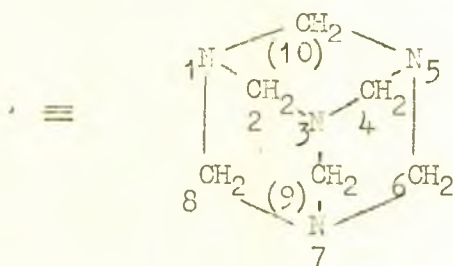
It may be desirable to repeat that the "short systematic names" may be converted into the "full systematic names" by the following list of equivalents.



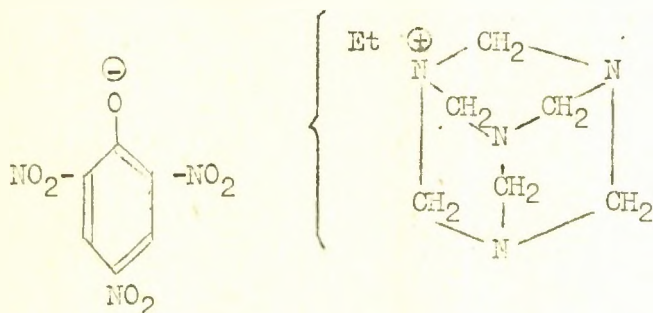
(P.T.)  $\equiv$  3:7-endomethylene(9)cyclo-2:4:6:8-tetramethylene-  
1:3:5:7-tetramine ("pentamethylenetetramine")



(Hex.)  $\equiv$  1:5-endomethylene(10)-3:7-endomethylene(9)-  
cyclo-2:4:6:8-tetramethylene-1:3:5:7-tetramine.  
("Hexamine").



Thus the compound:-



is listed under the headings H.30; P.S.2(Et); "Hexamine Ethopicrate";  
1-ethyl-(Hex.)-1-picrate.

Under each of the names of a given compound is recorded (a) a list of all the other names of the compound (b) a full set of para. references. The paragraph number underlined is the main reference, being that of the paragraph dealing with the structure, physical properties and preparation of the compound: the other references are to paragraphs in which transformations of the compound are discussed.

A

AcAn; (1:7-Bis(acetoxymethyl)-1:3:5:7-tetranitro-(7-chain);

73, 76, 77, 78, 88, 94, 98.

1-Acetamidomethyl-(Hex)-1-chloride; (H.2.C1);

170, 172, 173.

1-Acetamidomethyl-(Hex)-1-nitrate; (H.2);

82, 89, 91, 96, 144, 170, 171, 172, 173, 212.

1-Acetamidomethyl-(Hex)-1-picrate; (H.3);

160, 173, 212, 215.

N-Acetyl-E.D.N.A.; 183.

ATX; NBSX; 1:5-Bis(nitroxymethyl)-1:3:5-trinitro-(5-chain);

64, 65, 66, 67, 69.

2ATX: AcMe; 66.

B

BCX; ("Stabiliser Compound"; 1:5-dimethyl-(Hex)-1:5-dinitrate).

92, 180, 180a, 220.

BCX-picrate; (Stabiliser compound picrate; 1:5-dimethyl-(Hex)-1:5-dipicrate).

180, 180a.

1-Benzamidomethyl-(Hex)-1-nitrate; (Benzoic-H.2);

175, 176.

1-Benzamidomethyl-(Hex)-1-picrate; (Benzoic-H.3);

176.

Benzoic-H.2; (1-Benzamidomethyl-(Hex)-1-nitrate);

175, 176.

Benzoic-H.3; (1-Benzamidomethyl-(Hex)-1-picrate);

176.

1:3-Bis(acetoxymethyl)-1:3-dinitro-(3-chain); (TEX);

31, 32, 65, 91, 94, 94a, 146, 223.

N:N'-Bisacetoxymethyl-E.D.N.A.; (Bisacetoxymethylenc-E.D.N.A.);

186.

Bisacetoxymethylenc-E.D.N.A.; (N:N'-Bisacetoxymethyl-E.D.N.A.);

186.

Bis(acetoxymethyl)nitramine; 15a, 15b, 63.

1:7-Bis(acetoxymethyl)-1:3:5:7-tetranitro-(7-chain); (AcAn);

73, 76, 77, 78, 88, 94, 98.

1:5-Bis(acetoxymethyl)-1:3:5-trinitro-(5-chain); (BSX);

15b, 32, 48, 52, 63, 64, 65, 66, 70, 88, 91, 94, 98, 146.

1:7-Bis(acetoxymethyl)-1:3:7-trinitro-5-acetyl-(7-chain); (H.16; W.R.X.);

78, 82, 94.

1:5-Bis(benzylideneamino)-(P.T.); 150.

1:5-Bis(chloromethyl)-1:3:5-trinitro-(5-chain); (G.S.X.);

64, 67, 70.

1:5-Bis(cinnamylideneamino)-(P.T.); 150.

(1:7)-(3:5) or (1:5)-(3:7)-Bis(endoethylene)-(8-ring);

(OETA; Octamethylenetetramine);

192.

1:3-Bis(ethoxymethyl)-1:3-dinitro-(3-chain); (N:N'-Bis(ethoxymethyl)-MEDNA);

34.

N:N'-Bis(ethoxymethyl)-MEDNA; (1:3-Bis(ethoxymethyl)-1:3-dinitro-(3-chain));

34.

1:7-Bis(ethoxymethyl)-1:3:5:7-tetranitro-(7-chain);

78, 81.

1:5-Bis(ethoxymethyl)-1:3:5-trinitro-(5-chain); 69.

1:3-Bis(methoxymethyl)-1:3-dinitro-(3-chain);

(N:N'-Bis(methoxymethyl)-MEDNA); 33.

N:N'-Bis(methoxymethyl)-MEDNA; (1:3-Bis(methoxymethyl)-1:3-dinitro-(3-chain));

33.

1:7-Bis(methoxymethyl)-1:3:5:7-tetranitro-(7-chain);

78, 80.

1:5-Bis(methoxymethyl)-1:3:5-trinitro-(5-chain); ("104");

64, 67.

1:3-Bis(methylol)-1:3-dinitro-(3-chain); (N:N'-Bis(methylol)-MEDNA);

26, 30, 32.

N:N'-Bismethylol-1:3:5-trinitrotrimethylenediamine; (N:N'-Bismethylol-TMDNA);

195.

N:N'-Bismethylol-EDNA; 185, 189, 190.

N:N'-Bis(methylol)-MEDNA; (1:3-Bis(methylol)-1:3-dinitro-(3-chain));

26, 30, 32.

Bismethylolnitramine; 15.

1:7-Bis(methylol)-1:3:5:7-tetranitro-(7-chain);

75, 77, 79.

1:9-Bismethylol-1:3:7:9-tetranitro-5-methyl-(9-chain);

82b, 138a.

N:N'-Bismethylol-TMDNA; (N:N'-Bismethylol-N:N'-dinitro-trimethylenediamine);

195.

1:5-Bis(m-nitrobenzylidene)-(P.T.); 150.

Bis( $\beta$ -nitroxyethyl)-nitramine; (DINA); 16.

1:3-Bis(nitroxymethyl)-1:3-dinitro-(3-chain); (C.C.X.);

31, 32, 33, 34, 74, 94.

1:3-Bis(nitroxymethyl)lin-1:3-dioxo-2-methylene; (P.2);

8, 9, 94.

Bis(nitroxymethyl)nitramine; 15a, 15b, 146.

1:7-Bis(nitroxymethyl)-1:3:5:7-tetranitro-(7-chain); ("106");

76, 78, 79, 80, 81, 88, 94.

1:5-Bis(nitroxymethyl)-1:3:5-trinitro-(5-chain); (ATK; NBSZ);

64, 65, 66, 67, 69.

1:5-Bis(salicylideneamino)-(P.T.); 150.

Bristol Chloro-Compound; 207, 208.

BSX; (1:5-Bis(acetoxymethyl)-1:3:5-trinitro-(5-chain));

15b, 32, 48; 52, 63, 64, 65, 66, 70, 88, 91, 94, 98, 146.

C

Tert. Butyl-H.X.; (1:5:7-trinitro-3-tert.butoxymethyl-(8-ring));

135.

$C_4H_{10}N_6O_7$  (prob. 1:3-Dinitro-5-methylol-(6-ring)-5-nitrite;

Methylol-PCX-nitrite);

65, 101, 205.

$C_{12}H_{21}N_4Cl_3$ ; (Trichloro-deriv. from "hexaethylidenetetramine"

(Tricrotonylidenetetramine));

211.

$C_{12}H_{21}N_4(NO)_3$ ; (Trinitroso-deriv. from "hexaethylidenetetramine"

(Tricrotonylidenetetramine));

210.

Chloralbenzamide; (N-( $\alpha$ -Hydroxy- $\beta$ : $\beta$ : $\beta$ :-trichloroethylbenzamide);

21.

5-Chloro-2:4:6-trimethylcyclo-1:3-dioxo-2:4:6-trimethylene-5-amine;

121.

C.M.X.; (1-Methyl-1:3:5-trinitro-(5-chain)); 49, 50.

C.O.X.; (1:3-Bis(nitroxymethyl)-1:3-dinitro-(3-chain));

31, 32, 33, 34, 74, 94.

Cyclonite Oxide; (3:5-Dinitrocyclo-1-oxo-2:4-dimethylene-3:5-diamine);

31, 94, 118, 119.

D

D.A.P.T.; (H.6; 1:5-Diacetyl-P.T.));

37, 92, 125a, 140, 141, 151, 152, 152a, 155a, 170, 215, 216, 217.

1:8-Diacetoxy-2:5:7-trinitro-2:5:7-triazaoctane;

187, 188.

1:3-Diacetyl-(3-chain); (H.7; Methylene bisacetamide);

26, 29a, 36.

1:3-Diacetyl-1:3-dinitro-(3-chain); (N:N'-Diacetyl-MEDNA);

26, 29a.

N:N'-Diacetyl-MEDNA; (1:3-Diacetyl-1:3-dinitro-(3-chain);

26, 29a.

1:3-Diacetyl-2-methyl-(3-chain); (Ethylidene bisacetamide);

38.

1:5-Diacetyl-3-methyl-(P.T.)-3-salts; (H.6-"Metho-salts");

155a.

1:5-Diacetyl-(P.T.); (H.6; DAPT);

37, 92, 125a, 140, 141, 151, 152, 152a, 155a, 170, 215, 216, 217.

1:5-Diacetyl-(P.T.)-3-picrate; (H.6 Picrate);

152a.

1:3-Diacetyl-2(trichloromethyl)-(3-chain); 39.

"Diacetyl-Tröger's Base"; 199.

1:5-Diamino-(P.T.); 150.

1:3-Dibenzoyl-(3-chain); (Methylenebisbenzamide);

40, 41.

N:N'-Dibenzoyl(ethylidenediamine; (1:3-Dibenzoyl-2-methyl-  
(3-chain); ethylidene bisbenzamide);

42.

1:3-Dibenzoyl-2-methyl-(3-chain); (N:N'-Dibenzoylethylidene-diamine;  
Ethylidene bisbenzamide);

42.

1:3-Dibenzoyl-2(trichloromethyl)-(3-chain); (Trichloroethylidene  
bisbenzamide);

43.

"Dibenzoyl-Tröger's Base"; 200.

1:3-Dicarbethoxy-(3-chain); (Methylene bisurethane); 44.

1:5-Dichloro- (P.T.); 108, 149.

1:3-Diformyl-(3-chain); (Methylene bisformamide); 35, 40, 45.

1:5-Dimethyl-1-acetoxymethyl-(P.T.)-1:5-dinitrate; (H.23; see also  
1:5-Dimethyl-3-acetoxymethyl-(P.T.)-1:3-dinitrate);

156.

1:5-Dimethyl-3-acetoxymethyl-(P.T.)-1:3-dinitrate; (H.23; see also  
1:5-Dimethyl-1-acetoxymethyl-(P.T.)-1:5-dinitrate;

156.

1:5-Dimethyl-(Hex.)-1:5-dinitrate; (BCX; stabiliser compound);

92, 180, 180a, 220.

1:5-Dimethyl-(Hex.)-1:5-dipicrate; (BCX picrate; stabiliser compd. picrate);

180, 180a.

1:5-Dimethyl-(Hex.)-1-nitrate-5-iodide; 180a.

Dimethylnitramine; 13.

1:5-Dimethyl-(P.T.) picrate; 92, 153.

1:7-Dimethyl-1:3:5:7-tetranitro-(7-chain); (DMTH); 74.

Dimorpholine deriv. of N:N'-Bis(methylol)-EDNA; 185.

Dimorpholine deriv. of N:N'-Bis(methylol)-TMDNA; 195.

D.I.N.A.; (Bis ( $\beta$ -nitroxyethyl)nitramine); 16.

1:3-Dinitro-5-acetyl-(6-ring); (TAX); 88, 89, 90, 98, 99, 131.

1:3-Dinitro-(3-chain); (MEDNA; MDN; Methylenedinitramine);

25, 26, 27, 28, 29, 30, 32, 33, 34a, 53, 59, 93, 103a, 138a, 145,

146, 203, 223.

1:3-Dinitro(5-chain)-5-nitrate; 47.

1:5-Dinitro-3:7-diacetyl-(8-ring); (H.12); 137.

1:5-Dinitro-3:7-dibenzyl-(8-ring); 105, 139.

1:5-Dinitro-3:7-dimethyl-(8-ring); 138.

1:7-Dinitro-3:5-dimethyl-(8-ring); 82b, 138a.

3:7-Dinitrocyclo-1:5-dioxo-2:4:6:8-tetramethylene-3:7-diamine; (P.S.1);

15a, 91, 94a, 203, 204.

1:5-Dinitro-3:7-endoethylene-(8-ring); 191.

1:5-Dinitro-3:7-endoethylidene-(8-ring); (1:5-Dinitro-2-methyl-(P.T.));

115, 126, 147.

N:N'-Dinitroethylenediamine; (EDNA; ethylene dinitramine);

182, 183, 184, 185, 186, 189, 190, 190a, 191, 192.

1:3-Dinitro-5-ethoxymethyl-(6-ring); 102.

1:3-Dinitro-5-methoxymethyl-(6-ring); 101.

1:3-Dinitro-5-methylol-(6-ring); (Methylol-PCX; PCX(A));

90, 96, 99, 100, 145, 146.

1:3-Dinitro-5-methylol-(6-ring)-5-nitrite; (Methylol-PCX-nitrite;

$C_4H_{10}N_6O_7$ );

65, 101, 205.

1:5-Dinitro-9-methyl-(P.T.); (1:5-Dinitro-3:7-endoethylidene-(8-ring));

115, 126, 147.

1:5-Dinitro-3-methyl-(P.T.)-3-nitrate; (H.19); 154, 164.

3:6-Dinitro-1-methylcyclo-1:3:6-triazaheptane; 189.

1:3-Dinitro-5-nitroso-(6-ring); (Nitroso-PCX);

90, 91, 96, 97, 99, 205.

1:5-Dinitro-3-nitroso-7-acetyl-(8-ring); (QNX); 131, 136.

3:6-Dinitrocyclo-1-oxa-3:6-diazaheptane; (Homo-Cyclonite Oxide); 190a.

3:5-Dinitrocyclo-1-oxo-2:4-2:4:6-trimethylene-3:5-diamine; (Cyclonite Oxide);

31, 94, 118, 119.

1:5-Dinitro-(P.T.); (DPT; DNPT);

26, 32, 52, 65, 66, 67, 75, 76, 78, 79, 89, 91, 94, 94a, 100, 103a,  
124, 128, 129; 132, 132a, 136, 137, 143, 144, 145, 146, 164, 166,  
204, 216, 218, 223.

1:3-Dinitro-(6-ring)-5-nitrate; (PCX; HOX);

25, 89, 94, 95, 96, 98, 100, 103, 145, 146, 222.

N:N'-Dinitrotrimethylenediamine; (TMDNA; Trimethylenedinitramine);

194, 195.

1:5-Dinitroso-(P.T.); 148, 150.

"Dinitroso-Tröger's Base"; 198.

1:7-Dipotassio-1:3:5:7-tetranitro-(7-chain); (K<sub>2</sub>AcAn); 73.

1:5-Dipotassio-1:3:5-trinitro-(5-chain); (K<sub>2</sub>BSX); 27, 48.

1:5-Dipropionyl-(P.T.); (H.17); 152.

DMTN; (1:7-Dimethyl-1:3:5:7-tetranitro-(7-chain); 74.

DNPT; (DPT; 1:5-Dinitro-(P.T.));

26, 32, 52, 65, 66, 67, 75, 76, 78, 79, 89, 91, 94, 94a, 100, 103a,  
124, 128, 129, 132, 132a, 136, 137, 143, 144, 145, 146, 164, 166,  
204, 216, 218, 223.

DPT; (DNPT; 1:5-Dinitro-(P.T.));

26, 32, 52, 65, 66, 67, 75, 76, 78, 79, 89, 91, 94, 94a, 100, 103a,  
124, 128, 129, 132, 132a, 136, 137, 143, 144, 145, 146, 164, 166,  
204, 216, 218, 223.

E

EDNA; (Ethylenedinitramine; N:N'-Dinitroethylenediamine);

182, 183, 184, 185, 186, 189, 190, 190a, 191, 192.

EDX; (constitution unsettled); 32, 94a, 146, 223.

EDX(A); 32, 223.

EDX(B); 223.

1-Ethoxymethyl-5-acetoxymethyl-1:3:5-trinitro-(5-chain); ("107");

64, 66, 68.

Et-HX; (1:5:7-Trinitro-3-ethoxymethyl-(8-ring)); 134, 145.

1-Ethyl-5-acetoxymethyl-1:3:5-trinitro-(5-chain); (H.28);

53, 58, 59, 60, 61, 62, 90.

1-Ethyl-5-chloromethyl-1:3:5-trinitro-(5-chain); (H.33); 62.

Ethylenedinitramine; (EDNA; N:N'-dinitroethylenediamine);

182, 183, 184, 185, 186, 189, 190, 190a, 191, 192.

1-Ethyl-5-ethoxymethyl-1:3:5-trinitro-(5-chain); (H.32); 61.

1-Ethyl-(Hex.)-1-iodide; (Hex. ethiodide); 167, 169, 224.

1-Ethyl-(Hex.)-1-nitrate; (H.29; Hex. ethonitrate);

53, 58, 90, 168.

1-Ethyl-(Hex.)-1-picrate; (H.30; PS.2(Et); Hex. ethopicrate);

59, 169.

Ethylidene bisacetamide; (1:3-Diacetyl-2-methyl-(3-chain); 38.

Ethylidene bisbenzamide; (1:3-Dibenzoyl-2-methyl-(3-chain);

N:N'-Dibenzoylethylidenediamine);

42.

1-Ethyl-5-methoxymethyl-1:3:5-trinitro-(5-chain); (H.31); 60.

F

Furfurylidenenitramine; 23.

G

G.S.X.; (1:5-Bis(chloromethyl)-1:3:5-trinitro-(5-chain));

64, 67, 70.

H

H.1; (H.18; H.20; Hex. methonitrate; 1-Methyl-(Hex.)-1-nitrate);

52, 53, 58, 90, 92, 145, 154, 155, 156, 164, 165, 166, 168,

179, 180, 180a, 218.

H.2; (H.1-Acetamidomethyl-(Hex.)-1-nitrate);

82, 89, 91, 96, 144, 170, 171, 172, 173, 212.

- H.2.Cl; (1-Acetamidomethyl-(Hex)-1-chloride); 170, 172, 173.
- H.3; (1-Acetamidomethyl-(Hex)-1-picrate); 160, 173, 212, 215.
- H.4; (constitution unsettled); 212.
- H.5; (Propionic H.2; 1-Propionamide-(Hex)-1-nitrate; 174.
- H.6; (DAPT; 1:5-Diacetyl-(P.T.)); 37, 92, 125a, 140, 141, 151, 152, 152a, 155a, 170, 215, 216, 217.
- H.6-"Metho-Salts"; (1:5-Diacetyl-3-methyl-(P.T.)-3-salts); 155a.
- H.6 P; (H.14); (uncertain constitution); 216.
- H.6 Picrate; (1:5-Diacetyl-(P.T.)-3-picrate); 152a.
- H.7; (Methylene bisacetamide; 1:3-diacetyl-(3-chain)); 26, 29a, 36.
- H.8; 1:3:5:7-Tetracetyl-(8-ring); 126, 141, 213.
- H.9; (constitution unsettled); 126, 213, 214.
- H.10; (N:N:N':N'-Tetracetylmethylenediamine; 1:1:3:3-Tetracetyl-(3-chain)); 36, 37.
- H.11; (constitution unsettled); 126, 214.
- H.12; (1:5-Dinitro-3:7-diacetyl-(8-ring)); 137.
- H.13; (constitution unsettled); 215, 217.
- H.14; (H.6.P); (constitution unsettled); 216.
- H.15; (constitution unsettled); 217.
- H.16; (W.R.X.; 1:7-Bis(acetoxymethyl)-1:3:7-trinitro-5-acetyl-(7-chain)); 78, 82, 94.
- H.17; (1:5-Dipropionyl-P.T.); 152.
- H.18; (H.1; H.20; Hex. methonitrate; 1-Methyl-(Hex)-1-nitrate); 52, 53, 58, 90, 92, 145, 154, 155, 156, 164, 165, 166, 168, 179, 180, 180a, 218.
- H.19; (1:5-Dinitro-3-methyl-(P.T.)-3-nitrate; 154, 164.
- H.20; (H.1; H.18; Hex. methonitrate; 1-Methyl-(Hex)-1-nitrate); 52, 53, 58, 90, 92, 145, 154, 155, 156, 164, 165, 166, 168, 179, 180, 180a, 218.
- H.21; (MSX; 1-Methyl-5-acetoxymethyl-1:3:5-trinitro-(5-chain)); 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 65, 90, 145.

- H.22; (constitution unsettled); 218.
- H.23; (1:5-Dimethyl-1-acetoxymethyl-(P.T.)-1:5-dinitrate; or  
1:5-Dimethyl-3-acetoxymethyl-(P.T.)-1:3-dinitrate);  
156.
- H.24; (MSX-Et; 1-Methyl-5-ethoxymethyl-1:3:5-trinitro-(5-chain));  
56.
- H.25; (MSX-Me; 1-Methyl-5-methoxymethyl-1:3:5-trinitro-(5-chain));  
55.
- H.26; (1-Methyl-(Hex)-1:5-dinitrate; Hex.nitrate methonitrate);  
52, 179.
- H.27; (constitution unsettled); 79, 219.
- H.28; (1-Ethyl-5-acetoxymethyl-1:3:5-trinitro-(5-chain));  
53, 58, 59, 60, 61, 62, 90.
- H.29; (Hex. ethonitrate; 1-Ethyl-(Hex)-1-nitrate);  
53, 58, 90, 168.
- H.30; (P.S.2(Et); Hex. ethopicate; 1-Ethyl-(Hex)-1-picrate);  
59, 169.
- H.31; (1-Ethyl-5-methoxymethyl-1:3:5-trinitro-(5-chain); 60.
- H.32; (1-Ethyl-5-ethoxymethyl-1:3:5-trinitro-(5-chain); 61.
- H.33; (1-Ethyl-5-chloromethyl-1:3:5-trinitro-(5-chain)); 62.
- HADN; (Hex. dinitrate);  
27, 47, 63, 66, 85, 86, 95, 102, 143, 144, 146, 165, 170, 177, 203, 204.
- HAMN; (Hex. mononitrate; Hex.-1-nitrate);  
65, 66, 159, 170, 174, 175, 178.
- Hepta RDX; (Homo RDX; 1:3:6-trinitrocyclo-1:3:6-triazaheptane); 185, 187, 188.
- Hex; (Hexamine; Hexamethylenetetramine);  
15b, 22, 27, 40, 51, 58, 63, 66, 67, 68, 71, 78, 82, 84, 85, 86, 87, 88, 92, 93, 94, 94a, 96, 98, 104, 106, 109, 118, 119, 124, 125, 125a, 130, 131, 143, 148, 149, 151, 158, 159, 160, 161, 162, 163, 164, 166, 167, 168, 170, 171, 174, 175, 177, 178, 180, 203, 208, 209, 219, 220, 224.
- Hexaethylidenetetramine; (Tricrotonylidene tetramine);  
209, 210, 211.

Hexamethylenetetramine; (Hex.; Hexamine);

15b, 22, 27, 40, 51, 58, 63, 66, 67, 68, 71, 78, 82, 84, 85, 86, 87,  
88, 92, 93, 94, 94a, 96, 98, 104, 106, 109, 118, 119, 124, 125, 125a,  
130, 131, 143, 148, 149, 151, 158, 159, 160, 161, 162, 163, 164, 166,  
167, 168, 170, 171, 174, 175, 177, 178, 180, 203, 208, 209, 219, 220,  
224.

Hexamine; (Hex.; Hexamethylenetetramine); see preceding item.

Hexamine dinitrate; (HADN);

27, 47, 63, 85, 86, 95, 102, 143, 144, 146, 165, 170, 177, 203, 204.

Hex. ethiodide; (1-Ethyl-(Hex)-1-iodide); 167, 169, 224.

Hex. Ethiodide by-product; 167, 224.

Hex. Ethonitrate; (H.29; 1-Ethyl-(Hex)-1-nitrate); 53, 58, 90, 168.

Hex. ethopierate; (H.30; P.S.2(Et); 1-Ethyl-(Hex)-1-pierate);

Hex. methiodide; (1-Methyl-(Hex)-1-iodide); 163.

Hex. methonitrate; (H.1; H.18; H.20; 1-Methyl-(Hex)-1-nitrate);

52, 53, 58, 90, 92, 145, 154, 155, 156, 164, 165, 166, 168, 179, 180,  
180a, 218.

Hex. methopierate; (P.S.2; 1-Methyl-(Hex)-1-pierate); 52, 166, 216.

Hex. mononitrate; (HAMN; Hex.-1-nitrate); 65, 66, 159, 170, 174, 175, 178.

Hex. nitrate methonitrate; (1-Methyl-(Hex)-1:5-dinitrate; H.26); 52, 179.

Hex. nitrourethane; 162.

Hex.-1-nitrate; (HAMN; Hex.mononitrate); 65, 66, 159, 170, 174, 175, 178.

Hex-1-nitrate-5-acetate; 178.

Hex. pierate; 160, 173.

Hex. styphnate; 161.

HMX; (1:3:5:7-Tetranitro-(8-ring)); 51, 73, 88, 89, 115, 124, 125, 125a, 126  
127, 131, 213.

Homo Cyclonite Oxide; (3:6-Dinitrocyclo-1-Oxo-3:6-diazaheptane); 190a.

Homo RDX; (Hepta-RDX; 1:3:6-Trinitrocyclo-1:3:6-triazaheptane);  
185, 187, 188.

H.O.X.; (P.C.X.; 1:3-Dinitro-(6-ring)-5-nitrate);

25, 89, 94, 95, 96, 98, 100, 103, 145, 146, 222.

N-Hydroxymethyl-EDNA; (N-Methylol EDNA; N-Methylol-N:N'-dinitro-  
ethylenediamine);

184, 190a.

N-( $\alpha$ -Hydroxy- $\beta$ : $\beta$ : $\beta$ -trichloroethyl)-benzamide; (Chloralbenzamide); 21.

I

ISX; (uncertain constitution); 221.

K

K<sub>2</sub>AcAn; (1:7-Dipotassio-1:3:5:7-tetranitro-(7-chain)); 73.

K<sub>2</sub>BSX; (1:5-Dipotassio-1:3:5-trinitro-(5-chain)); 27, 48.

KCMX; (1-Methyl-5-potassio-1:3:5-trinitro-(5-chain)); 50.

L

LMX; (uncertain constitution); 220, 221.

M

McGill Compound; 89, 222.

MDN; (MEDNA; Methylenedinitramine; 1:3-Dinitro-(3-chain));  
25, 26, 27, 28, 29, 30, 32, 33, 34a, 53, 59, 82b, 93, 103a, 138a, 145,  
146, 203, 223.

MEDNA; (Methylenedinitramine; MDN; 1:3-Dinitro-(3-chain));  
see preceding item.

(MEDNA-CH<sub>2</sub>O) polymer; 34a.

MEDNA Dimethyl Ether; (Methylene dinitramine dimethyl ether); 29.

MEDNA Salts; 27.

Me - HX; (1:5:7-Trinitro-3-methoxymethyl-(6-ring)); 133, 144.

1-Methyl-5-acetoxymethyl-1:3:5-trinitro-(5-chain); (H.21; MSX);  
49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 65, 90, 145.

1-Methyl-5-chloromethyl-1:3:5-trinitro-(5-chain); (O.F.X.);  
52, 57, 74.

Methylene biacetamide; (H.7; 1:3-diacetyl-(3-chain)); 26, 29a, 36.

Methylene bisbenzamide; (1:3-Dibenzoyl-(3-chain)); 40, 41.

Methylene bis(1:3-dinitro-(6-ring)-5-); 94a, 103a, 146.

Methylene bis(3:6-dinitrocyclo-1:3:6-triazaheptane-1); 187, 188, 190.

Methylene bisformamide; (1:3-Diformyl-(3-chain)); 35, 40, 45.

Methylene bismorpholine; 45a.

Methylene bispiperidine; 45a.

Methylene bisurethane; (1:3-Dicarbethoxy-(3-chain)); 44.

Methylenediamine salts; 45, 88, 106, 125a.

Methylenedinitramine; (MEDNA; MDN; 1:3-Dinitro(3-chain));  
25, 26, 27, 28, 29, 30, 32, 33, 34a, 53, 59, 82b, 93, 103a, 138a,  
145, 146, 203, 223.

Methylene Dinitramine Dimethyl Ether; (MEDNA Dimethyl Ether); 29.

Methylene dinitrate; (P<sub>1</sub>); 8, 9, 94.

Methylenimine; 18, 84.

1-Methyl-5-ethoxymethyl-1:3:5-trinitro-(5-chain); (MSX-Et; H.24); 56.

1-Methyl-(Hex)-1:5-dinitrate; (H.26; Hex. nitrate methonitrate);  
52, 179.

1-Methyl-(Hex)-1-iodide; (Hex. methiodide); 163.

1-Methyl-(Hex)-1-nitrate; (H.1; H.18; H.20; Hex.methonitrate);  
52, 53, 58, 90, 92, 145, 154, 155, 156, 164, 165, 166, 168, 179, 180,  
180a, 218.

1-Methyl-(Hex)-1-picrate; (P.S.2; Hex.methopierate); 52, 166, 216.

1-Methyl-5-methoxymethyl-1:3:5-trinitro-(5-chain); (H.25; MSX-Me);  
55.

Methylmethylnitramine; 14.

Methylnitramine; 12, 13, 14, 74.

1-Methyl-5-nitroxymethyl-1:3:5-trinitro-(5-chain); (MSX nitrate);  
51, 52, 54, 55, 74.

Methylolacetamide; 19.

Methylolamine; 18, 84.

Methylolamine nitrate; 27, 93, 160, 202.

Methylolbenzamide; 20, 40.

1-Methylol-1:3-dibenzoyl-(3-chain); 41.

N-Methylol-N:N'-dinitroethylenediamine; (N-Methylol-EDNA;  
N-Hydroxymethyl-EDNA); 184, 190a.

N-Methylol-EDNA; (N-Hydroxymethyl-EDNA; N-Methylol-N:N'-dinitro-  
ethylenediamine); 184, 190a.

Methylolnitramine; 12a.

Methylol-PCX; (PCX(A); 1:3-Dinitro-5-methylol-(6-ring));  
90, 96, 99, 100, 145, 146.

Methylol-PCX nitrite; (1:3-Dinitro-5-methylol-(6-ring)-5-nitrite);  
65, 101, 205.

1-Methyl-5-potassio-1:3:5-trinitro-(5-chain); (KCMX); 50.

1-Methyl-1:3:5-trinitro-(5-chain); (CMX); 49, 50.

MMX; (Nitroso HMX; 1:5:7-Trinitro-3-nitroso-(8-ring)); 126, 129.

Morpholine deriv. of methyl methylnitramine; 14.

MSX; (H.21; 1-Methyl-5-acetoxymethyl-1:3:5-trinitro-(5-chain);  
49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 65, 90, 145.

MSX-Et; (H.24; 1-Methyl-5-ethoxymethyl-1:3:5-trinitro-(5-chain));

56.

MSX-Me; (H.25; 1-Methyl-5-methoxymethyl-1:3:5-trinitro-(5-chain));

55.

MSX nitrate; (1-Methyl-5-nitroxymethyl-1:3:5-trinitro-(5-chain));

51, 52, 54, 55, 74.

N

NBSX; (ATX; 1:5-Bis(nitroxymethyl)-1:3:5-trinitro-(5-chain));

64, 65, 66, 67, 69.

Nitramide; (Nitramine); 11, 15, 23, 104, 105, 138, 139, 143, 145, 147, 184, 186,

190a, 191, 204.

Nitramine; (Nitramide); see preceding item.

1-Nitro-3:5-dibenzyl-(6-ring); 105, 139.

1-Nitro-3:5-diethylhexyl-(6-ring); 104.

1-Nitro-5-nitroso-3:7-diacetyl-(8-ring); (Nitroso-H.6); 140.

1-Nitro-5-nitroso-3-methyl-(P.T.)-3-nitrate; (Nitroso H.19); 155.

Nitroso H.6; (1-Nitro-5-nitroso-3:7-diacetyl-(8-ring)); 140.

Nitroso H.19; (1-Nitro-5-nitroso-3-methyl-(P.T.)-3-nitrate); 155.

Nitroso HMX; (HMX; 1:5:7-Trinitro-3-nitroso-(8-ring)); 126, 129.

Nitrosoparalidine; (5-Nitroso-2:4:6-trimethylcyclo-1:3-dioxo-

2:4:6-trimethylene-5-amine); 120.

Nitroso-(PCX); (1:3-Dinitro-5-nitroso-(6-ring)); 90, 91, 96, 97, 99, 205.

5-Nitroso-2:4:6-trimethylcyclo-1:3-dioxo-2:4:6-trimethylene-5-amine;

(Nitrosoparalidine); 120.

O

Octamethylenetetramine; OMTA; Bis(endoethylene)-(8-ring)); 192.

OFX; (1-Methyl-5-chloromethyl-1:3:5-trinitro-(5-chain));

52, 57, 74.

OMTA; (Octamethylenetetramine; Bis(endoethylene)-(8-ring)); 192.

P

P<sub>1</sub>; (Methylene dinitrate); 8, 9, 94.

P<sub>2</sub>; (1:3-Bis(nitroxymethyl)lin-1:3-dioxo-2-methylene); 8, 9, 94.

P<sub>3</sub>; (P.P.C.X.; 1:3-Dinitro-5-bis(nitroxymethyl)aminomethyl-(6-ring));

103.

PCX; (HOM; 1:3-dinitro-(6-ring)-5-nitrate); 25, 89, 94, 95, 96, 98, 100, 103, 145, 146, 222.

PCX(A); (Methylol-PCX; 1:3-Dinitro-5-methylol-(6-ring)); 90, 96, 99, 100, 145, 146.

Phenylurethane of methylolbenzamide; 20.

PHX; (1:5:7-Trinitro-3-acetoxymethyl-(8-ring)); 76, 125a, 129, 132, 133, 134, 135, 144, 170.

P.2 IX; (1:5:7-Trinitro-3-propionoxymethyl-(8-ring)); 132a.

P.P.C.X.; (P<sub>3</sub>; 1:3-Dinitro-5-bis(nitroxymethyl)aminomethyl-(6-ring)); 103.

1-Propionamidomethyl-(Hex)-1-nitrate; (H.5; Propionic H.2); 171.

Propionic H.2; (H.5; 1-Propionamidomethyl-(Hex)-1-nitrate); 171.

P.S.1; (constitution unsettled; prob. 3:7-Dinitrocyclo-1:5-dioxo-2:4:6:8-tetramethylene-3:7-diamine); 15a, 91, 94a, 146, 203, 204.

P.S.2; (Hex. methopicate; 1-Methyl-(Hex)-1-picate); 52, 166, 216.

P.S.2 (Et); (H.50; Hex. ethopicate; 1-Ethyl-(Hex)-1-picate); 59, 169.

## Q

QDX; (SEX; 1:3:5-Trinitro-7-acetyl-(8-ring)); 88, 98, 126, 130, 131.

QFX; (1:5-Dinitro-3-nitroso-7-acetyl-(8-ring)); 131, 136.

## R

RDX; (1:3:5-Trinitro-(6-ring));

48, 51, 58, 66, 67, 68, 78, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 94a, 96, 107, 119, 125, 125a, 131, 143, 144, 223.

RDX(II); (RSX; 87); product from Bachmann Combination Process;

32, 51, 52, 58, 63, 65, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 94a, 95, 97, 98, 118, 124, 125, 130, 131, 146, 223.

6-Ring; (Cyclo-2:4:6-trimethylene-1:3:5-triamine); 18, 84.

## S

SEX; (QDX; 1:3:5-Trinitro-7-acetyl-(8-ring)); 88, 98, 126, 130, 131.

"Stabiliser Compound"; (BCX; 1:5-Dimethyl-(Hex)-1:5-dinitrate); 92, 180, 180a, 220.

"Stabiliser compound" picrate; (BCX picrate; 1:5-Dimethyl-(Hex)-1:5-dipicrate);  
180, 180a.

T

TAX; (1:3-Dinitro-5-acetyl-(6-ring)); 88, 89, 90, 98, 99, 131.

TEMD; (1:1:3:3-Tetraethyl-(3-chain)); 45a.

1:1:3:3-Tetracetyl-(3-chain); (H.10; N:N:N':N'-Tetracetyl-methylenediamine);  
36, 37.

N:N:N':N'-Tetracetylmethylenediamine; (H.10; 1:1:3:3-Tetracetyl-(3-chain));  
36, 37.

1:3:5:7-Tetracetyl-(8-ring); (H.8); 126, 141, 213.

1:3:5:7-Tetrabenzoyl-(8-ring); 206.

1:1:3:3-Tetraethyl-(3-chain); (TEMD); 45a.

Tetramethyl-(3-chain); 45a.

1:3:5:7-Tetranitro-(8-ring); (HEX);  
51, 73, 88, 89, 115, 124, 125, 125a, 126, 127, 131, 213.

TEX; (1:3-Bis(acetoxymethyl)-1:3-dinitro-(3-chain));  
31, 32, 65, 91, 94, 94a, 146, 223.

Thialdine; (2:4:6-trimethylcyclo-1:3-dithio-2:4:6-trimethylene-5-amine);  
122.

TMDNA; (N:N'-Dinitrotrimethylenediamine; trimethylenedinitramine);  
194, 195.

1:3:5-Triacetyl-2:4:6-tris(trichloromethyl)-(6-ring); 206.

1:3:5-Triamino-(6-ring); 107.

1:3:5-Tribenzoyl-(5-chain); 71, 109.

1:3:5-Tribenzoyl-(6-ring); 40, 71, 109.

1:3:5-Tribenzoyl-2:4:6-tris(trichloromethyl)-(6-ring); 206.

1:3:5-Tricarbethoxy-(6-ring); 110.

1:3:5-Tricarbethoxy-2:4:6-Tris(trichloromethyl)-(6-ring); 206.

Trichloro-deriv. from "hexaethylidenetetramine"; (tricrotonylidenetetramine);  
 $C_{12}H_{24}N_4Cl_3$ ; 211.

Trichloroethylidene-bisbenzamide; (1:3-Dibenzoyl-2-(trichloromethyl)-(3-chain));  
43.

1:3:5-Trichloro-(6-ring); 108.

Tricrotonylidene tetramine; (Hexaethylidene tetramine);  
209, 210, 211.

1:3:5-Triformyl-2:4:6-tris(trichloromethyl)-(6-ring); 206.

Trimethylene dinitramine; (TMDNA; N:N'-Dinitrotrimethylenediamine);

194, 195.

Cyclo-2:4:6-Trimethyl-1:3:5-triamine; (6-ring); 18, 84.

2:4:6-Trimethylcyclo-1:3-dithio-2:4:6-trimethylene-5-amine; (Thialdine); 122.

2:4:6-Trimethylcyclo-1-thio-2:4:6-trimethylene-1:5-diamine; 122.

1:3:5-Trimethyl-(6-ring); 111, 180.

2:4:6-Trimethyl-(6-ring); 42, 113, 114, 120, 121, 122, 209.

1:5:7-Trinitro-3-acetoxymethyl-(8-ring); (PHX);

76, 125a, 129, 132, 133, 134, 135, 144, 170.

1:3:5-Trinitro-7-acetyl-(8-ring); (QDX; SEX); 88, 98, 126, 130, 131.

1:5:7-Trinitro-3-tert.butoxymethyl-(8-ring); (Tert.butyl-HX); 135.

1:5:7-Trinitro-3-ethoxymethyl-(8-ring); (Et-HX); 134, 145.

1:5:7-Trinitro-3-methoxymethyl-(8-ring); (Me-HX); 133, 144.

1:3:5-Trinitro-2-methyl-(6-ring); 115, 126.

1:5:7-Trinitro-3-nitroso-(8-ring); (MNX; Nitroso-HMX); 126, 129.

1:5:7-Trinitro-3-propionoxymethyl-(8-ring); (P.2.HX); 132a.

1:3:5-Trinitro-(6-ring); (RDX, and main component of RDX(B);

32, 48, 51, 52, 58, 63, 65, 66, 67, 68, 78, 85, 86, 87, 88, 89, 90,

91, 92, 93, 94, 94a, 95, 96, 98, 107, 118, 119, 124, 125, 130, 131,

143, 144, 146, 223.

1:3:5-Trinitro-(8-ring)-7-nitrate; 128, 129.

Trinitroso-deriv. from "hexaethylidenetetramine"; (Tricrotonylidene tetramine);

$C_{12}H_{21}N_4(NO)_3$ ; 210.

1:3:5-Trinitroso-(6-ring); 88, 106.

1:3:5-Trinitroso-2:4:6-trimethyl-(6-ring); 114, 120.

1:3:6-Trinitrocyclo-1:3:6-triazaheptane; (Hepta-RDX; Homo-RDX);

185, 187, 188.

Tris(benzamidomethyl)amine; 22.

1:3:5-Tris(nitroxymethyl)-(6-ring); 204.

Tris(salicylideneamino)-(6-ring); 107.

(1-2:4:6-Tris(trichloromethyl)-(6-ring); 116.

(3-2:4:6-Tris(trichloromethyl)-(6-ring); 116.

Troger's Base; 197, 198, 199, 200.

Troger's Base picrate; 197.

W

WRX; (H.16; 1:7-Bis(acetoxymethyl)-1:3:7-trinitro-5-acetyl-(7-chain));

73, 82, 94.

"104"; (1:5-Bis(methoxymethyl)-1:3:5-trinitro-(5-chain));

64, 67.

"106"; (1:7-Bis(nitroxymethyl)-1:3:5:7-tetranitro-(7-chain));

76, 78, 79, 80, 81, 88, 94.

"107"; (1-Ethoxymethyl-5-acetoxymethyl-1:3:5-trinitro-(5-chain));

64, 66, 68.

Defense Technical Information Center (DTIC)  
8725 John J. Kingman Road, Suit 0944  
Fort Belvoir, VA 22060-6218  
U.S.A.

AD#:

Date of Search: 16 February 2007

Record Summary:

Title: Explosives Research Committee (Chemistry): index of compounds related to hexamine and R.D.X.  
Covering dates 1944  
Availability Open Document, Open Description, Normal Closure before FOI Act: 30 years  
Former reference (Department) AC 7791  
Held by The National Archives, Kew

This document is now available at the National Archives, Kew, Surrey, United Kingdom.

DTIC has checked the National Archives Catalogue website (<http://www.nationalarchives.gov.uk>) and found the document is available and releasable to the public.

Access to UK public records is governed by statute, namely the Public Records Act, 1958, and the Public Records Act, 1967.  
The document has been released under the 30 year rule.  
(The vast majority of records selected for permanent preservation are made available to the public when they are 30 years old. This is commonly referred to as the 30 year rule and was established by the Public Records Act of 1967).

This document may be treated as UNLIMITED.