

Christian Gloor
Journal Club Group Meeting
16.01.2014

Chemical warfare agents

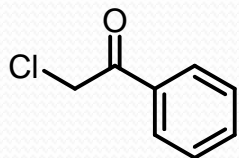


Definitions

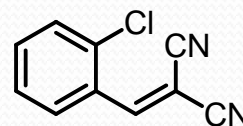
- Chemical Weapons (CW):
 - Toxic chemicals and their precursors, except where intended for purposes not prohibited under the convention, as long as the types and quantities are consistent with such purposes
 - Munitions and devices, specially designed to cause death or other harm
- Purposes not prohibited under the convention
 - Industrial, agricultural, research, medicinal, pharmaceutical or other peaceful purposes
 - Protective purposes, namely against chemical weapons

Classes of chemical warfare agents

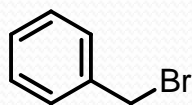
- Harassing agents



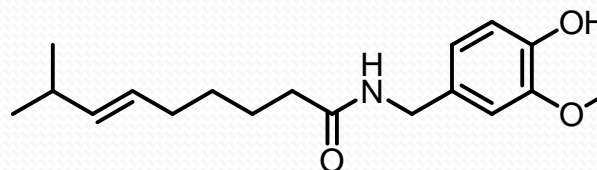
Chloracetophenone (CN)



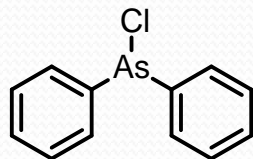
Ortho-chlorobenzylidene malononitrile (CS)



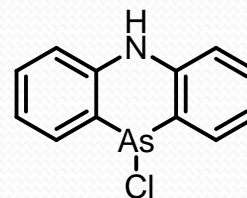
Benzyl bromide



Capsaicin (OC)



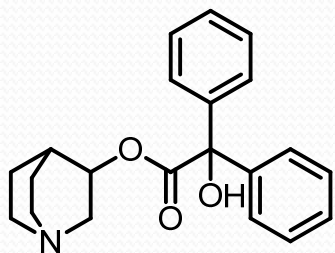
Diphenylchloroarsine (DA)



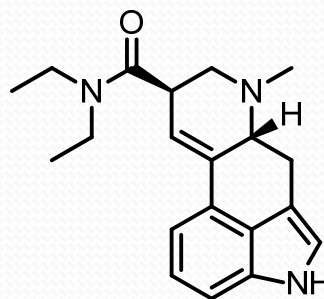
Adamsite (DM)

Classes of chemical warfare agents

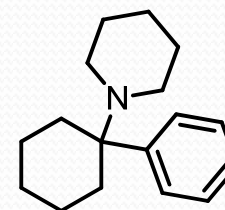
- Incapacitating agents



3-Quinuclidinyl benzilate (BZ)

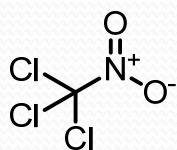


Lysergic acid diethylamide (K)

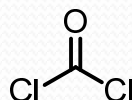


Phencyclidine (SN)

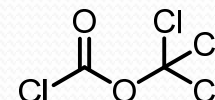
- Choking agents



chloropicrin (PS)



phosgene (CG)



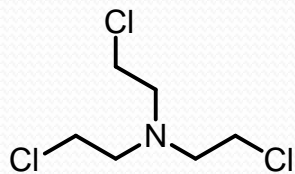
diphosgene (DP)

- Blood agents

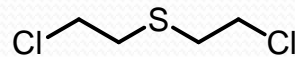
hydrogen cyanide (AC); Arsine (SA); cyanogen chloride (CK)

Classes of chemical warfare agents

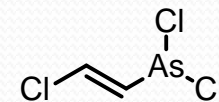
- Blister agents



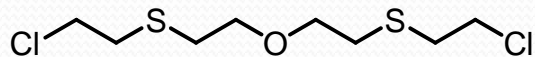
Tris(2-chloroethyl)amine (HN3)



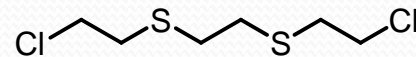
Bis(2-chloroethyl) sulfide (HD)



2-Chlorovinyl dichloroarsine (L)



Bis(2-chloroethylthioethyl) ether (T)



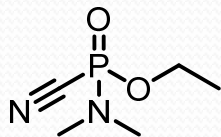
1,2-Bis(2-chloroethylthio) ethane (Q)

Symptoms of blister agents

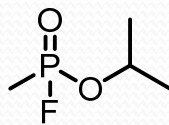


Classes of chemical warfare agents

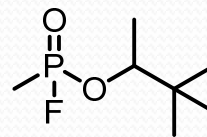
- Nerve agents



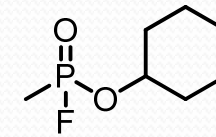
Tabun (GA)



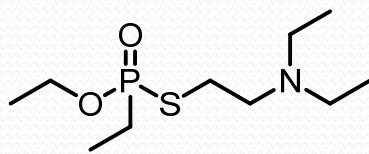
Sarin (GB)



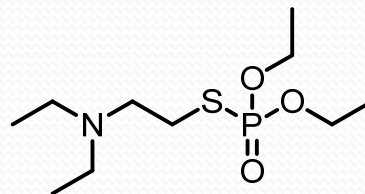
Soman (GD)



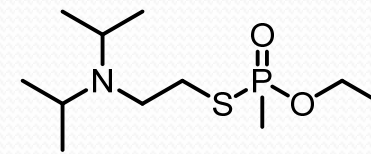
Cyclosarin (GF)



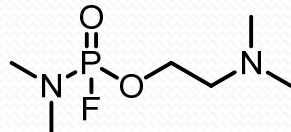
VE



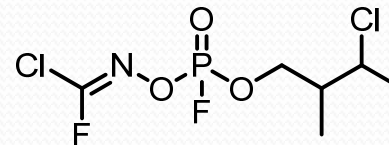
VG



VX

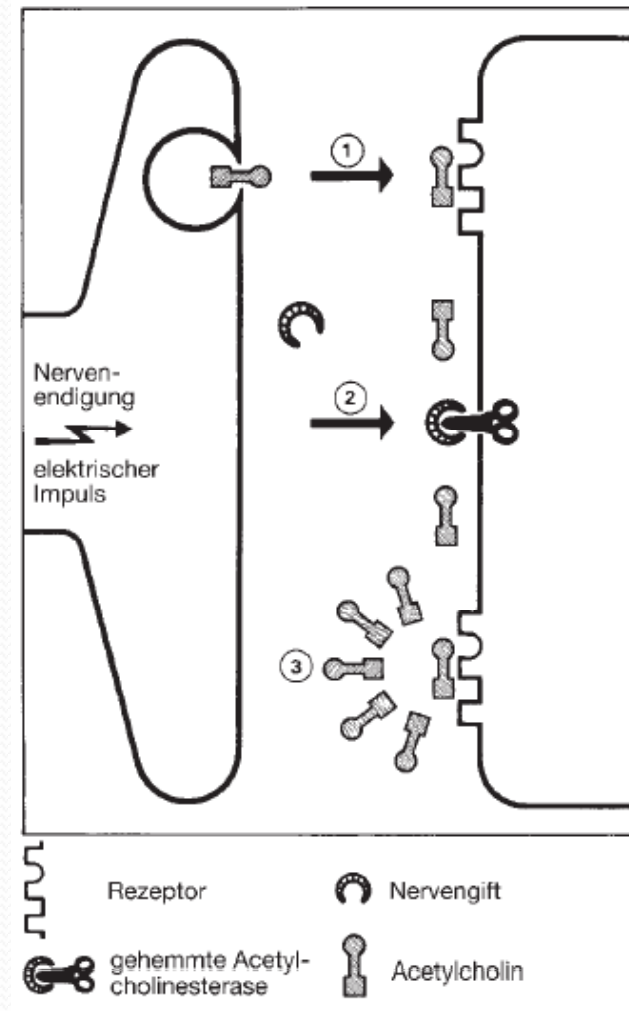
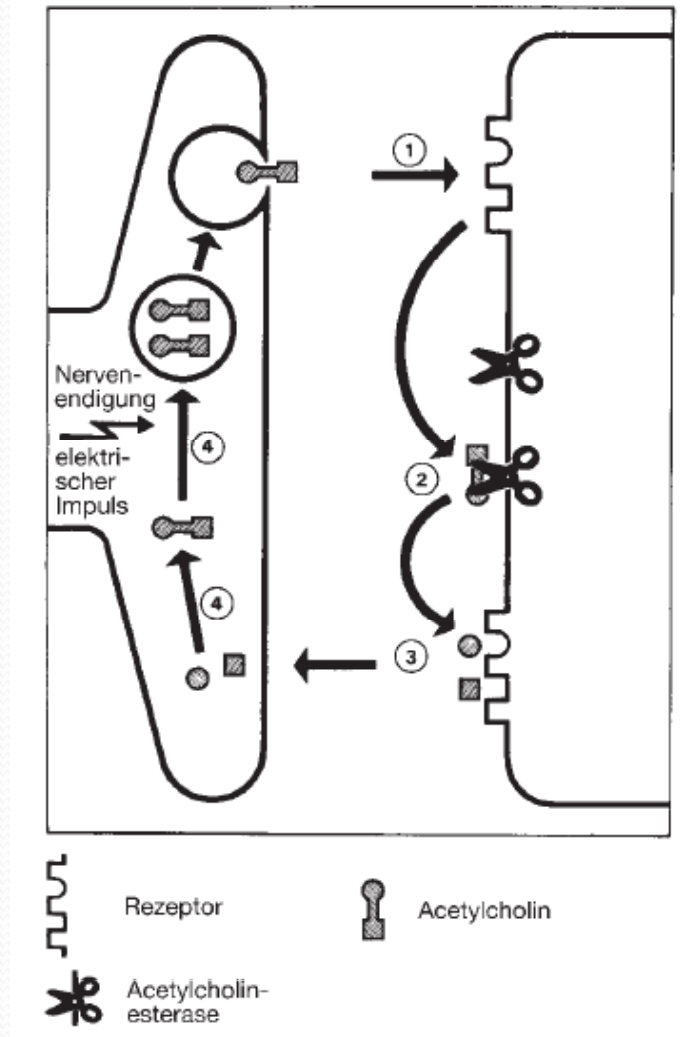


GV

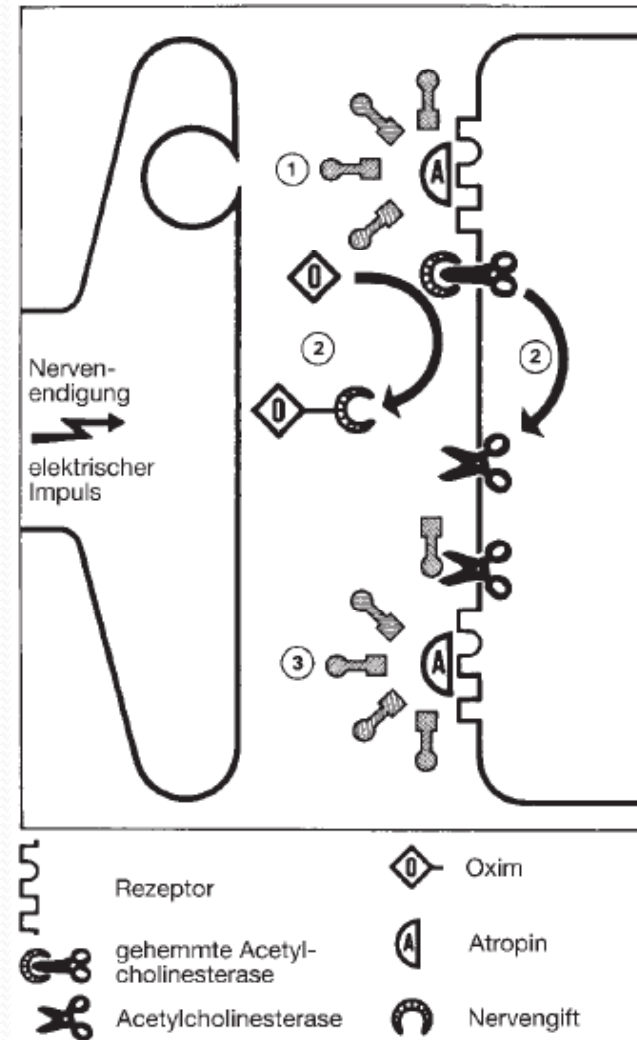
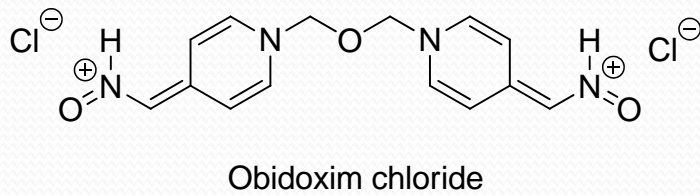
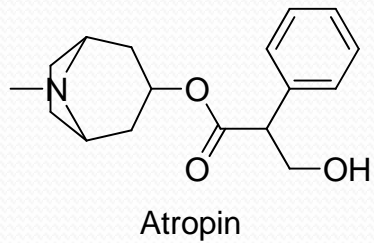


Novichok 7

Mode of action of nerve agents



Antidotes for nerve agents

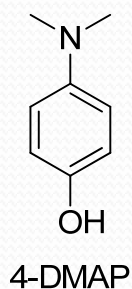


Antidotes

- For blister agents

A mixture of bleaching powder with 35% active chlorine, molecular sieve, magnesium oxide and silica. Destruction by absorption and oxidation of the blister agent.

- For blood agents (e.g. HCN)



together with $\text{Na}_2\text{S}_2\text{O}_3$, fresh air

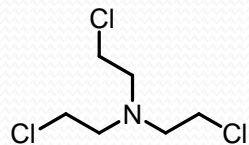
Classes of chemicals treated by the convention

- Schedule 1: chemical weapons or chemicals that are structurally related to them.

- O-Alkyl alkyl-phosphonofluoridates e.g. Sarin 

- O-Alkyl N,N-dialkyl phosphoramidocyanidates e.g. Tabun 

- Sulfur mustards e.g. Bis(2-chloroethyl)sulfide 

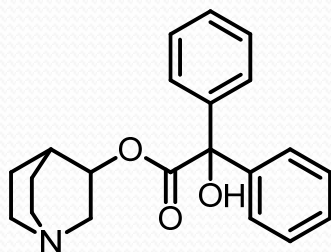
- Nitrogen mustards e.g. Tris (2-chloroethyl)amine 

- Precursors similar to CW e.g. 

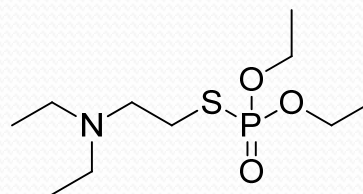
Methylphosphonyldifluoride

Classes of chemicals treated by the convention

- Schedule 2: chemicals that are used directly in the final stage reaction of a CW or a chemical that poses a significant risk to be used as a CW. e.g.:



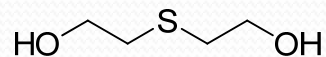
3-Quinuclidinyl benzilate (BZ)



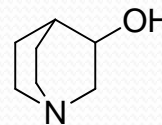
Amiton
(Insecticide and precursor of VX)



Chemicals, except for those listed in Schedule 1 containing a phosphorus atom to which is bonded one alkyl group but no further carbon atoms.



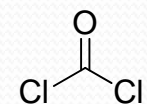
Bis(2-hydroxyethyl)sulfide



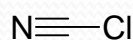
quinuclidin-3-ol

Classes of chemicals treated by the convention

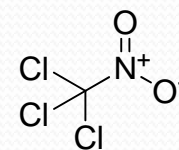
- Schedule 3: Chemicals produced in large commercial quantities for purposes not prohibited under the convention and chemicals that poses risks to be used as a CW or were used as CW, which are not listed in Schedule 1 and 2. e.g.:



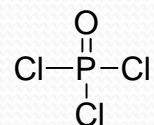
phosgene



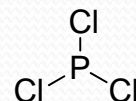
cyanogen chloride



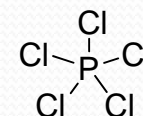
trichloronitromethane



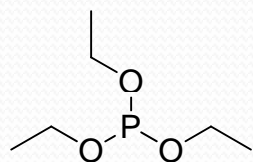
phosphorus oxychloride



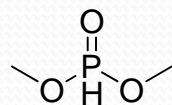
phosphorus trichloride



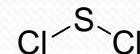
phosphorus pentachloride



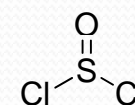
triethyl phosphite



Dimethyl phosphite



sulfur dichloride



thionyl chloride



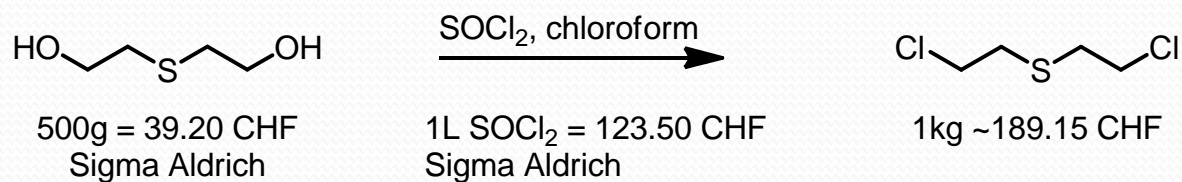
Literature used for this presentation

- OPCW *Convention on the prohibition of the development, production, stockpiling and use of chemical weapons and on their destruction, Version 2013*
- Schweizer Armee, *Technische Unterlagen C Dienst, 2001*

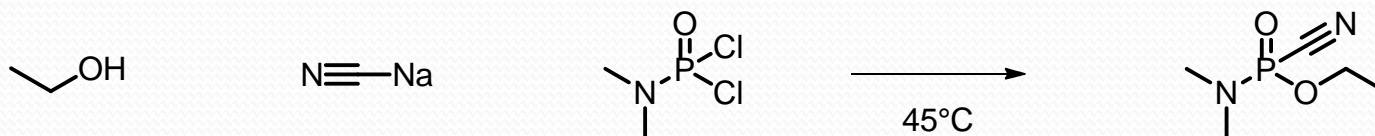
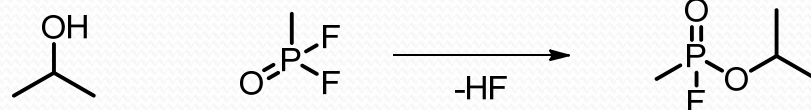


Thank you for your attention

Examples for the synthesis of warfare agents



Examples for the synthesis of warfare agents



2.5L = 82.40 CHF
Sigma-Aldrich

1kg = 114.00 CHF
Sigma-Aldrich

10mL = 94.60 CHF
Sigma-Aldrich

1kg = 7748.20 CHF
LD₅₀ = 4mg/human (inhalation)

Lindberg, Goesta; Norlin, Rikard *J. Labelled Comp. Radiopharm.*, **2003**, *46*, 599
Holmstedt *Acta physiol.scand.Spl.*, **1951**, *90*, 26