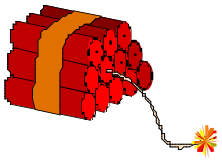

SEKTIONEN FÖR DETONIK OCH FÖRBRÄNNING
www.sdfsweden.se
The Swedish Section for Detonics and Combustion
affiliated with *The Combustion Institute*
(www.combustioninstitute.org)

NEWSLETTER 2/2020

2020-10-08

Again, August 14, we were reminded of the treacherous behaviour of ammonium nitrate and the still valid statement of C. H. Johansson & P. A. Persson (Detonics of High Explosives, Academic Press,1970, 6: "*Ammonium nitrate in small quantities is regarded as a very insensitive oxidizer, although fitting the ... definition of an intricically explosive substance. In sufficiently large quantities, and especially when brought towards oxygen balance by the addition of fuel such as carbon wood or other hydrocarbons, it can burn to detonation under the confining action of the large mass of the material itself.*

The number of devastating "burning to detonation" is very large, the world over. Efforts to identify the initiation step land as rule in more or less probable speculations. The enormous explosion catastrophy at the BASF factory at Oppau, Germany 1921, killing 621 people, injuring 1500 and demolished about 1000 houses, was caused by a had been used charge used to break up caked a 300 tons mixture of discarded ammonium nitrate and ammonium sulphate in a 2:1 proportion for recovering. However, the onset of the of decomposition must have been something else in view of the fact that about 30 thousand dynamite blasting cartridges had been used for the same purpose without causing detonation. (For a detailed survey of major ammonium nitrate accidents, see Rolf K. Eckhoff., Explosion Hazards in the Process Industry, Gulf Publishing Comp., 2005.)

For a unique and detailed eyewitness account of the worst explosion accident in Sweden,, which occurred at Bofors 17 December 1940, see below. TNT and ammunition items were involved. In this case, the series of events appears to be fairly well understood.

Would it be possible to improve our knowledge as to the chemistry and physics of intrinsically explosive substances? Conferences on chemical kinetics of pyrotechnics and explosives have been held. SDF has been invited to participate in a series of online workshops in the fields of energetic materials, combustion, detonics, blast and impact physics run by the respected journal Defence Technology see the Newsletter complement distributed July 3rd), so maybe a study group for establishing the state of the art of these conference could

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be worthwhile.

Fredsteknik/Peace Technology

Editor: Hans Wallin

2020 Omprövningens år: fortsättning/2020 Year of reconsideration: continued

Vi är nu medvetna om att det som tidigare ansågs så osannolikt att man inte behöver ta hänsyn till att det likväl händer – till allas vår förvåning.

We are now aware that what was previously considered so unlikely that one did not have to take into account what all is happening anyway – to everyone's surprise.

Beirut-katastrofen är det senaste exemplet

Det är väl dokumenterat att ammoniumnitrat kan explodera – redogörelser för tidigare olyckor finns tillgängliga via Internet.

FN har utvecklat ett reviderbart styrsystem *International Ammunition Technical Guidelines* (IATG). Om detta styrsystem hade, tillämpats hade katastrofen kunnat undvikas. För att bli tydligare bör styrsystemet omfatta alla typer av explosivämnen, både kommersiella och militära. Förslag på nytt namn är *International Explosives Technical Guidelines* (IETG). IETG skall liksom IATG vara åtkomligt för alla via Internet. För mer information om IATG besök: https://www.un.org/disarmament/un-saferguard/ eller kontakta Hans Wallin.

The disaster in Beirut is the latest example

It is well documented that ammonium nitrate can explode – accounts of previous accidents are available via the Internet.

The UN has developed a revisable *International Ammunition Technical Guidelines* (IATG) control system. If this control system had been applied, the disaster would have been avoided. To be clearer, the control system should cover all types of explosives, both commercial and military. The proposed new name is the *International Explosives Technical Guidelines* (IETG). IETG, like IATG, must be accessible to everyone via the Internet. For more info about IATG visit https://www.un.org/disarmament/un-saferguard/ or contact Hans Wallin.

Stölden av 50000 skott 9 mm pistolammunition när chaufförен sov

Pistolammunition bör i dagens samhälle med i stort sätt dagliga skjutningar betraktas som mycket stöldbegärlig och det är självklart att sådana stölder inte får upprepas. Innehavaren/transportansvarig måste åläggas se till att transporten sker på sådant sätt att tillgrepp förhindras.

Det svenska företaget Cesium AB

Theft of 50,000 rounds of 9 mm pistol ammunition while the driver was asleep

Pistol ammunition should in today's society with largely daily shootings be considered very theft-prone and it is obvious that the theft must not be repeated. The holder/transport manager must be required to see to it that transports are done in such a way that access is prevented.

marknadsför olika storlekar av inbrottssäkra transportcontainers, som via satellittelefon står i kontakt med larmcentral.

Stöld som ännu ej hänt – men som kan ge en ny katastrof

På samma sätt som pistolammunitionen ovan, transporteras mycket stora mängder kommersiella sprängämnen genom Sverige. Genom att kapa en sprängämneslastad långtradare kan en terrorist åstadkomma en enorm förödelse även i Sverige – hur förebygger vi detta?

The Swedish company Cesium AB markets various sizes of burglary-proof transport containers that are in contact with the alarm center via satellite telephone.

Theft that has not yet happened – but which can lead to a new disaster

In the same way as the pistol ammunition above, very large quantities of commercial explosives are transported through Sweden. By hijacking an explosive-laden truck, a terrorist can wreak enormous havoc in Sweden as well – how do we prevent this?

Cesium AB Satellite tracked Mobile Security Vault for Transportation and Storage theft-prone material. Available in different sizes. Certified according to SS-EN-1143-1 grade 6 and up.

Explosivämnen är idag som ett oumbärligt verktyg för att forma och utveckla vårt moderna samhälle.

• Svartkrutet uppfanns på 700-talet i Kina och spred sig över de flesta delar av Eurasien i slutet av 1200-talet.
• Dynamit uppfanns av Alfred Nobel och patenterades 1867.
• I dag används moderna syntetiserade sprängämnen huvudsakligen inom gruv-, stenbrotts-, bygg- och rivningsindustrin.
• Miljoner ton kommersiella spräng-

Today, explosives have become an indispensable tool for shaping and developing our modern society.

• Black powder was invented in China in the ninth century and spread to most of Eurasia in the late 13th century.
• Svartkrutet Explosives were invented by Alfred Nobel and patented in 1867.
• Today, modern synthetic explosives are used mainly in the mining, quarrying, construction and demolition industries.
• Millions of tons of commercial explo-

ämnen används varje år för att utvinna de mineraler och metaller som vi alla använder i våra dagliga liv. Det är till exempel mineraler som används för att odla vår mat och, metaller som våra datorer och mobiltelefoner behöver fungera korrekt och material som används för att bygga byggnader och anlägga våra vägar.

• Explosiva ämnen används också som grundläggande komponent i vapen som används av försvarsmakter och polisorganisationer.

Vi skall inte glömma bort att uppskjutning av satelliter sker med hjälp av explosivämnen.

• De personer som arbetar med explosivämnen, måste ha specialutbildning, hög yrkeskompetens och vara erfarna samt vidta de försiktighetsåtgärder som krävs för att säkerställa säkerheten hos dem som kan beröras inom riskområdet och de omgivande samhällena.

Kommersiella sprängämnen kan dock också användas som vapen av terrorister och brottslingar samtidigt som vådahändelser kan orsaka stora skador på vårt samhälle. Det är därför angeläget att alla länder använder det styrsystem, ”IATG”, som utvecklats av FN och nu finns tillgängligt via Internet.

sives are used every year to extract minerals and metals used in our daily lives. For example, the minerals and metals used each year are extracted from minerals and metals, and vibrations are used to build buildings and build roads.

• Explosives are also used as a basic component of weapons used by armed forces and police organizations.

We must not forget to turn off the satellite launch with the help of explosives.

• Personnel using explosives must be specially trained, have high professional knowledge and rich experience and take the necessary precautions to ensure that safety is provided.

However, commercial explosives can also be used as weapons by terrorists and criminals, and dangerous events can cause enormous damage to our society.

Therefore, all countries must use the control "IATG" system developed by the UN, which is currently available via the Internet.

IATG now available in French and Spanish

SDF Newsletter are pleased to inform that the full set of the **International Ammunition Technical Guidelines (IATG)** are now available in **French** and **Spanish.**

https://www.un.org/disarmament/un-saferguard/guide-lines/

As a reminder, the IATG are also available in Arabic, English, Portuguese and Russian. A few modules have also been translated to German. The IATG were translated to these critical languages – French and Spanish-- with generous funding provided by Germany and Switzerland.

Please also note that the IATG are currently undergoing a thorough update, as per the ISO guideline to update such guidance every 5 years. The UN SaferGuard Technical Review Board is fully seized of this undertaking.

Therefore, **Version 3 of the IATG** will be available in **early 2021** at which time the respective updates will also be translated to French and Spanish.

For more info please contact hans.wallin@cesium.se

PEP History. 7.

The explosion at Björkborn on 17 December 1940 around 15 o´clock.

This is the title of an interview text relate to the worst explosion accident in Sweden. Buildings totally destroyed, eleven persons killed. It occurred at the Bofors ammunition factory in Björkborn, a suburb to the Nobel city of Karlskoga.

The eye witness – who became too close for comfort – was Police Officer Håkan Rosvall. At the age of 91 years in 1999 he was interviewed by Björn Albinson of Värmland´s Brandhistoriska Klubb (*Fire Historical Club*). By courtesy of this club, we have made an English translation for publication on our website. It is attached to the 2020/2 Newsletter covering letter as well. The text has slightly, as far as possible, been adjusted for improved readability.

In this case, the cause of the initial devastating explosion could be found. For recovery of waste from turning TNT pieces molded in shellaced cardboard sleeves into grenade ammunition, one boiled the residues in large, 200 litres open pots. A water hose was placed on floor nearby, in case it started to burn in the pot. This happened sometimes, but the flames were easily extinguished. This day, however, an unexperienced apprentice – a young boy – was left alone for a while by the two ordinary workers in charge. When the pot burst into flames, he became scared and ran away. It burned for about twenty minutes until the first bang. In the meanwhile Björkborn's fire brigade had come and began to through water. They all were lost.

Near the burning pot lay six torpedoes and seven mines. It was these and in addition 200 litres TNT that exploded.

(Thus, lessons to be learnt about competence, experience and work force instruction in the first place, and of storing of PEP stuff.)

An Annex to this Newsletter, titled *The explosion at Björkborn on 17 December 1940 around 15 o´clock*, and PDF-files with a number of unique photos from Bofors Historical Archives is available on our website:

www.sdfsweden.se/newsletters.sv.asp

Climatology

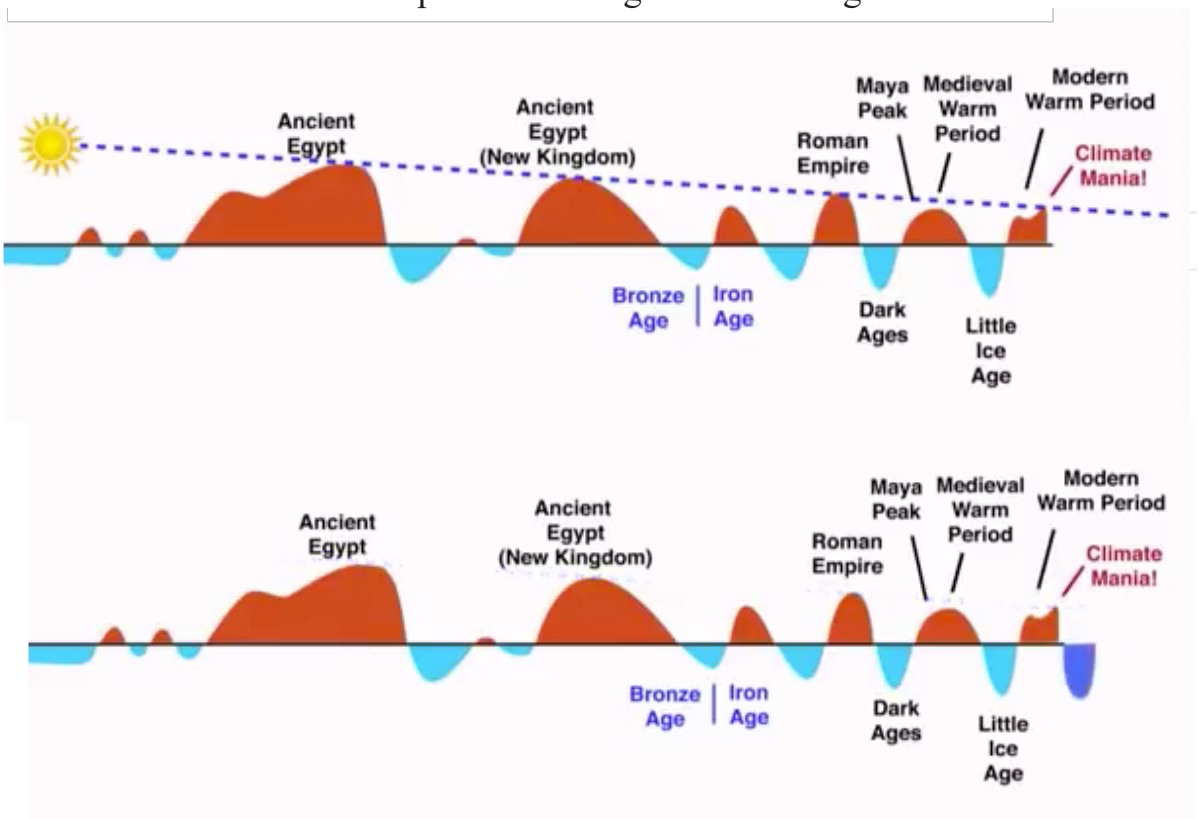
Edidtor Dr. T. Lindblom

The diagrams below are extracted from a measured lecture on the web (https://www.facebook.com/ucme2day/videos/10156743845691071/) by a Hugh

Foster of WCI (acronym not explained). The information given in the talk is based on updated ice age data from Greenland ice cores (GISP2 1992).

About 1900, Dr. Raymond H. Wheele (1892-1961) and 200 ice age researchers found that the sun and the planets are the main drivers of climate change, and that its schedule is highly predictable – including the onset of the dark blue blob in the lower diagram.

In Philosophical Magazine April 1896, Nobel laureate (chemistry 1903) Svante Arrhenius (1859-1927) published an article titled ”*On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground*”. This hypothesis was suggested by the Irish chemist John Tyndall already in 1859, and thus known to Arrhenius by the time. Worried about the ”blue blob” a-coming (as it seems to do now 120 years later!) and foreseeing increasing heating (with traditional fuels – fossil ones hardly among them at the time), he investigated whether the CO_2 greenhouse effect could be expected to mitigate the cooling.



Chemical Mathematics. No. 27.

Stig R. Johansson

The Entropy Contradiction

In No. 26 (N 3/2019), we had to face the fact that as far as chemistry is concerned, we must distinguish between *calorimetric* (ΔH) and *non-calorimetric* ($T\Delta S$) heat, and further realizing that the entropy term – albeit having the same dimension as heat, *i.e.*, kJ – must be a measure of disorder instead (so perhaps *ordinary* and *virtual heat* are more adequate designations). While true heat is

related to the breaking and forming of bonds between atoms in reactant and product molecules, what is disorder and the entropy term related to?

For a chemical reaction to be free (to occur), the free enthalpy term in the equation $\Delta G = \Delta H - T \cdot \Delta S$ must be negative. The entropy term contributes to this condition if $\Delta S > 0$, *i.e.*, if S is a measure of disorder of some kind. One obvious kind (and maybe the only one?) is the number of products in relation to the number of reactants: more products than reactants means disorder increase, and *vice versa*. Disorder increase lessens ΔG and, in principle, helps to increase the driving force of a chemical reaction.

In textbooks, the teaching of chemical thermodynamics starts with introducing entropy by the derivative $dS = \frac{\eth q_{rev}}{T}$, where q is calorimetric heat, and thus entropy, S, as well. Why reversibility has to be involved is not that clear. The actual Chapter (No. 11, p. 116) in the classic "Thermodynamics" (McGraw-Hill 1961), G. N. Lewis *et al*., begins "*Unquestionably the idea of entropy appears at first sight a little abstruse*".

Obviously, *TS cannot be both a real and a virtual heat term in the same context*. So, here we are again: physics and chemistry not being kept apart (originating in epistemology being ignored). It turns out, namely, that the processes involved in the reasoning are phase changes. Since these are physical processes, the concept of reversibility is related to energy, while chemical processes are related to mass. (This was pointed out in a manuscript dated January 1968 and titled "*The Concept of Reversibility in Chemistry*". But *J. Chem. Education*, of all journals, could 'not afford the space it would require'. One reviewer found his "enthusiasm for this paper decreasing steadily ('and irreversibly!)' as he read it, a second reviewer was " definitely in favor of publication".)

Processes like $H_2O(s) \rightarrow H_2O(l)$ and $H_2O(l) \rightarrow H_2O(g)$ are not dealt with in chemistry; there is no mass action, no equilibrium constant. The equilibrium referred to takes place at the transition point only. At a lower temperature, there is no water (*i.e.*, liquid dihydrogen oxide), at a higher no ice; one writes "*At the melting point the two phases are in equilibrium. That is to say, there is a state of balance such that if the external temperature is raised by an infinitesimal amount*," (thus the differential dq in the entropy definition) "*the solid will melt and if it is diminished by an infinitesimal amount the liquid will melt*".

It is difficult to see that the TS term in the free enthalpy relation could be anything but a measure of disorder. The obvious one is the stoichiometric relation between products and reactants. But how can that – and other disorder processes, if any – be understood in physical

tems? While the real energy term, ΔH, is physically comprehensible, the disorder ones remain to be understood.

In search of controllable mechanism of explosive initiation, the TS term has to be considered only as far as endothermicity is concerned – if endothermic explosives happens to exist.

Chemical study of explosion processes is limited by the fact kinetics and the principles of equilibrium cannot be applied to physical, inhomogeneous mixtures. For example, if the black powder process ended in an equilibrium state, the reaction formulas should be:

$6\ KNO_3(s) + C_7H_4O(s) \rightarrow 3\ K_2O(s) + 2\ NO(g) + 2\ N_2(g) + 7\ CO_2(g) + 2\ H_2O(l)$

$4\ KNO_3(s) + 5\ S(s) \rightarrow 2\ K_2O(s) + 2\ N_2(g) + 5\ SO_2(g)$

The outcome depends on the composition, usually 75 w-% saltpetre, 15 w-% charcoal and 10 w-% sulphur. In reality, the final state contains almost all possible combinations (se Newsletter 2/18, p. 6).

Conferences
Education and Training
2020

Sverige

KCEM. För aktuella konferenser och kurser, se www.kcem.se.

FOI.

U. K.

University of Leeds. www.leeds.ac.uk.

The Royal Military College of Science. www.rmcs.cranfield.ac.uk.

Imperial College, London

Best practices guidelines for CFD of turbulent combustion.
London, 11th and 12th December 2019.

U. S. A.

Franklin Applied Physics. Visit info@franklinphysics.com.

International Society of Explosives Engineers. Visit www.isee.org/ for the society's newsletter *Explosives Industry News*.

Munitions Safety Information Analysis Center, MSIAC. Visit http://www.msiac.nato.int.