&C +8BMCB
2(' 1%&

"&) MNGI #! "%

OEC< ; FFCE &C +8BMCB

4?F?G GC G> ; ' >?B8 / E : B8B9 ; 2C9? ; GL ; G9 ?B - 8L #! "$

' / . 3(. 32

8FLNP + ; DLN 6NLDCOOLN *L 1?KVLK

8 : / / -89- , 67-8-49) 9O548

" 7CACKP) BR?KACO GK -KCNECPGA 3 ?PCNG?IO GK 8SCBCK

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$ X>CNL 9LICN?KACY W 8L J C < ?UO PL) RLGB 2LOOCO GK OKPCNK?PGLK?I 5MCN?PGLKO

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OEC<;FFCE &C +8BMCB 2>CEG '4

Bo Janzon received an M.Sc.(Eng. Phys., 1968) from the KTH, Stockholm and a Ph.D (Med. Sci., 1983), from the Göteborg University, both in Sweden.

He is Owner/CEO of SECRAB Security Research, Sweden, active in research and technology for security and defence, and a Director of Trace-in-Metal Ltd., UK, working with metal anti-theft marking.

He is Professor (h.c., 2008-) of Ballistics at the Nanjing University of Science and Technology, China and was Adjoint Professor of Energy Technology at the Mälardalen University (2010-2013). He worked at the FOI/FOA, Sweden (1968-2007), among other as Director/ Founder (1994-2002) of the Weapons and Protection Division, as Research Director and Section Head. He is an Associate Editor of the scientific journal "Defence Technology" (China), and of the noted "Journal of Applied Mechanics" (USA). In 1991-93 he was visiting scientist posted to DSTO Australia.

He is a Fellow of the Royal Swedish Academy of War Sciences (KKrVA), founding Fellow and Executive Board member of the International Ballistics Society (IBS), member of the American Society of Mechanical Engineers and of the Swedish Association of Graduate Engineers (Sveriges ingenjörer).

He was born at Solna, Sweden, in 1943, and spent most of his life in and around Stockholm, excepting two years in Melbourne, Australia. He has extensive travel experience.

His and SECRAB's main competences are in ballistics, including

- Explosives, their effects, detection and protection
- Weapons, weapons effects, ballistics and physical protection
- IED, UXO and mine clearance, demining
- Terrorism, counter-terrorism, protection against organised crime
- Wound ballistics and forensic ballistics
- Advanced rock drilling and blasting, shaped charges and deep underwater blasting.

Professor Janzon has managed organisations with over 100 scientists, many large national and international projects and written over 100 scientific papers and reports. He is an acclaimed expert on explosives, terminal ballistics, wound ballistics and weapons effects.

He has a keen interest in motor sports, especially rallying, has organised many rally contests in Sweden including six years of the International Swedish Rally, and attended about 25 Monte-Carlo Rallies in various capacities. Lately he returned to do several historical rallies in 1970's Saab 99 turbo cars, which he also built, competing for the Royal Automobile Club of Sweden (KAK), where he is a member since more than fifty years, formerly being its competition manager and a board member. He is an accomplished chef, specialising in traditional Swedish foods.

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1;9;BG%:I8B9;F?B (B;E=;G?9 -8G;E?8@F?B 2J;:;B

Professor Bo Janzon[1]
SECRAB Security Research
bo.janzon@secrab.eu

Summary

During the twentieth century, few breakthroughs occurred in energetic materials. Hexanitrobenzene was judged by U.S. experts, only 25 years ago, to be the theoretically best explosive. Hexanitrohexaazaisowurtzitane (3<#(&) later proved to be 20% better than octogen and 6% better than hexanitrobenzene.

In the early 1990s, the FOA (National Defence Research Establishment, Sweden) synthesized 3<# (&, enabling Sweden to purchase it from the United States. In 1995, an effective synthesis for ammonium dinitramide (14> was found. 14> gives much lower signature in rockets than ammonium perchlorate (1@), higher performance, and low environmental impact. Diaminodinitroethene (6?G#,) is a high explosive with lower sensitivity than C>C and similar performance to hexogen (A4G $ N-guanylurea dinitramide (6?G#'() has properties similar to >3 but is very insensitive and inherently more thermally stable.

An FOI effort to synthetize new high energy density materials started with tetrahedral tetraazatetrahedrane (>*), sponsored by the U. S. DoD/DARPA. This non-natural substance was modeled by numerical quantum mechanics, and promises to have three to four times the energy of octogen. So far, the existence of this molecule has not been verified; but efforts continue. Other nitrogen clusters, such as >- or polymeric >^, promise even higher yields. The pentazolate ion (N_5^-) was successfully made at FOI by laser synthesis. With the N_5^+ counterion, synthesized by the U. S. Air Force Research Laboratory, it could form a very energetic all-nitrogen molecule.

The step in energy density from octogen to >* is much greater than the change from black powder to high explosives, such as picric acid or trinitrotoluene, occurring in the 1870s. That change most certainly caused a complete revolution in warfare methods and weapons technology.

2 hours

[1] 3V#H[ZOVXLK]PZO 4X$ 8LUXPR aYZTHXR" 6?9" B]LKLU

)HGHE; 3E;B:F ?B 5 8E>;8:F %EACHE8B: &8@@?FG?9F

Professor Bo Janzon[2]
SECRAB Security Research
bo.janzon@secrab.eu

Summary

In 1983 a "Grand Old Man" of Ballistic Science, Dr. Robert J. Eichelberger, wrote: "Ballistic technology is generally considered a mature technology – as it should be after centuries of intensive attention of some of the finest scientific minds of the world." He predicted that increased understanding of relevant physics and chemistry and development of mathematical techniques and computer models would be key elements in the future of ballistics and weapon system design. These predictions were very accurate!

But to-day's developments and those of the foreseeable future go beyond this. Warheads and ballistics – interior, exterior and terminal – are very dependent on the use and properties of energetic materials – propellants and explosives – for their functioning. New, potentially very powerful substances such as the N_5^+ and N_5^- ions and metallic hydrogen were created in labs. Air-breathing propulsion – ramjets etc. - and efficient use of the high combustion energy of some metals adds to the potential for performance increases. Increased use of artificial intelligence, computers, sensors, guidance and fuzing in weapons, munitions and armours has added another dimension to the efficiency achievable. New high-performance materials have also meant great increases in effects and protection potential.

Developments possible in the next 20 years may have similar effects on warfare as the revolution in weapons, munitions and armour that occurred in the late 19th century. That ballistic technology is a mature technology is no longer true. Any nation that will abstain from following the developments closely and exploiting their advances will run the risk both of having weapons, munitions and protection that prove inadequate and of making grave mis-investments.

2 hours

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