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TECHNOLOGY AND INTERNATIONAL SECURITY SINCE 1945

by

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~ 5000 words

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TECHNOLOGY AND INTERNATIONAL SECURITY SINCE 1945

CONTENTS

- reference to my background (wartime) in radar fire control of antiaircraft artillery
- can be explained on basis of yesterday's presentation on the ~~Prussian~~ selection by Prussian officers as to which branch of the army to join — an attraction for matters technical, and an allergy for horses
- at this conference I am in an uncomfortable position — instead of being the local expert on operational research or nuclear physics, I am the most untrained in history and education in the midst of a collection of ~~highly~~ eminent historians and (highly literate) ~~accomplished~~ speakers — a mere technician amongst artists

TECHNOLOGY AND INTERNATIONAL SECURITY SINCE 1945

- escaped one of the hazards of being the last speaker — all the others were restricted to time periods finishing before mine starts [Forlorn hope]

INTRODUCTION

- have listened to presentations on

  Men, Machines, and War through the ages

  Prussia, Technology and War ~~as applied by Prussia~~

  Technology and Tactics ~~as applied~~ by the British Army

  } in the latter half of the nineteenth century

  British Army Tactics 1904-1945

  Technological Change in British Naval Policy and Doctrine 1815-1945

  The Influence of Technology on Air Power 1919-1945

- although both technology and tactics do develop in peacetime, their great tests come in war, and, ~~for those~~ when the wars last~~ing~~ more than a few weeks, major developments are made during the wars.

- my ~~task~~ assignment this afternoon is to talk about technology and international security since 1945

- type of evidence is rather different in character from that considered in the previous presentations, ~~for which~~ the time period (for the last three of which) included the two World Wars

- period 1945-1984 has included some wars, though none approaching the magnitude of the two World Wars
  - but, (wars aside) it has seen an unprecedented development of military technology and tactics by countries not at war, and in many cases producing weapons and doctrines that have not been tested in war

- in particular, the years since 1945 have seen ~~immense~~ remarkable developments in the design, testing, and deployment of nuclear weapons, and in the use of the presence of nuclear weapons for the deterrence of war, and for the exercise of influence, but never for their actual employment in war

- another major difference between the world prior to ~~1945~~ WW II, and the ~~forty~~ years subsequent to WW II is the significance for international security of negotiations on arms control and disarmament. Although the technology and deployment of the largest navies were constrained by disarmament treaties negotiated between the two world wars, the linkage of nuclear technology and the deployment of nuclear weapons to international treaties during the last twenty years has been much more significant

- whereas most of the military technology developed prior to 1945 can best be judged by its success or failure in actual war, the post-war nuclear technology is better judged by the absence of nuclear war. Instead of wars, one needs to examine other aspects of international security.

- apart from nuclear weapons, there have been many other developments in military technology since 1945, some of which have been demonstrated in war

- before returning to the post-war history of nuclear technology, and its related strategic consequences, let us look briefly at wars which have occurred since 1945 in which new non-nuclear military technology has been of some importance.

2. TECHNOLOGICAL ASPECTS OF WARS SINCE 1945

- There have been many large civil wars since 1945 involving many hundreds of thousands of deaths

Colombia	~~1949-1962~~	30⁰	Sudan	~~1963-1972~~	250
China	1946-1950	1000	Nigeria	~~1967-1970~~	1000
Zaire	~~1960-1965~~	100	Cambodia	~~1970-1975~~	156
Yemen	~~1962-1969~~	101	Pakistan	1971	500

but these have involved little in the way of new military technology

- ~~same generally true for~~ many smaller armed conflicts, whether internal or between states have seen little development of new technology of military importance

- Korean War, 1950-1953, was fought on the ground with WW II equipment. The air war saw the introduction of helicopters, and ~~better~~ greatly improved jet fighter aircraft, with the best opponents being the Soviet-built MIG-15s and American F86 Sabres. The amphibious landing at Inchon demonstrated the effectiveness of WW II techniques, that at Wonsan showed the importance of mines and minesweeping, which the Navy could have forgotten.

Indochina Wars

- the various wars in Indochina between 1945 and 1975 involved France for ten years and the USA for fifteen, as well as equipment and tactics originating in the USSR. Considering the number of troops involved, the absence of fixed fronts was notable. Employment of advanced technology by the Americans included instant communications between the forces in combat and the national headquarters half way around the world. Efforts were made to implant detection devices and other automatic systems on an "electronic battlefield". Chemical defoliants were used to strip away the cover offered by thick vegetation, with unforeseen long-term biological effects.

- the most important applications of new military technology in the Indochina wars were in air-to-ground and ground-to-air operations.
  - heavy interdiction bombing from US airfields and carriers, involving enormous tonnages of munitions (6 megatons, > all previous wars)
  - use of "smart weapons" for accurate attack of difficult targets
  - effectiveness of Soviet-built surface-to-air missiles against FWA and helicopters
  - consequent need for evasive manoeuvres, electronic counter-measures, defence suppresion, and use of large formations of specialized aircraft in "strike packages"
  - development of heavily-armed attack helicopters

Middle East Wars

- among the many clashes in the Middle East, three revealed new weapons and tactics in the hands of well-armed forces

- Suez War of 1956 saw amphibious assault by British and French forces, employing embarked helicopters

- Six Day war of 1967 saw highly successful employment of surprise in Israeli preemptive air attack on Arab airfields. Also of great interest was the sinking of the Israeli destroyer Eilat by a Soviet-built Styx antiship cruise missile launched from a small Komar patrol boat.

- In 1973 the Yom Kippur war saw surprise achieved by the Egyptians, together with novel applications of military engineering in the crossing of the Suez Canal, and most effective use of an umbrella of surface-to-air missiles to fend off air attack
  - the vulnerability of tanks to modern ATGMs revealed
  - lesson of WW II relearned and underlined: armour needs to be operated in conjunction with artillery, infantry, engineers, and air. It was interesting to hear from Profs McNeill and Showalter about the problems experienced in the past regarding cooperation (or the lack of it) between cavalry and infantry, and infantry and artillery.
  - vulnerability of air to modern ground-based AA defences revealed
  - consequent lesson that achievement of air superiority needs to be preceded by defence suppression .

Value of AA arty which can keep up with the forward troops has a link with the 'Prussian' problem in finding (field) artillery firepower with mobility

- effectiveness of antiship cruise missiles demonstrated again, as well as possibility of countermeasures

- recent military operations in Lebanon (1982) have shown Israeli concern for the presence of Soviet-built SAM sites in areas where Israelis wish to maintain air reconnaissance, also the possibilities of Remotely Piloted Vehicles for recce, and the importance of electronic warfare

Other Recent Wars (continued)

- Soviet invasion of Afghanistan underlines problems of modern army operating against guerillas

- Iran-Iraq war seems to combine possession of a few modern weapons with operations reminiscent of much more old-fashioned battles

- in both cases there is evidence of use of mycotoxins, sometimes described as "yellow rain"

Falklands War

- the short war in the Falklands Islands in 1982 demonstrated the vulnerability of surface ships to air-delivered antiship missiles, especially the sea-skimming Exocet, and especially in the absence of Airborne Early Warning. It also confirmed the effectiveness of nuclear-powered attack submarines against a less-than-first-class surface navy.

Conclusions

Of the new military technology that has been demonstrated in wars since 1945, the most significant appears to be the precise guidance of various types of missile.

3. PRECISION GUIDED MISSILES

- the torpedo is a form of guided missile
  - gyro controlled straight-running versions have been in existence throughout this century
  - acoustic homing torpedo used by German U-boats late in WW II

- airborne guided missiles had appeared on the scene before the end of WW II
  - German radio-controlled air-launched antiship glide bomb
- ~~so had~~ cruise missiles (German V1) and long-range rockets (German V2), though these could not be described as "precision guided"
- all three just too late to have decisive effect

Surface-to-Air Missiles

- AA gun fires a small unguided projectile whose time of flight beyond the shortest ranges is measured in tens of seconds
  - during this time a fast aircraft will travel as much as several miles which may or may not be in the same direction, and with same height and speed as it had while the

gunners were calculating the trajectory to give their shell

- even with radar control and a proximity-fuzed shell, AA guns are extremely ineffective against fast aircraft flying at altitude and taking evasive action

- tremendous change in situation with advent of guided SAM
  - can correct course in flight and may be able to out-manoeuvre the target if it takes evasive action
  - ~~may be~~ able to home on radar reflections or heat emissions from target aircraft

- countermeasures are possible
  - manoeuvre, chaff, jamming, IR flares
  - attack of ground radar or launchers HARM

- most effective against aircraft at medium or high altitude (e.g. Soviet SA-2 vs Gary Powers' U2 in 1960)
  - time needed to track target, launch missile
  - hence, cause aircraft to come at low altitude

- SAMs can be based on ships as well as on land. In 1968 an American cruiser used a Talos SAM to destroy an aircraft over Vietnam at a range of 65 miles

Air-toAir Missiles

- many of the remarks regarding SAMs apply also to AAMs
    - superiority over guns, except at very short range

- manoeuvrability of AAM makes manoeuvrability less important for the launching aircraft

- Sidewinder IR homing AAM proven in combat, improved versions being produced over twenty year period

- Phoenix long range AAM for F-14, able to control six interceptions simultaneously

- problem of look down - shoot down against low fliers

Air-to-Surface Missiles

- gravity-dropped bombs lacked accuracy, obliged bomber to fly straight and level run-in

- guided "smart bomb"
    - TV guided
    - laser guided

(destruction of Than Hoa railway bridge in North Vietnam (1972))

- many longer range ASMs have been deployed, but with limited accuracy

- missile to home on radiation, "radar buster" successful in Vietnam

- new accurate long range ASM is the ALCM
    - more significance as a strategic than a tactical weapon

Antiship Missiles

- technically, a ship on the open sea makes a very good target for a homing missile
    - a sharp contrast to the background: cannot hide

- ASSM can skim very low over the water, and be hard to detect
    - or can dive at hypersonic speed from high altitude

- Japanese Kamikaze attack in 1945 gave preview of effectiveness of homing ASSM

- have mentioned success of air-launched Exocet ASSMs in the Falklands in 1982

- abrupt change in threat that small ship can offer to a much larger one
    - don't need large platform as for a big gun (Styx,Exocet,Gabriel)
    - [illegible] to torpedo boat of 1880's

- in addition to experience already mentioned in Middle East, in 1971 Indian MTBs with Soviet Styx ASSMs sank a Pakistan destroyer and other ships

- ASSMs can be launched from submerged submarines, at far greater distances than can be reached by torpedoes, & by aircraft at distance beyond range of AA weapons

- consequence is that surface ships now need an antimissile defence
    - the shorter range antiaircraft SAMs have a chance
    - British Seawolf has good capability
    - small calibre automatically-controlled guns with very high rate of fire now being mounted on most warships

- some possibility of defeating the ASSM by chaff, IR decoys, electronic jamming

- should remember that the torpedo is an antiship missile
    - wire-guided from the submarine
    - acoustic passive homing
    - acoustic active homing

ATGMs

- the disadvantages of guns that were described for AA use are less of disadvantage for the A Tk application
    - target does not travel very far during t_f
    - nevertheless range needs to be estimated in order to set proper elevation and deflection

- a major difference is that tanks have heavy armour
    - contest between naval guns & armour described by Prof Simmonds has a parallel between A Tk weapons and tanks

- another is that the tank is very likely to shoot back at the A Tk crew, and quickly

- sequel to shooting and missing likely to be getting shot

- many feel that the best A Tk weapon is another tank with a high velocity gun
  - dense round fired at high velocity can defeat thick armour

- technical problem of guiding ATGM to hit a tank which can be seen is not very difficult

- more difficult problems are
  - to knock the tank out of action with the first hit

  and - to avoid retaliation against the A Tk crew during the t_f of the ATGM

- favoured kill mechanism is the shaped charge
  - missile does not have enough velocity to penetrate thick armour
  - explosion of shaped charge on surface of armour directs energy to penetrate turret

- missile can be guided by wires, or optical, or radar beams

- three "generations" of sophistication

  1st - operator steers missile all the way to the target

  2nd - operator follows the target, missile follows

  3rd - operator acquires target, missile homes on it

  ("fire and forget", "launch and leave")

- launcher can be on ground, in vehicle, or in a helicopter, or on FWA

- can have laser designation, directed from observer on ground, in vehicle, helo, or FWA

- alternatively, gun-fired shell can be steered to target by laser designator

- ATGM with proven success on battlefield in Soviet-built "Sagger", by Egyptians in 1973

- conclusion is NOT that tanks have ceased to be key weapons of the land battle,
  - BUT that tanks need to limit their exposure at long range, by appropriate selection of ground, approach routes, weather and smoke
  - AND that they need the support of other arms (artillery, infantry, air) to suppress the A Tk defences

Strategic Cruise Missiles

- although a number of long range cruise missiles were deployed in the 1950s (US Matador, Regulus, Snark, and Mace and some Soviet ground and sea launched), it is the advent of precise navigation by terrain comparison that has revived the interest in the cruise missile as a strategic weapon, combined with more efficient small turbofan engines and small nuclear warheads

- the USA is now deploying GLCM, ALCM, and SLCM
    - also able to use in tactical roles with conventional warheads

Strategic Ballistic Missiles

- since their appearance twenty years ago long range ballistic missiles have been made steadily more and more accurate
    - whereas the Atlas, Titan, SS-8 and SS-9 had circular errors of half a mile or more, the newest ICBMs achieve something closer to one tenth of a mile

- another major development has been the fitting of MIRV on a single missile, thus enabling one weapon to attack several opposing weapons

- in the case of SLBMs, the accuracy is less than for corresponding ICBMs because of uncertainty in the precise position of the launch platform, but MIRVs are deployed

4. NUCLEAR TECHNOLOGY

- it is now possible to design a nuclear warhead with any yield above 1 kiloton TNT equivalent, and also somewhat smaller than 1 KT

- for small yields, it is cheapest to use fission

- warhead can be made small enough to fit inside a 155^{mm} howitzer shell

- for yields above about 50 KT it is cheaper to use fusion and the weapon will be smaller than a pure fission weapon

- proportion of fission to fusion may be altered in order to control proportion of energy released in form of radiation (as opposed to blast and heat) (ERW - "neutron bomb")

- no upper limit to what could be released (58 MT USSR 1961) using boosted fusion

- yield-to-weight ratio of weapons higher for big weapons than small - close to a million times what can be achieved with HE

- first nuclear tests

1945	USA	all have fusion as well as fission weapons
1949	USSR	
1952	UK	
1960	France	
1964	China	
1974	India	

- in the discussion following Prof Merrill's presentation it should be pointed out that some scientists give considerably more physical limitations which cannot be exceeded. Such limits exist for the yield-to-weight ratio of nuclear weapons, being 17 million for fission and 80 million for fusion. It would be wise to say the difference between a few million and a few more million really matters very much as compared to the difference between a few million and one.

- nuclear weapons now take the forms of:

  air-dropped bombs

  ASMs

  ICBMs (in single and multiple warheads)

  SSMs of shorter range, including ASSMs

  SLBMs

  SAMs

  AAMs

  AFAPs

  ADMs

  NDBs

  nuclear torpedoes

  ABMM

  GLCM

  SLCM

- their effectiveness is a combination of the warhead yield and the accuracy with which it can be delivered

- increased accuracy is allowing some weapons with nuclear warheads to be supplanted by equally effective conventional replacements

  AAM SAM

- ERW would allow better A Tk effectiveness with smaller total yield (and consequent collateral damage)

5. MILITARY SIGNIFICANCE OF PRECISELY GUIDED NUCLEAR WEAPONS

- no installation on surface of earth is invulnerable

- strategic ~~attack~~ destruction is possible without having to first defeat defensive forces

- no direct defence possible, only assured retaliation
  - to be assured, retaliatory force must be adequately survivable to surprise attack
  - hence diversity of strategic weapons into ICBMs, SSBNs, heavy bombers
  - and attempts to increase survivability through hardening, mobility, concealment, airborne alert, keeping submarines submerged at sea

- small fighter-type aircraft can carry enormous destructive power (remember factor of 1 million in yield-to-weight ratio)

- theoretical possibility of controlled escalation

OMIT IF AFTER 4.50

6. INTERNATIONAL NUCLEAR AGREEMENTS

- concern for danger of nuclear weapons becoming available generally

- series of arms control agreements concerning nuclear weapons

Multilateral	Bilateral
1961 Antarctic Treaty	1962 Outer Space Treaty
1963 Limited Test Ban	1971 Accidents Measures Agreement
1967 Latin American Nuclear Free Zone	1972 SALT I Accords - offensive weapons - ABM Treaty
1968 Non-Proliferation Treaty (not signed by Argentina, Brazil, China, Israel, Spain & others)	1974 Threshold Test Ban
	1976 PNE
	1979 SALT II signed but not ratified by USA (numerical limit on SNDVs, MIRVed ICBMs & SLBMs, ALCMs)

- other bilateral negotiations
  - START 1979 --
  - INF 1980 --

- concern over ability to verify compliance with undertakings
  - detection of nuclear explosions (including underground)
  - counting of deployed weapons

- concern over diversion of fissile material from nuclear reactors intended to produce electric power
  - IAEA Safeguards
  - Israeli raid on Iraqi nuclear installation (1981)

7. PRESERVATION OF STABLE NUCLEAR DETERRENCE

- according to many, international security depends on the preservation of stable nuclear deterrence between the US and USSR

- most feel that nuclear deterrence exists today, and is reasonably stable

- many fear that technology threatens to destabilize deterrence, if not remove it altogether

History of nuclear deterrence ~~since~~ 1945 - 1964

US Monopoly - Unilateral Nuclear Deterrence

1946 30 B-29 bombers configured to carry nuclear weapons
9 nuclear warheads in US inventory

1948 first B-36 and B-50 bombers and first refueling tankers delivered to SAC

1953 first wing of B-47 jet bombers in SAC

1954 1750 nuclear warheads in US inventory
Dulles' doctrine of massive retaliation

1956 first USAF B-52 bombers
first Soviet long range Bison and Bear bombers

1957 orbiting of Sputnik showed USSR able to launch payloads to intercontinental ranges

1958 USAF began deployment of Atlas ICBM

1960 first B-58 supersonic bombers for SAC

1960-62 USN deployment of 656 Polaris SLBM on SSBNs

1961 USSR began deployment of SS-7 ICBM
USSR began deployment of Sark SLBM on SSBs

1962-67 USA deployment of 1000 Minutemen ICBMs

1963 USA and USSR each had at least 100 ICBMs, 100 SLBMs, and 200 long range bombers in service

1964 USSR began deployment of Serb SLBM on SSBNs
could conclude that mutual strategic deterrence was now in effect

Technological and operational developments affecting the stability of deterrence

1957 one-third of SAC bombers put on ground alert

S	1959	some SAC bombers put on airborne alert
		Wohlstetter: "The Delicate Balance of Terror"
S	1959	first US photographic reconnaissance satellite
S	1960	beginning of MIDAS satellites to detect missile launch
S	1961	beginning of BMEWS
S	1962	Titan ICBM deployed in underground silo
S	1963	first Minutemen squadron with solid fuel (and in underground silo)
S		beginning of Vela satellites to detect nuclear explosions
S/D	1965	first Soviet SS-9, in underground silo, with 15,000 lb throw-weight
D	1970	first USAF Minutemen III squadron (3 MIRV)
S	1971	first USN Poseidon SLBM with 10 MIRV
S/D	1974	first Soviet SS-N-6 Mod 3 with 2 MIRV
D	1975	Soviet SS-17, 18, and 19 all with MIRV (4, 8, 6)
S/D	1977-84	360 Soviet SS-20 mobile IRBM with 3 MIRV
S/D	1983	first NATO GLCM, Pershing II (both mobile)

D 1970-84 continuous improvement to accuracy of MIRVs on ICBMs

- one missile can destroy several of opponents land-based missiles

[observations]

- some of the technology enhances crisis stability, some reduces it

  e.g. mobility, hardening, good EW concealment

  e.g. MIRV, high accuracy, big payload, short t_f

- likewise some enhances arms control stability, while some reduces it

  e.g. good surveillance, easy verifiability

  e.g. mobility

- it should be possible to favour future technology which enhances the stability of deterrence

  e.g. make land-based component small mobile missiles with a single warhead (Midgetman)

- destruction since 1945 has not been a real race to destruction out of human control
- number of nuclear weapons how is not unlimited upwards it an exponential by expanding rate
- stable mutual deterrence has been established
- there is very probability that ~~stable mutual deterrence~~ it can be maintained
- but management of the nuclear balance is going to take determination and strong nerves
  - will not be achieved by good intentions & unilateral disarmament
  - will need exploit use of all the knowledge that we can combine from strategic studies, military science, and history

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