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Technology used during the Peloponnesian war

Analysis of the technology used in any war is a good way to understand the state of art of the society. Societies in conflict will optimize available resources towards winning the conflict, with technology and strategy playing critical roles. Technology is the application scientific knowledge for practical purposes, especially in industry. The Athenian empire - a huge military industrial complex of its time has its share of technology marvels that were intended to shock and awe the enemy into submission. This paper analyzes the technologies used during the Peloponnesian war and their impacts to the war.

Adaptation of the trireme technology was the most factors that catapulted Athens from a small city state to an empire and from a democracy to a tyrannical thalassocracy. Naval technology evolved from wind (using sails) based propulsion to oar (using manual labor) based propulsion giving navies a radical new capability – ability to move in any direction independent of the wind. Oar driven galley remained the main naval weapon until the arrival of galleasses in battle of Lepanto in 1571. Speed was achieved using either with additional oars or multiple rowers per oar. The rowers' arrangement evolved from a single layer to multiple layers. The bireme involving two layers of rowers was probably invented by the Phoenicians and later acquired by the Corcyraeans "would boast of substantial naval superiority, even basing their claim on the nautical fame of the island's original inhabitants, the Phaeacians" (Thu 1.25). Thucydides credits the Corinthians for inventing the Trireme – "the first triremes in Greece were built in Corinth. A Corinthian shipbuilder, Ameinocles, is known to have built four ships for the

Samians,.." (Thu 1.13). The Trireme was the Dreadnought of its time, a game changer and was likewise prohibitively expensive. This explains why the Greeks had few. "They employed few triremes and were still equipped with the penteconters and long ships of that much earlier age." (Thu 1.14) The Trireme propelled by 170 (calculated using Thu 8.29) rowers in three levels (hence the name), was designed for speed and maneuverability, could speed up to 10 knots and make a 90^0 turn within 30 secs (Pm P.11). Additionally it had under-belts called *hypozomata* that were tensioned fore and aft like a bow-string to keep it rigid, stop it flexing in waves and also protect its structure against the stresses of ramming (EKB P30) . Export of the *hypozomata* technology was a capital offence in Athens. The weapon of the Trireme was the ram, made of large timber baulks and sheathed with bronze, the bronze casting alone weighing 200-250 kg and typically had three horizontal 'blades' designed to wedge and open joints in planking, or split the planks themselves around the waterline. The Athenians also designed mechanisms to prevent the ram from penetrating deep into the hull making back off difficult. Speed and maneuverability were the key advances.

The other Greeks (eg: Corinthians , Corcyraeans etc) used "old-fashioned and unsophisticated mode of naval warfare " (Thu 1.24) that was "more like a land-battle at sea" (Thu 1.24) that involved boarding the enemy ship and fighting on the decks. The Athenians perfected naval warfare to an art form "Seamanship is an art " (Thu 1.142) using the Trireme as a weapon instead of a transport and developed complex tactical maneuvering techniques like *diekplous* – "breakthroughs and turn-backs" (Thu 2.89), *periplus* - "preferred technique of encircling and ramming amidships" (Thu 7.36) and *Kyklos*. They Athenian strategy was to ram the enemy ship and quickly back off,

eliminating any combat on the decks and water logging the enemy ship which would destabilize and roll over or capsize. With oars withdrawn and sailing fast close an enemy ship, they could shear away the enemy ships' oars rendering it immobile and a helpless target for ramming. Like an orchestra playing in unison, the oarsmen rowed in precise coordination, rammed, receded and sheared, and multiple ships coordinated their formations. These synchronized activities elevated the Trireme from a lanky galley to a formidable naval weapon prompting the playwright Aeschylus to pen "Then on and on, with ships for spears, they fought."

One of the most impressive engineering marvels constructed few decades prior to the Peloponnesian war is the canal of Xerxes, traces of which can still be seen. The constructions of breakwaters, quay walls, the covering of the slopes with clay to secure the walls, lay-by basins etc all require fair among of engineering. The planning and subsequent execution to success is a testimony to the state-of-art that existed around the time of the Peloponnesian war. Thucydides makes a passing reference to this in book 4 when describing the Brasidas' campaign against peninsula called Acte, "which stretches out into the Aegean sea from the canal dug by the Persian King and terminates in the height of Mount Athos". (Thu . 4.109). Another effective usage of canals was in the siege of Prosopitis where the Athenians held out against the Persians for eighteen months, the Persian navy being no match to the Athenian naval agility and bravado. The Persians then dug many canals to divert the flow away from the arms of the Nile within which the Athenians lay effectively "grounding" the Athenian navy. Then the Persian army walked over to the island forcing Athenians to surrender. "In the end he drained the canal by diverting the water elsewhere, leaving their ships on dry land and most of the island now

joined to the mainland: he then crossed over on foot and took the island." (Thu. 1.109). Canal construction was not the exclusivity of the Persians. The Greeks too embraced this technology and when the Corinthians colonized Leucas a peninsula, they artificially made it an island by digging a canal through the isthmus in 7th century BC. (Manly. P 27). But by the time of the Peloponnesian war the canal appears choked up with sand deposits and no longer available for sailing across. Thucydides mentions an isthmus near Leucas, "sailing close in to land: at Leucas they transported their ships across the isthmus.." (Thu. 3.81). The Spartan king Agis "began diverting the flow of river water into Mantinean land "(Thu 5.65) to lure the Argives into battle. One thus sees canal construction, diverting of rivers, emptying of lakes as well established and effectively used technologies although labor intensive.

Diolkos - the paved track way across the Isthmus of Corinth was frequently and regularly for transportation of commercial goods in the 5th century BC. It is mentioned in Aristophanes' play *Thesmophoriazusae* where clisthenes says "Why, friend, it's just like the Isthmus; you keep pulling your stick backwards and forwards more often than the Corinthians do their ships." . While transportation of heavy monolith over land has been known since the days of the pyramids, Portaging – the transportation of boats / ships over land is a Greek novelty. The Greeks pioneered Portaging as a technology. They mastered the techniques of hauling a warship out of water with help of derricks onto undercarriages, protecting its keel and hulk, protecting its structure, protecting it from toppling over, protecting the joints from stressing, and finally guiding it over land across the Diolkos. Excavations of the Diolkos have discovered grooves resembling tracks deliberately cut into the stone making the British historian M.J.T Lewis claim "Diolkos

was a railway within our definition. More debatable is what it carried" (MJTL). Thucydides does not mention Diolkos by name; he mentions the Spartans building slipways across the Isthmus of Corinth to haul their ships overland. ".. began preparing slipways at the Isthmus for the transport of ships overland from Corinth to the sea on the side facing Athens" (Thu 3.16). Later he mentions "Spartans sent three Spartiates to Corinth with instructions to arrange the immediate transport of the ships across the Isthmus from the Corinthian Gulf to the sea facing Athens " (Thu 8.7) and "the idea was to split the Athenians' attention between the ships setting out and the ships still to follow across the Isthmus." (Thu 8.8). The portaging technology developed and used during the war provided quick passage between the Corinthian and Saronic gulfs saving the long perilous sail across the rough seas of the Peloponnese.

When trade flourished and cities became wealthy, they built fortifying walls "for defense against neighboring peoples." (Thu 1.7). Necessity being the mother of invention, a siege engine was developed to batter the walls/gates or climb over the wall. The siege engines used during the Peloponnesian war were mostly rudimentary battering rams or ladders. Athenian two pronged strategy being naval supremacy at sea and homeland protection using fortifications; they developed fortification and siege technologies and gained "reputation for expertise in siege operations." (Thu 1.102) While extensively only one of the victories could be attributed to the siege engine. During the siege of Oenoe, the Spartans "prepared to attack the wall with siege-engines and by other means" (Thu 1.18), failed to take it and left empty-handed for Attica. Similarly in the siege on Potidaea, Hagnon and Cleopompus "brought up siege-engines against Potidaea and tried every possible means of taking the place. But they did not achieve either the

capture of the city or any other success" (Thu 2.18) left for home unsuccessful and an army devastated by the Plague. Thucydides gives a more detailed description of the siege-engine offence and it corresponding defense when describing the siege of Plataea. The siege-engine (battering ram) was "hauled up the ramp and battered down a large part of the superstructure," (Thu 2.76) and the Plataeans countered by "lassoing the rams and so deflecting them". (Thu 2.76) The Plataeans also rigged a device to drop a huge wooden beam from a height on an incoming ram to "snap off the nose of the ram" (Thu 2.76). The ram speeding down the ramp was thus rendered ineffective forcing the enemy to concede "their siege-engines ineffective and their ramp met by counter-fortifications, the Peloponnesians concluded that it was impossible to take the city". (Thu 2.77) The siege-engine deployed by the Spartans during the attack on Pylos was simply a scaling ladder. "..Construction of siege-engines, hoping that with these devices they could take the wall facing the bay, which might be high but afforded the best landing underneath it." (Thu 4.13). In the Syracuse campaign Demosthenes applied the siege-engines against the cross-wall, but "were set on fire by the enemy defense on the wall" (Thu 7.43). Only in late 5th century BC did this technology mature to torsion based engines like the ballista, the catapult and the Trebuchet. Engineers from Syracuse are credited with the invention of the catapult during the reign of the tyrant Dionysius. The only successful usage of the siege engine was in the siege and capture of the fortified towers of Minoa. "Nicias attacked from the sea and took two towers projecting out from Nisaea, using scaling-devices mounted on ships.. " (Thu 3.51) Thus we see the siege-engine technology as rudimentary and immature, deployed but hardly effective. Walled cities were besieged into submission by starvation or using traitors within – the time tested technique. "There

is no fortress so strong, but it might be taken, if an ass laden with gold was brought to the gate." argued Philips II of Macedonia decades later.

Use of incendiary technology in war dates to pre-historic times and the Peloponnesian war was no exception. Thucydides cites numerous instances of fire being used as a weapon. In the siege of Plataea the Spartans piled brushwood as high as possible against the city walls and "threw on sulphur and pitch, applied firebrands, and set light to the wood. The result was the greatest man-made sheet of flame ever seen by anyone up to that time." (Thu 2.77) A new fire-ball producing engine was deployed by the Boeotians during the successful capture of Delium. This engine had an air-tight iron pipe with a cauldron filled with lighted charcoal, sulphur and pitch at the other end. They applied large bellows to create an air blast that would catapult the burning cauldron over. "The result was a huge flame which set fire to the wall and made it impossible for anyone to stay manning it: the defenders abandoned the wall and took to flight, and so the fort was captured by this means." (Thu 4.100). Brasidas probably used a similar "machine designed to throw fire at the wooden breastwork" (Thu 4.115) during the attack on Lecythus. The Athenians prepared to douse the file by pouring water over it from a wooden tower. "They carried up many jars and pitchers of water and large stones, and many men climbed onto the tower. But the over laden building suddenly collapsed with a great crash" (Thu 4.115). Similarly in the battle in the great harbor, the Syracusians let a merchant ship on fire and left it drifting towards the Athenians who took "counter-measures to extinguish the flames and keep the fireship at a distance," (Thu 7.53).

Chemical and Biological weapons as understood in modern times were not used. Sulphur, charcoal and pitch could technically be considered chemical weaponry, but

these were mere incendiary agents. During the Plague in Athens, the Athenians “allege that the Peloponnesians had poisoned the wells” (Thu 2.48) is the only known instance of the alleged use of a chemical / biological weapon. The Plague that ravaged Athens can be attributed to overcrowding than to any actual chemical or biological weapon. Chemical or Biological warfare technology was non-existent. The burning of fields, poisoning of water, throwing feces and rotting carcasses and cutting of trees was their extent of any biological warfare.

Tunnel Construction technology was well developed in ancient Greece; the Tunnel of Eupalinos constructed in 530 B.C being a living testament. Workers dug the tunnel across the mountain simultaneously from both ends and met in the center of the channel within 2 ft error. Knowledge of tunneling was effectively applied against the mound raised by the Peloponnesians. The Plataeans “dug a tunnel out from the city, calculating its length and dept under the mound, and again began to steal the infill back into the city” (Thu 2.76). For a long time the attacking Peloponnesians did were clueless as to why their mound kept sinking despite bring piled with more and more earth. The developed waterworks technologies and created elaborate waterworks that included water carrying tunnels, pipes, and fountains. “The Athenians now destroyed the pipes laid underground to bring drinking water into the city” (Thu 6.100), “Then there is the fountain now called Enneacrounos..” (Thu 2.15), “..half-dead creatures staggering about the streets and round every fountain, craving for water” (Thu 2.52) all attest to the technical capabilities of the ancient Greeks. These technologies were used in sabotage operations during the war.

The Peloponnesian war being fought both on land and sea, it comes as no surprise that submersibles were effectively deployed as deterrent against enemy ships. The Syracusans dug large stakes in the sea bed which served as underwater hidden reef and would damage an approaching ship. The Athenians deployed frogmen - “hired divers who went down and sawed them off” (Thu 7.25). Similarly divers used to deliver much needed supplies to the besieged Spartan in Sphacteria “And divers would make their way across from the harbor, swimming underwater and pulling on a cord behind them skins filled with honeyed poppy-seed and crushed linseed” (Thu 4.26) These hired divers capable of operating independently under water were the precursors to the frogmen of any modern navy.

To sum it all, the Greek civilization at the pinnacle of its creativity got embroiled in an unparalleled savage war and could not produce any technological breakthrough that would tip the fortunes of the war. The Trireme remained the primary shock-and-awe weapon until its lethality was check-mated by the Syracusans’ lately acquired head-on tactics. The Phalanx remained the shock-and-awe strategy of the Spartans and it was rendered impotent by the Athenian fortifications. The two major powers Athens and Sparta were engaged in asymmetrical combat, with Athens the naval power dominating the seas and Sparta the infantry power dominating on land. The war dragged on for thirty years as no side could deliver the knock-out punch. The prolonged war left most Greek states physically, psychologically and economically drained. And they could never rise back from the ashes of the war.

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Reference Pictures

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