Naval War College Review

Volume 38
Number 4 *May-Jun*

Article 2

1985

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Brent L. Gravatt
U.S. Navy

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Commander Brent L. Gravatt, US Navy

Conventional war in one medium or environment is not much different from that in another. The tools vary, but the work is the same. With exceptions made for the variance in weaponry, an assault in space against a piece of star dust in the "n^{th}" century will be similar in concept and execution to the familiar amphibious assault of the 20th century against a speck of coral dust. It behooves military personnel with expertise in the conventional warfare of one medium to understand the basics of conventional warfare that are applicable to all—joint operations demand such an understanding.

Conventional warfare in the mediums is not just analogous; it is, with the likely exception of tactics in space, homologous; meaning, the principles of conventional warfare on land, on the sea, in the air, and in space are similar and of common origin. The single source being warfare on land. What we know about the fundamentals of conventional warfare in any medium stems mainly from the principles men first derived from land warfare.[1]

As regards tactics, the indication of the common nature and origin of tactics in three of the mediums is the reflection of land warfare in the nascent stages of sea and air warfare. For naval warfare, the Age of the Galley provides the example and for air warfare, World War I. For space warfare, we can form an analogy with the tactics of land warfare but not a homology. Initial tactics in space will likely start from the existent level of air tactics. Even should this not be true, the transition from a "land style" to a "space style" will probably be short. The length of the transition period, should it occur, will be dependent on technology, not on conceptual development, and the rapidity of modern technological advances will ensure the brevity of the transition.

Galley warfare was essentially land warfare afloat. Floating platforms with soldiers on board engaged other soldiers on other floating platforms in individual combat. The use of the ram, with some notable exceptions, served only to supplement the principal tactic of soldiers boarding and capturing.[2]

In the air, during the early stages of World War I, the land-based air services of the antagonists were "flying cavalry," organized to perform one of the

Commander Gravatt holds an MA from Duke University and is assigned to International Security Affairs in the Office of the Secretary of Defense.

primary tasks of cavalry, reconnaissance.[3] "Knights of the air" engaged each other in the air version of the joust. The synchronized machine gun replaced the lance. By the end of WWI, air warfare had progressed considerably from its cavalry and knightly origins, but its roots were clearly in land warfare.

Just as air warfare evolved from the cavalry mission of reconnaissance, so today we see the same impetus for space warfare. One of the two initial military uses of space has been for reconnaissance, the other being communications. Today's satellite is yesterday's horse, dispatch boat, and scout plane. Because the satellite is successful at reconnaissance, just as its predecessors were, we have started to develop antisatellite devices just as we developed counters to the satellite's forerunners. These new anti-reconnaissance machines will beget other machines not only for the defense of the

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satellite but for other purposes as well; and soon thereafter, a panoply of specialized warcraft will be plying the cosmos. The development of these spacecraft await technological advancements similar to those that awaited the aeroplane before WWI—breakthroughs that will provide endurance, payload, lightweight yet effective weaponry, and battlefield reliability of the frame and propulsion system.[4] Just as the air theorists between the World Wars borrowed from the then existing tenets of seapower, the conceptual basis for the use of these new space machines will likely be those already developed for airpower.[5] But the fundamentals of space warfare will harken back to their origin—warfare on land.

Land warfare provides a basis for discussion, investigation, and explanation for all conventional warfare. *Inter alia*, in land warfare we find the clearest expression of principles and tactics. From the study of conventional warfare on land, by analogy and extrapolation, we can explain and understand conventional warfare in the other mediums. When war comes to space, we need not reinvent its theoretical wheel, we will only need to modify its construction to fit the peculiar requirements of space and the impact of new weaponry.

The "principles of war," whether embodied in the acronym MOOSEMUSS* or in some other similar list, are familiar to men in all shades of uniform. Because of the homologous nature of conventional warfare in the

*Mass, Objective, Offensive, Surprise, Economy of force, Maneuver, Unity of command, Simplicity, Security.

mediums, these "principles" are independent of the medium and are applicable to conventional war on land, sea, air, and space. The homology of conventional war in the mediums encompasses not only the "principles," but it also extends to the concept of medium control as well as to the encounter. By these and other examples, we intend to demonstrate the heuristic value of recognizing the commonality of conventional warfare in the mediums.

The immediate purpose of medium control is an improvement in one's own mobility, an increase in one's ability to move things and people through the medium, and a concomitant relative or absolute decrease in the opponent's ability to do the same.[6] Mobility encompasses more than the transporting of men and equipment to the front or the maneuvering of forces in battle. At its base, the mobility of a nation is the gathering and hauling of the nation's sustenance to feed the maw of war. It is resource collection and product distribution—human and otherwise.

This movement of things and people is in order to be able to engage—the engagement, or the threat of it, serving a further purpose. The engagement, however, is not necessarily the desirable outcome of mobility. A favorable encounter is. The favorable encounter results in the attainment of an objective, and it may or may not involve an engagement. To fight to achieve the objective may be necessary. To fight less, or not at all, and achieve the objective is, in many cases, better.[7] Clearly, when the purpose of the encounter is the destruction vice the neutralization of the opposing force or, for example, the forced occupation vice the induced abandonment of a place, the engagement is necessary.

Medium control, then, enhances mobility; mobility increases the opportunity for a favorable encounter, and the favorable encounter leads to the attainment of an objective. The extension or preservation of medium control, through the encounter, is but an intermediate objective.

Medium control is seldom universal, that is, absolute and in all places.[8] It is absolute in the medium where one side can move what it wants, when it wants, where it wants with no risk and the other side cannot. It approaches the absolute where this ability to move exists but is attended by some risk. These conditions of absolute and near-absolute control are most often present in only part of the medium while other portions are in contention. Furthermore, considerable portions of the medium are susceptible to the raid. Raids are nonrepetitive or sporadic and, therefore, are most often nuisances with normally only a transitory effect on medium control.[9] The single strike that does produce a decisive change in control of the medium is the exception rather than the rule. Such an example is the Israeli preemptive airstrike against Egyptian air bases in 1967.

Regions of the medium that are under absolute or near-absolute control exist because of a preponderance of might, of distance factors, or a combination of the two. Defensive might makes a favorable encounter for the

attacker unlikely, and distance simply puts the region beyond the attacker's effective reach but not necessarily beyond his raid radius. The high degree of mobility existent within the zones of absolute or near-absolute control provide regions of departure for offensive and defensive encounters and secure bases for extension or preservation of control of the medium. Zones of contention can also serve in these capacities, but they do so with greater difficulty and higher risk because of a lower level of mobility. The basics of medium control in space will be those we are already familiar with on Earth.

Offensive and defensive encounters in all mediums are of two general categories: encounters whose principal object is a place, and encounters whose principal object is a force.[10] In today's terminology, we would refer to the former as countervalue and the latter as counterforce. An encounter whose principal object is a place has as its primary aim the place itself or what it contains and only secondarily the destruction or neutralization of the opposing forces or the preservation of one's own. Places have a military importance because of what and where they are, and/or what they contain. A road crossing, a hill, a strait, an island, an industrial city, a stellar fortress, a moon, have value because of their physical characteristics and location, and/or their content. Forces can be "contents," but if they are the objective, the encounter is one for forces and not for the place. Thus, the primary aim of a "place encounter" is: the forced occupation, induced abandonment, destruction, or preservation of a place; and/or the destruction, acquisition, or retention of the contents. One's own forces or those of the opponent are secondary contents, not primary ones. Primary contents include populace, supplies, factories, raw materials, the leadership, landing strips, port facilities, etc.

An encounter whose principal object is a force has the destruction or neutralization of the opposing force or the preservation of one's own as almost its sole aim, the place being in most cases, irrelevant. The force is the objective, and its location is merely incidental to its being. The attainment of the principal objectives in the two general categories of encounters serve to further a longer-range goal.

Encounters in the mediums demonstrate a recurring tactical geometry that is common to all forms of conventional warfare. The concepts and terminology of land warfare provide the best tools for explaining this geometry and its applications. One branch of this geometry is unidirectional and has to do with lines and columns. The other branch is omnidirectional and is composed of circles, polygons, and their associated solids.

Relative to the direction of movement, the line in a horizontal plane is wider than it is deep, whereas the column in the same plane is deeper than it is wide. A line is wide, shallow, and permeable; and the column is narrow, deep, and resistant to penetration. Obviously, a series of lines in file can be a

column and series of columns in rank can be a line. By stacking lines and columns in the vertical plane, as can be the case with aircraft and spacecraft, concentration of destructive power and compactness of the formation can be achieved as well as defensive and offensive capabilities in the vertical direction. Both the line and the column are unidirectional in the sense that orientatiou of the offense and the defense is primarily in one direction. This direction coincides with that in which the most weapons can be brought to bear simultaneously on the opponent, and/or with the course of movement.

In land warfare—in galley warfare with the ram and boarding infantry located at the galley's bow, and for the forward-firing missile boat with fixed surface-to-surface launchers—the line, in offense and defense, is in the direction in which most weapons can be brought to bear simultaneously and is oriented on the direction of movement. The column, on the other hand, in offense and defense, is oriented only on the direction of movement and not on the direction in which the most weapons can be brought to bear simultaneously. Rather the destructive power of the column is brought to bear on the opponent sequentially, along the course of closure, one element after the other.

For the broadside-firing sailing ship and for the screw-propelled ship with rotatable, fore and aft, centerlined guns, missile launchers, and sensors, the direction in which the most weapons and sensors can be brought to bear simultaneously is at an angle to the direction of movement. In contrast then to tbe line on land, the line abreast for the side-firing platform is oriented on the direction of movement only and not on the direction of maximum simultaneous fire. The column (line ahead), however, is oriented on the direction in which the most weapons can be brought to bear simultaneously and not on the direction of movement. However, the line ahead of side-firing platforms has characteristics of botb the land line and the land column. Like the land column, units in a line ahead are in file in reference to the direction of movement and engage sequentially along that direction on a narrow front. On the other hand, a line ahead of side-firing platforms is like the land line in that the formation is designed around the simultaneous delivery of firepower, which in this case, is to the side.

Circles, squares, spheres, cubes, and other multisided formations are basically linear, hollow, and generally defensive. The sides or arcs are wider than they are deep, thus resembling the line. Between the "sides," there is more space than forces, and the multifaceted, dispersed disposition lends itself to omnidirectional and simultaneous protection, either en route to the attack or in static defense. Increases in depth are accomplished by adding similar polygons and concentric circles to the formation and by stacking congruent configurations. Combinations of these multisided formations can be joined so as to form lines and columns with the attainment of the corresponding characteristics of these simpler formations.

Unlike aggregations of land and sea combatants, aircraft—with the exception bombers—tend not to maintain an alignment upon contact with the enemy. Upon contact, formations of attack and fighter aircraft usually break into smaller collections, losing any physical resemblance to a formation. Even though these aircraft may bring their firepower to bear simultaneously or sequentially, and from multiple directions, they do so as coordinated separate entities rather than as a coherent line or column. Preengagement formations of attack and fighter aircraft are essentially defensive and seek to avoid visual and electronic "dead angles."

Bombers fly in formation for the same reasons. In addition, bombers have, or at least have had, defensive firepower; hence, they have also sought to prevent firepower dead angles through the mutual protection provided by the formation. Since, in terms of defense, bombers have been primarily side-firing platforms, they have flown in columnar formations rather than linear ones. Also, since it is generally easier to hit the long axis of a target with an "iron bomb" than the short axis, bombing formations have tended to be columnar and delivery sequential.

However, lines and columns are applicable to air warfare, but they have more to do with what is on the ground than with what is in the air. Detection devices, antiaircraft batteries, and airbases can be arranged to provide a linear or columnar defense. If arranged linearly, they present a wide front but are as susceptible to penetration as is any line. If in a column, they provide depth, sequentiality, and impermeability but on a narrow front.

Initially, tactical geometries in space will probably be similar to those of the air. However, as the platforms become larger and able to travel greater distances, spacecraft formations will likely evolve into something akin to those of present-day sea warfare with spacecraft carriers in place of aircraft carriers.

When formations with contrasting alignments of weapons power are opposed, the formation that presents the least amount of simultaneous destructive power must move quickly to counter the disparity. For example, on land when a line and a column meet head on, the line is susceptible to penetration by the column, but the column is exposed to the greater weapons power of the line.[11] For the column to be successful, it must, at least, neutralize this disparity. One way is to minimize the exposure time. The column cannot remain stationary while the greater weapons power of the line batters its narrow front and flanks. It must move through the "killing zone" posed by the weapons of the line rapidly, either in offense, or in defense to break up the attack of the line, and arrive at the line essentially intact. Another way is for ancillary attacks, or the threat of such attacks, to reduce or divert the weapons power of the line prior to the main assault of the column. Of course, the two methods can be employed in combination. The line, to be

successful, need only maintain its coherency so that it can continue to bring the maximum number of weapons to bear.

An example at sea of the clash of contrasting alignments is when two columns of side-firing ships meet each other at an angle. This is called "capping the T" or "raking" in which the ships forming the leg of the "T" are at the disadvantage.

History is replete with examples of the clash of contrasting alignments, of the narrow front *versus* the wide front. The manner in which soldiers, sailors, and airmen conducted these clashes was similar, and therein lies the lesson. It is simply this: tactical geometries and their use in the mediums are similar. It is the machines of war that are different. What is applicable in one medium is applicable, with some modification, in another.

Illustrations of the recurring tactical geometries and their analogous applications are plentiful. At Leuctra in 371 BC, Epaminondas employed a Theban column against one wing of a Spartan line while he threatened an ancillary attack against the Spartan center and opposite wing. By so doing, he diverted part of the weapons power of the Spartan line away from the main assault of his column.[12]

The contest between the column and the line appears again in the Napoleonic era. To reduce the firepower of the line, Napoleon used cannon fire and skirmishers to thin the opposing ranks prior to the assault of his columns. Wellington, in a countermove to maintain the coherency of his line, placed his ranks on the reverse slope to negate the artillery fire, deployed counterskirmishers, and then brought up his line in an enveloping attack on the advancing French columns.[13]

At sea, Nelson was demonstrating the same sort of tactical flexibility as a practitioner of the "meleeist school" of thought. In the intervening years between the First Anglo-Dutch War in the mid-1600s to the late eighteenth century, tactics at sea had been reduced to the "formalist school" approach of rigid adherence to the line ahead (single column).[14] Basically, this was the tactics of linear land warfare with opposing parallel lines blazing away at close range. At Trafalgar (1805), Nelson forwent this parallelism in exchange for what on land would be a column attack against a line. Nelson, in two columns, purposely allowed his "T" to be capped as he approached the combined French-Spanish line ahead with the aim of penetrating the allied line and bringing on a melee. To minimize the raking firepower of the French-Spanish line on his advancing columns, Nelson had all sails set in order to transit the "killing zone" as quickly as possible. In addition, he diverted part of that raking firepower by feinting toward the van, and thus holding it out of action, while the main attack developed against the center and rear.[15] Tactically, Trafalgar was Leuctra at sea.

By the beginning of the 20th century, the single line ahead had firmly reestablished itself as the basic tactical disposition for naval engagements, and

a certain rigidity, reminiscent of the "formalist school" of thought, had crept back into naval thinking. This was evident at Jutland (1916) where both Jellicoe and Scheer elected the single line of battle for their main bodies.[16] At Jutland, Scheer's employment of destroyers as skirmishers to cover the two battle turn-aways of his column, as Jellicoe's line was capping it, was akin to Napoleon's use of infantry skirmishers to prepare for the advance of his columns against the British line. At Jutland, however, the Germans used their "destroyer skirmishers" to reduce the raking firepower of Jellicoe's line as they withdrew their column.[17]

On land, a similar parallelism to the line ahead at sea emerged, particularly on the Western front where long trench lines of infantry engaged each other in positional warfare. It was in an attempt to break this stalemate that the Germans developed the attack-in-depth, with leading units bypassing strong points for mop-up later by following forces. Misnamed "Hutier tactics," these tactics were columnar in concept employing concentrated power more sequentially than in the normal WWI attacks. In addition, to reduce the firepower of the successive lines of defense prior to the arrival of the assault column, the Germans used a short, massed preassault bombardment followed by a creeping barrage that preceded the advancing infantry.[18]

In the air, the rudiments of "formation flying" did not appear until late in 1915.[19] As the war progressed, formation flying became more sophisticated with different formations being developed for the specialized tasks of the pursuit, observation, and day bombardment aircraft. American pursuit flights were in a wide, open "V," bombardment in a wide closed "V" (i.e., a triangle or delta), and observation craft flew in a protective diamond. Pursuit and bombardment flights were grouped together in aggregations called "chain formations." As the name implies, the individual flights of "Vs" were arranged in columnar fashion similar to the links in a chain. Pursuit "chains" tended to be just large "Vs," although deeper than wide. Bombardment "chains," however, were "Vs" in column and, hence, delivered their bomb loads sequentially.[20]

In World War II, the small American bombardment chains of WWI had swollen to "bomber streams" composed of hundreds of aircraft in columns up to a hundred miles long. The American bomber columns were composed of squadrons of aircraft in "combat boxes," which were much like the WWI closed "Vs."[21]

The strategic bomber offensive against Germany in WWII pitted the penetration power of the British and American bomber columns against the coherency of the German linear defenses, which included the Kammhuber Line of radars, flak and searchlight belts, and fighter bases.[22] The American belief in the invulnerability of the heavy bomber delayed the development of long-range fighters for use as either close escorts or as skirmishers in advance of the bomber columns. It was not until early 1944 that there were

enough long-range fighters to provide both the close escort and the preparatory fighter sweeps.[23]

On land, reduction in the firepower of a defensive line in preparation for the advance of a column was an integral part of the German blitzkrieg. Blitzkrieg was essentially mechanized "Hutier tactics" with tank columns replacing infantry storm columns and dive-bombing attacks replacing the preparatory artillery fires and the creeping barrages.[24] The blitzkrieg lives ou today in the form of the Soviet offensive doctrine for conventional war in Europe. Under this doctrine, tank and mechanized infantry columns supported by massed artillery and preceded by heavy airstrikes will attempt to penetrate Nato's forward linear defense. Like Napoleon's columns, the Warsaw Pact's successive echelons will be susceptible to enveloping attacks from the Nato line. The tactical situation on the Central front today is very much the line versus the column on a grand scale.[25]

The line versus the column also shows up in amphibious assaults. In World War II, many amphibious landings were basically column attacks against a linear defense. Successive waves of boated forces applied power sequentially on a narrow front. Ancillary attacks in the form of aerial and naval bombardment prepared the defending line for the arrival of the amphibious assault column. Upon landing, there was a rapid advance across the killing zone—the beach—and a push inland to penetrate the defensive line.

At sea during WWII, the line ahead continued to dominate battle formations in surface actions, but it was employed more flexibly to bring on a melee. Multiple columns were as common as the more conservative single line ahead. Fleets of carriers, with each subgroup of a carrier or carriers protected by its own ring of escorts, were formed in both lines and columns of these circles. These large linear or columnar aggregations encompassing hundreds of square miles had little to do with the simultaneity or sequentiality distinction normally associated with the line and column. As long as the carrier groups remained within mutual supporting distance of their primary offensive and defensive weapon—the aircraft—they could bring their firepower to bear simultaneously in any direction.

The defensive circle around the carrier is but one example of the omnidirectional defensive formarion. The "combat box" of WWII bombers, the closed "V" or triangle of the WWI bombardment planes, and the protective flying circle where one aircraft protects the tail of the other are examples in air warfare. In land warfare, the infantry square was used for centuries as a standard defensive formation against cavalry attacks.[26] The circle, in naval warfare, goes back to the Age of the Galley.[27]

The purpose behind employment of the tactical geometries is to gain and maintain an advantage over the opponent—more versus less. This is the concentration of which Jomini, Mahan, and others wrote and is

represented in the "principles of war" by the single word, "mass."[28] It is the bringing together of some element or combination of elements—numbers, firepower, mobility, position, etc.—such that an advantage is achieved.

This concentration, this massing, to accrue an advantage is the governing factor at the strategic and tactical levels of warfare in the mediums. Its implementation is best summed up in the phrase "holding and hitting."[29] Holding and hitting means to hold or divert part of the opponent so that one can achieve an advantage against the part that is the object of the "hit." Except for simple toe-to-toe slugging matches, holding and hitting is the essence of nearly every basic maneuver of forces, regardless of the medium.[30] The tactical maneuvers associated with land warfare best illustrate the concept for all mediums.

For example, for the maneuver of penetration of the center, holding attacks pin the flanks of the enemy while the main attack develops in the center. For the single and double envelopment, the enemy is held to the front while the main force attacks from the side, and/or rear. For the attack in oblique order, the center and one flank of the opponent are held while the weight of the assault falls on the opposite flank. In the feigned withdrawal, the center portion of the feigning force falls back more rapidly than the wings and then holds while the wings switch to an enveloping attack.

Historical examples of the application of the variations of holding and hitting are manifold. Two of David Chandler's books, *The Art of Warfare on Land* and *Atlas of Military Strategy* are rich with such examples for conventional warfare on land. Leuctra, previously mentioned, is an illustration of the attack in oblique order.

A few examples from sea and air warfare will indicate the universality of "holding and hitting." At Trafalgar, Nelson's feint toward the allied van was successful in holding it out of action while his two columns developed their attack in oblique order on the center and rear. At the Battle of Empress Augusta Bay in the Pacific in 1943, an American force of cruisers and destroyers met a similar Japanese force. The Japanese approach was in a flexible formation of three columns. The American plan of action was to cap the Japanese "T" with a center-holding force of cruisers while the destroyers were detached in a double envelopment of the Japanese flanks. As the engagement actually unfolded, the Americans were only successful in executing a single envelopment.[31]

In the air, a standard holding and hitting tactic is for a portion of the interception force to take on the escorting fighters to hold them out of the action while the remainder of the interceptors hit the attack force. To be successful, this tactic requires either superior numbers or interceptors qualitatively superior to the escorts. Another hold and hit tactic is for an attack force to conduct diversionary attacks against the intercepting force's bases in conjunction with the main assault against the principal objective.

When timed properly, this combination of a main thrust and diversionary holding attacks resembles a penetration of the center or an attack in oblique order.

On the strategic plane, holding and hitting is an obvious necessity when a nation is confronted with a two-front war and has only a one-front capacity. Thus, the Germans in 1914 planned to hold in the east while hitting in the west; the Americans and British in WWII agreed on the "Europe first" strategy; and the Israeli's, on the defense early in the 1973 Yom Kippur War, decided to hit the Syrians first while holding the Egyptians.

Holding and hitting on the defensive is premised on the two basic elements of defense—depth and reserves.[32] Depth provides resiliency (holding) and buys time to react. Reserves provide the reaction (hitting).

Reserves, of course, are not solely the preserve of the defense. They are just as useful on the offense. Reserves, in offense or defense, are forces initially held back from the battle for two fundamental purposes: (1) to exploit opportunities or (2) to prevent disaster.[33] The use in modern times of battlefield reserves is most common on land, less so in the air, and the least on the sea. At sea, the use of the battlefield reserve, quite frequent during the Age of the Galley, has become distinctly less so, although, Nelson at Trafalgar *planned* to use a reserve and both the Japanese and the Americans at Midway held back part of their strike aircraft while waiting for the situation to clarify. Also, fast battleships accompanying carriers in WWII served not only as defensive antiaircraft batteries but also as offensive reserves to exploit the opportunity to mop up the enemy fleet following the carrier airstrikes. Such was Yamamoto's intent at Midway and Halsey's at Leyte.[34] Nevertheless, the tendency in modern naval engagements has been to commit to battle all one's forces present. For whatever reason, this is a loss in flexibility. In space, the use of a battlefield reserve will probably parallel that of the air.

Defense-in-depth is nothing more than successive layers. We are already beginning to see application of the concept in space with regard to ballistic missile defense. At present, the aim is to counter the ballistic missile in each phase of its flight—boost, post-boost, mid-course, and terminal.[35] At a more mundane level, the consecutive rows of trenches in WWI and the sequential rings of the Japanese island outposts are examples of defense-in-depth on a grand scale.[36] On a lesser scale, the concentric bands of firepower of interceptors, surface-to-air missiles, and point-defense systems which surround the carrier battle group is illustrative of a present-day defense-in-depth arrangement. An earlier application of the concept is to be found in the Vauban fort with its successive lines of walls, ditches, and firing bastions.[37]

Fortifications, whether permanent or temporary and regardless of the medium in which they are located, serve both the defense and offense. They are at once places to fight *in* and places to fight *from*. This will be as true tomorrow in space as it was for the campaigning Roman who nightly

constructed a fortified camp.[38] Without control of the intervening medium, however, fortified places are susceptible to being isolated and overrun or bypassed. It happened to Vauban's forts, to Japanese island bases in WWII, to fortified villages in Vietnam, and it will happen to outposts in space.[39]

Choices to plug the medium gaps between posts are a physical plug, and/or a maneuver plug. A physical plug is a continuous, tangible line between strong points and so far has only been applicable to land warfare. The Great Wall of China, Hadrian's Wall, the trench system of WWI, the Maginot and Siegfried Lines, and the present-day Moroccan berm are examples. Maneuver plugs are mobile forces—either sallying forth from a strong point as an inherent part of the physical plug, or they can be a separate force advancing from some centralized location behind the line of strong points. The Japanese employed this latter method in WWII. They employed their fleet as a central reserve to aid the threatened sector in their rings of fortified island outposts. The interplay of a fortified post under attack, the rescuing Japanese fleet, and the attacking American fleet is characteristic of a siege on land.[40]

The inclusive elements of sieges in any medium are:

(1) a single entity objective—a fortified place or the contents of the place,
(2) a besieged force in the place,
(3) a besieging force,
(4) an external relief force coming to the aid of the besieged force,
(5) a distinct covering force supporting the besieging force, and
(6) duration.[41]

When elements (4) and (5) are absent, sieges take on the nature of a blockade. All military operations have duration, but sieges are lengthy undertakings. In the 17th century, besiegers planned for a minimum of 48 days to capitulation for a decently fortified place manned by staunch defenders.[42] However, the Siege of Lille in 1708 took 120 days. Guadalcanal took 6 months.

Other examples of maritime sieges in the Pacific in WWII include Midway (a siege operation in everything but duration), Bougainville, Saipan, and Leyte. At Midway, there was little contact between the besieging force (the Japanese amphibious task force) and the besieged force (the Americans on Midway). The main contest took place between the covering force (the Japanese carriers) and the relief force (the American carriers). Because the American relief force soundly defeated the Japanese covering force and thereby threatened the besieging force, the Japanese broke off the siege before it got started.

Amphibious operations in the Pacific generally had as their primary objective a place—somewhere to put a landing strip—rather than the forces occupying the place. Midway, Saipan, and Leyte had both place and force as their objective, but the targeted force was not the besieged force but the relief force. At Midway, the primary objective was the American relief force; at Saipan, the place; and at Leyte, it was not clear which objective had priority.[43]

Midway, with its primary objective of the relief force, is an excellent illustration of the bait and trap technique. One attacks a valued possession of the opponent and then lays in wait in expectation of the arrival of the relief force. It is a common guerrilla tactic and will be as applicable to space as it has been to land, sea, and air.

The lessons of the maritime sieges in the Pacific are applicable to siege warfare in other mediums. One lesson, which is not unique to siege warfare, is the need for a clear statement and understanding of the objective. At Saipan, Spruance covered the beachhead—his primary task. At Leyte, Halsey uncovered the beachhead because it was not clear whether the primary object of the operation was a place (Leyte) or a force, the Japanese carriers.

The solutions to the three problems in the Pacific of how to free the besieger from dependence on rearward bases (afloat repair and provisioning), how to counter the land-based air on island outposts (carrier air), and how to assault those fortified outposts (amphibious task force) provide a lesson for warfare in space.[44] The great spatial combat zone of space, dotted with fortified outposts equipped with galactic fighters and attack craft, is analogous to the vastness of the Pacific with its fortified islands and land-based air. The solutions found for the Pacific will likely be those for space.

Another lesson is the need for specialization of function. Unless the besiegers have a superfluity of force, dual tasking of a single element to perform both the functions of the besieging force and the covering force can cause difficulties. At Midway, the Japanese carriers provided aircraft to strike Midway, and therefore were part of the besieging force; they simultaneously provided aircraft to attack the American carriers, thereby participating in the covering force, also. Aircraft from the American carriers caught the Japanese planes on deck as they were in the process of preparing for an attack on the American carriers following their earlier attack on Midway.[45] The Americans solved the specialization problem by building escort carriers for the besieging force and the larger battle carriers for the covering force.

A lesson of Guadalcanal is that failure to isolate the place under siege results in a very long campaign. In land sieges, lines of contravallation and circumvallation accomplish the isolation. At Guadalcanal, the American inability to secure local command of the sea around Guadalcanal enabled the Japanese to run resupply and reinforcement convoys to their beleaguered garrison and, in the end, to withdraw it.

Convoys in any medium are escorted and organized aggregates of cargo carriers whose principal purpose is the delivery of their cargoes. Convoys are usually cyclical. They repetitively travel from origin to destination, back to origin, and return to destination. They do not conduct sustained combat at the destination. This factor and their cyclical nature distinguishes convoys from other military formations which have their own peculiar loads for extended

expenditure at the battleline. The "bomber streams" of WWII, with their cargo of bombs, were convoys. They were not battle formations en route to sustained combat.[46] Cargo can be most anything: people, food, raw material, equipment, munitions. Carriers are just as varied and can be people, animals, wagons, trucks, ships, planes, spacecraft. The self-defense capability of the assembled cargo carriers, however, is usually less than the offensive strength of its attackers. Hence, protection of the convoy falls mainly on its escorts and supporting forces.

Protection of the convoy in the mediums is accomplished in two basic ways: destruction of the attacker, and/or keeping the attacker away from the convoy. Escorts and supporting forces perform both functions but with different emphasis.

Both the close escort and the distant escort (far-ranging skirmishers) tend to emphasize the engagement over the encounter. That is, they seek the destruction not just the neutralization of the attacker. Supporting forces on the other hand emphasize the encounter over the engagement, seeking neutralization vice destruction. This latter approach is neatly summed up in an aphorism pertaining to the sea, but it is applicable to all mediums: "Sea power is not sea control but harbor control."[47] If you can keep the enemy in his base, or at least away from that part of the medium you wish to control, you may not have to fight him. If he does sally forth, he will be fighting on your terms where you are strong and not on his where he is strong, in his base area. The clash of the German High Seas Fleet and the British Grand Fleet at Jutland is a prime example. It was a tactical victory for the Germans but also a strategic defeat. After the battle, the British distant blockade still held—the British still had the German fleet bottled up. The High Seas Fleet dared not sortie again, for it could not sustain the attrition ratio of a series of Jutlands.[48]

The British distant blockade of WWI and the battle of Jutland are illustrative of the Mahanian argument for control of the medium. Seek out the opposing force and neutralize or destroy it—blockade or battle. The Roman Vegetius and the Chinese Sun Tzu expressed a similar concept.[49] However, Douhet, the airpower theorist, argued that the destruction of the opposing force was the only way to accomplish control of the medium and attacking the enemy in his bases was the most effective method of destroying him.[50]

It may very well be necessary or even desirable to destroy the enemy in his base to maintain or gain control of some part of the medium. If so, the risk of the engagement is commensurate with the gain. However, the military planner must give careful consideration to the option to neutralize rather than to destroy. The Grand Fleet's distant blockade in WWI, its refrainment from attacking the German fleet in its strongly fortified base area, and its willingness to engage on the open sea provide an appropriate analogy for the US Navy *vis-à-vis* the Soviet Navy.

The neutralization and destruction arguments will accompany us into space just as will the question of "to convoy or not to convoy." However, history has repeatedly demonstrated that convoying in the mediums is the more prudent measure than not convoying. When the subject of galactic merchant convoys comes up, we will likely hear again the same arguments from the past for not convoying: economically infeasible, origin and destination points will be overloaded; convoys are too slow; craft proceeding independently are faster and safer; cargo carrier masters will not be able to keep station; combatants are needed for offensive operations and cannot be spared, and so forth.[51] In all likelihood, these arguments will be specious.

As the reference to convoying in space indicates, we need to heed the lessons of the past if we are to avoid errors in the future. Recognizing the commonality of conventional warfare in the medium provides the military observer with a valuable tool for doing just that, as well as for understanding warfare not only in his own specialty but in others as well. While each member of a service is expected to be an expert in his own field, he needs also to be able to recognize warfare's common characteristics so that he can apply the lessons learned from warfare in another medium to his own. In the present and future military man, there needs to be a lot of the forester in addition to the expert caretaker of one variety of tree.

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Ψ

"For a long era, happily past, our Navy had a cult of prejudice against the student officer. The academician was supposed to be irreconcilable with the well qualified seaman-fighter. The latter needed to be rather 'rough and ready' and above all practical, and these qualities were assumed to preclude intellectuality. The career of Jones will belie these theories. He bowed to none in seamanship, whether in gale, battle, or normal circumstances, and as a fighter was peerless—yet was an indefatigable student. In interludes between stirring events, he devoured all professional and many other books available to him—frequently by midnight oil or candle after a hard day's work.

"Moreover Jones constantly sought opportunities for professional study through observation. He was not content to be proficient merely as a single ship commander. He tried earnestly to acquire knowledge of fleet tactics and practices through experience as an observer in active fleet operations."

From a book review by Captain Dudley W. Knox, USN (Retired) of Lincoln Lorenz's *John Paul Jones: Fighting for Freedom and Glory*, US Naval Institute, 1943.