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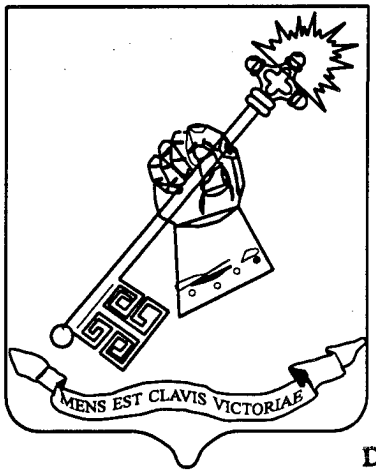
ABSTRACT

The purpose of this study is to explore and expand the concept of a line of operations and determine its relevance to operational art, and its application to campaign design. Currently, the concept of a line of operations is misunderstood and poorly defined. But it remains a relevant and enduring concept of great utility towards operational art and modern warfare. To better understand this enduring concept, this study will review the theory of a line of operations: the elements, application, characteristics, and principles. A line of operations has both a logistics and maneuver component. After exploring the concept of a line of operations, the author will present a new perspective derived from the concept of a line of operations: the vector of operations. This study will also discuss the concepts of interior and exterior lines of operations. The author will present new forms of lines of operations that provide one of the ways to achieve ones aims (effects) by coordinating vectors of operations in time and space relative to the enemy. This study will conclude with a section on the relevance and application of the concepts of lines of operations to campaign design.

ON LINES OF OPERATION: A FRAMEWORK FOR CAMPAIGN DESIGN

A Monograph
By
Major Charles W. Coxwell, Jr.
Infantry



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Fort Leavenwoth, Kansas

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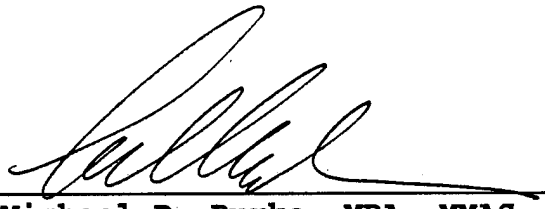

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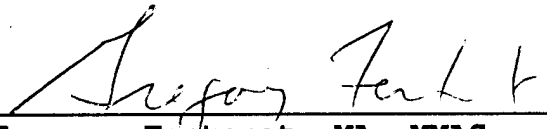

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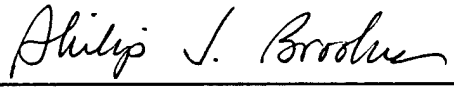

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ABSTRACT

The purpose of this study is to explore and expand the concept of a line of operations and determine its relevance to operational art, and its application to campaign design. Currently, the concept of a line of operations is misunderstood and poorly defined. But it remains a relevant and enduring concept of great utility towards operational art and modern warfare. To better understand this enduring concept, this study will review the theory of a line of operations: the elements, application, characteristics, and principles. A line of operations has both a logistics and maneuver component. After exploring the concept of a line of operations, the author will present a new perspective derived from the concept of a line of operations: the vector of operations. This study will also discuss the concepts of interior and exterior lines of operations. The author will present new forms of lines of operations that provide one of the ways to achieve ones aims (effects) by coordinating vectors of operations in time and space relative to the enemy. This study will conclude with a section on the relevance and application of the concepts of lines of operations to campaign design.

I. Introduction

The concept of a line of operations originated with Major General Henry Lloyd, a Welshman who served in the French, Prussian, Austrian, and Russian armies during the Seven Years War.[1] Lloyd was to Frederick the Great what Jomini was to Napoleon: a theorist with the exception that Lloyd was more critic than advocate of Frederick.

Trying to capture the essence of warfare in the Eighteenth Century, in particular the Seven Years War, in 1781 Lloyd wrote The History of the Late War in Germany, Between the King of Prussia, and the Empress of Germany and Her Allies. In volume two, later published as a separate book, Military Memoirs, Lloyd presented a treatise on the general principles of war. According to Lloyd:

> we have fixed and determined points to lodge our stores and provisions, from whence they are transported to the army, which must proceed from those given points to other fixed and determined points in the enemy's country, if you carry on an offensive war...The line that unites these points, on which every army must act is called The Lines of Operations; and of all those we have mentioned is the most important.[2]

Lloyd saw the line of operations as central to the conduct of strategy, "For on the good or bad choice of this line the final event of the war chiefly depends. If it is ill chosen all your successes, however, brilliant, will, in the end, be found useless."[3]

Lloyd's concept was very narrow and reflected the warfare of his time -- passive, logistics dependent, and defensive. In defining the constraints of his day, he wrote, "They [armies] cannot advance a hundred miles, and are continually turning about in a narrow circle of which the magazines are the center."[4] From the writings of Lloyd emerged classical strategy as encapsulated in the writings of Baron Henri Jomini, a student of Lloyd:

> The great art, then, of properly directing lines of operations is so to establish them in reference to the base and to the marches of the army as to seize the communications of the enemy without imperiling one's own, and is the most important and difficult problem in strategy.[5]

Baron Henri Jomini is the most famous writer on the concept of a line of operations. Chief of staff to Marshall Ney, Jomini documented Napoleon's strategic method in his work Treatise on Major Operations of the Seven Year's War which was praised by Napoleon who is reputed to have said, "he was one of the officers who understood best my system of war."[6]

Jomini derived his concept of a line of operations from Lloyd, but departed from the Welshman to develop the concept of lines of operations along more dynamic lines.[7] Jomini did not see a line of operations as simply a relationship between the army and its depots. He also saw lines of operations as embracing the "enterprises of the army" in its seizure of decisive points that controlled the enemy. This led him to compare the

relative advantages and disadvantages of one's own line of operations in time, space, and concentration with that of the enemy's. Through induction (observation and experience), Jomini developed the concepts of interior and exterior lines of operations. Although Jomini advanced his theory on lines of operations in 1830, no significant writings have since advanced the theory of a line of operations. The theory remains locked within the Jominian paradigms of interior and exterior lines.

The purpose of this study is to further explore and expand the concept of a line of operations and determine its relevance to operational art, and its application to campaign design. Currently, the concept of a line of operations is misunderstood and poorly defined. But it remains a relevant and enduring concept of great utility towards operational art and modern warfare.

To better understand this enduring concept, this study will review the theory of a line of operations: the elements, application, characteristics, and principles. A line of operations has both a logistics and maneuver component. This study will elaborate on the aspects and characteristics of each separately and on their significance to each other within the concept of a line of operations. After exploring the concept of a line of operations, the author will present a new perspective derived from the concept of a line of operations: the vector of operations. A concept that is based on physical

mechanics, not geometry, a vector of operations is fully dimensional and incorporates air and maritime operations rather than just two dimensional land operations. A vector of operations functions to synchronize combat operations resulting in a synergistic effect throughout the depth of the battlefield.

This study will also discuss the concepts of interior and exterior lines of operations. Jomini determined these concepts through his observation and experience. This inductive reasoning resulted in the presentation of an incomplete and narrowly confined relationship between time and space. The author will present new forms of lines of operations that provide one of the ways to achieve ones aims (effects) by coordinating vectors of operations in time and space relative to the enemy.

This study will conclude with a section on the relevance and application of the concepts of lines of operations to campaign design. The conceptual elements that comprise a line of operations provide the basis for the analysis of theater battlespace. These elements assist one in identifying potential vectors of operations. By applying the concept of a vector of operations, the linkage is established between the physical line of operations using an operational framework that synchronizes logistics operations, security operations, operational maneuver, and operational fires. These operations respectively move, sustain, and protect a concentration of

force, and orient and posture that force in a position of advantage to achieve its objectives through decisive combat operations. Finally, by combining vectors of operations in time and space, using the forms of lines of operations, one can synchronize and sequence operations to achieve operational objectives and strategic aims.

To better understand these concepts, the next section will provide an overview of general theory of a line of operations: elements, application, characteristics, and principles.

II. On Lines of Operations

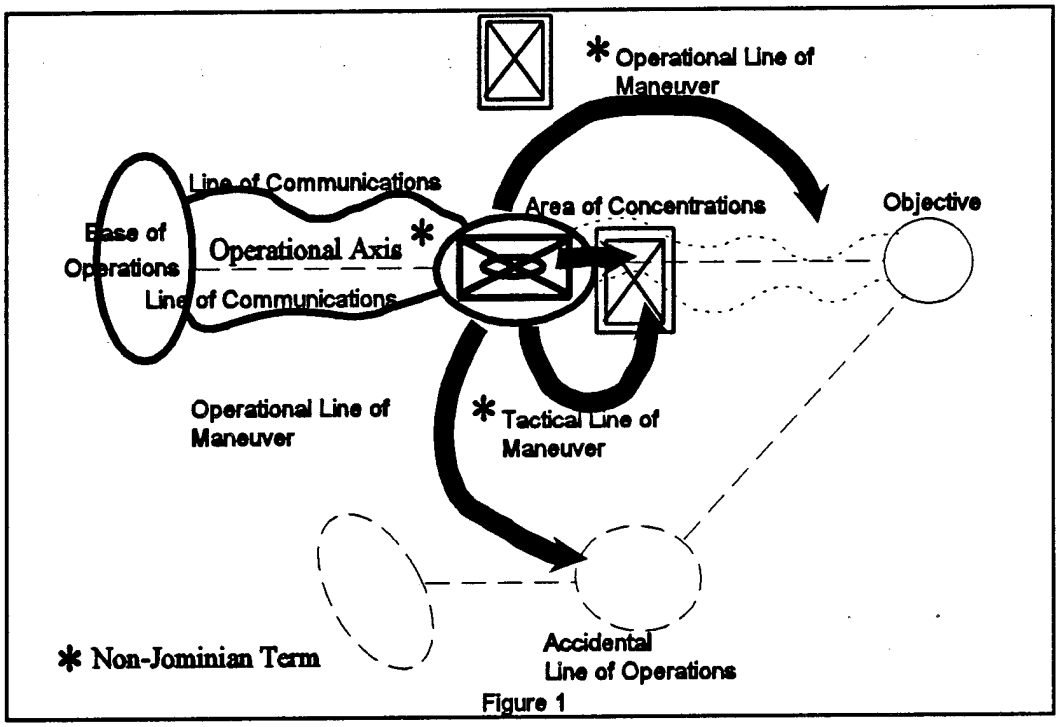


Figure 1

According to Jomini, a line of operations consists of a base of operations, lines of communication, an army with a front of operations, lines of maneuver, and objective points.[8] (Figure 1) To summarize:

- Jomini defines a base of operations as the area, "from which the army obtains its reinforcements and resources, from which it starts when it takes the offensive, to which it retreats when necessary, and by which it is supported when it takes positions to cover the country defensively."[9]

- The lines of communication "designate the practical routes between the different portions of the army occupying different positions throughout the zone of operations."[10] These are the routes over which the reinforcements and resources move between the army and the base. They are lateral and longitudinal.

- A front of operations is that portion of a strategic front upon which the masses of an army are positioned, and that contact with the enemy is likely -- an area of concentration.[11]

- Lines of maneuver are "those lines which the army would follow to reach a decisive point, or to accomplish an important maneuver which requires a temporary deviation from the principal line of operations."[12] Lines of maneuver are temporary and compliment the principal line of operation.

- Objective points are decisive points relevant to the plan of campaign.

Decisive points are "those which are capable of exercising a marked influence either upon the result of the campaign or upon a single enterprise." Objective points are force oriented or terrain oriented.[13]

Understanding the elements of a line of operations provides a basis from which to explore its application. A commander applies the concept of a line of operations to orient his force on operational objectives; he uses the concept to move and sustain a concentration of a force (logistics), and posture the force in a position of advantage (maneuver) to achieve his objectives through decisive combat operations. The commander generally directs these operations against the enemy's center of gravity.

The classical concept of a center of gravity is based on the principle of concentration. According to Clausewitz:

> A center of gravity is always found where the mass is concentrated most densely. It presents the most effective target for a blow; furthermore, the heaviest blow is that struck by the center of gravity. A major battle in a theater of operations is a collision between two centers of gravity; the more forces we can concentrate on our center of gravity, the more certain and massive the effect will be.[14]

A concentration of force is not to be confused with a massing of force. A massed force is highly focused but vulnerable and inflexible. Massing a force is generally conducive at the tactical level against a decisive point. On the other hand, a concentration is more agile and conducive to the

operational level of war. A concentration allows one to threaten several decisive points, and thus when threatened make the enemy conform to friendly movements -- initiative. Julian Corbett, maritime strategist, wrote that, "the maxim 'Keep your forces together' does not , however, necessarily mean keeping them all concentrated in mass, but rather keeping them so disposed that they can unite readily at will."[15] Napoleon referred to this as "assembly". It meant the placing of major units within march distance of each other, establishing mutual support.[16]

Clausewitz' center of gravity and Jomini's concept of a line of operations are commonly viewed today as mutually exclusive concepts. Actually, they are mutually inclusive concepts. Concentration is the common point for both. The essence of the classical concept of a center of gravity (*Schwerpuntk*) is superior concentration of force. The essence of a line of operations is to facilitate that concentration of force. Further, without logistics a concentration of force (center of gravity) can not occur, and without a positional advantage the *Schwerpunkt* can not be brought to bear decisively against the enemy. As Liddell Hart wrote in Strategy, "The principles of war, not merely one principle, can be condensed into a single word 'concentration'."[17]

The four characteristics associated with a line of operations are finite capacity, culmination with distance, offensive nature, and long term

duration.

The scale of forces which may be employed along a line of operations is directly proportional to the output of the base of operations. In addition, the capacity of the infrastructure of lines of communications to distribute that output also determines the scale of forces that can be employed. Therefore, logistics capability determines the size of the force that can operate along a line of operations. This characteristic is not new; it was characterized in the writings of Henri Lloyd. He wrote, "Numbers beyond a certain point, can add nothing to the force of an army, unless they can be made to act together; they increase its inactivity and render it altogether unmanageable."[18]

The scale of the forces operating along a line of operations is also inversely proportional to the length of the line of operations. Dr. Schneider, military theorist, suggests that the scale of forces is inversely proportional to the square of its length . In other words, the mass of the force diminishes over distance. The farther a force advances from its base the more transportation assets are required and the longer it takes to move its provisions. If the capability of the base is not expanded, or the lines of communications shortened (or both), fewer provisions will be delivered over a given period of time. With fewer provisions, only a smaller force can adequately be supported. In theory, the distance could become so great

as to eliminate the offensive capability of the force -- culmination. Lloyd wrote of this characteristic:

> ... though the convoy meet with no other difficulty, but such as arise from the length of the road, bad weather, accident etc...I am so convinced myself of this, that if you place twenty-thousand foot, and five-thousand horse, on any spot, so that they subsist only upon what is brought from one given point, a hundred miles off, they must in a week go and meet their convoy, disperse, or perish.[19]

Lines of operations are offensive in nature. The offensive characteristic is implied by Jomini's distinction between lines of defense and lines of operations. Lines of defense have a negative aim, whereas lines of operations have a positive aim.

The duration of a line of operations is long term. One can deduce the long term duration of a line of operations from Jomini's distinction between a line of operations and lines of maneuver. Lines of maneuver are temporary, whereas lines of operation exist until they end with victory or culmination.[20]

Eight principles can be culled from the writings of Frederick the Great, Lloyd, Napoleon, Jomini, and Moltke to guide the application of the concept of a line of operations to operational art. They are objective, unity of effort, maneuver, agility, concentration, continuity, anticipation, and security. The principles of unity of effort, agility, and concentration

directly reflect the fundamental principles of Joint Pub 1 Joint Warfare of the US Armed Forces, the capstone manual for joint warfare. The principles of anticipation and continuity are logistics characteristics from FM 100-5 Operations, the Army's capstone doctrine manual. The principles of objective, maneuver, and security are principles of war.

Objective

The end state of a line of operations is a decision. Lloyd wrote in his third principle on lines of operations, "That, it [line of operations] leads you to some decisive object, otherwise ten campaigns, however, fortunate, will give you nothing worth having."[21] This principle subordinates the tactical to the operational level of war in pursuit of a strategic objective.

Unity of Effort

A line of operation should have but one objective. Napoleon wrote in Maxim XII, "An army ought to have one line of operations. It should be preserved with care, and never abandoned but in the last extremity." According to David Chandler, military historian, when Napoleon stressed a single line of operations, he is not implying that all troops should use a single road; he is stating that the target must be clearly defined and every possible formation directed towards it -- unity of effort.[22]

Maneuver

An aim of a line of operations is to gain a positional advantage over the

enemy. Jomini's concept of decisive point focused on gaining a "marked advantage". Jomini expresses this in his maxim, "To throw by strategic movements the mass of an army, successively, upon the decisive points of a theater of war, and also upon the communications of the enemy as much as possible without compromising one's own."[23]

Agility

To gain a positional advantage over an enemy requires agility. Napoleon's Maxim XX suggests such agility, "An army which changes skillfully it lines of operations deceives the enemy, who becomes ignorant where to look for its rear, or upon what weak points it is assailable."[24] Jomini also wrote," Accidental lines are those brought about by events which change the original plan and give new direction to operations. These are of the highest importance. The proper occasions for their use are fully recognized only by a great and active mind."[25]

Concentration

The essence of a line of operation is to facilitate a concentration of force -- center of gravity (*Schwerpuntk*). The commander can not impose his will on an enemy without a superior concentration of force. Sustaining a concentration, however, is a difficult task. Moltke wrote about the difficulty of sustaining a large concentration, "Every close concentration of large masses is inherently a calamity"[26]

Continuity

To sustain a concentration of force requires continuity. Breaks in logistical support directly affect the combat power of the force. The effect of breaks can be minimized if they are anticipated. Through his concept of *centre d'operations* (mobile logistics trains) Napoleon would willingly sever his line of communications without disrupting the continuity of his support. He accomplished this by having enough provisions stored in reserve to sustain the force until the new line(s) of communications could be established to support his new line of operations.[27]

Anticipation

Anticipation allows one to set the tempo and seize the initiative. Initiative is born of anticipation. Anticipation also allows one to maintain continuity by preparing for the unexpected. Napoleon's *coup d'oeil* allowed him to anticipate events and prepare unexpected moves, as implied in his Maxim XX. Anticipation also supports agility by allowing a commander to gain time on an opponent.

Security

Lines of operations require protection of associated lines of communications. Frederick the Great wrote on his project of campaign for Bohemia, "After having chosen a point of attack it is necessary to consider the security of the depots and the country ...to cover the country in such a

manner that the convoys from the interior of Lower Silesia, which furnish and refill the depot at Schweidnitz, can arrive there in security."[28] Moltke wrote, "One will almost always be compelled to leave a strong detachment for the protection of the lines of communications, thus weakening the means for the attack following the envelopment."[29]

Through the review of the concept of a line of operations, the following postulation is presented to captures its essence: the concept of a line of operations assists a commander to orient a force on operational objectives; move and sustain a concentration of force, and posture the force in a position of advantage to achieve its objectives through decisive combat operations.

This definition was clearly envisioned by the Russian strategist G. A. Leer. According to military theorist General Aleksandr Svechin:

> Leer saw the line of operations fundamentally as an operation in terms of its goal and direction; the section of this line which had been covered represented the territorial routes linking an armed force to its base (line of communication), while the section of this line which had not been covered represented the idea and plan of the operation.[30]

Leer saw a line of operations as having two components: logistics and maneuver. The next two sections address each of those components.

III. On Lines of Communications

To move and sustain a major concentration of force requires operational logistics. Operational logistics focuses on force reception, infrastructure development, distribution, and the management of materiel, movements, personnel, and health services.[31] A line of operations has a logistics component made up of two elements: the base of operations and lines of communications. It is this portion of the line of operations that moves and sustains a concentration of force.

Logistics capabilities determine the feasibility of a concept of operations. Joint Pub 1 emphasizes that logistics sets the campaign's limits. The lead time needed to arrange logistics support and resolve logistical concerns require continuous integration of logistics considerations into the operational planning process.[32]

Operational concentration, operational maneuver, and the exploitation of success depend first on the adequacy of logistics(the base)and second, on the ability of the force to safeguard its critical lines of communications. The commander may wish to concentrate his force in a region that by its position appears decisive. Logistics, however, will determine whether or not this is feasible. This reality is captured in a quote by Rear Admiral Eccles, USN, in Joint Pub 1, "The essence of flexibility is in the mind of

the commander; the substance of flexibility is in logistics."[33]

Jomini defined a base of operations as "the portion of the country from which the army obtains its reinforcements and resources, from which it starts when it takes the offensive, to which it retreats when necessary, and by which it is supported when it takes position to cover the country defensively." Jomini defined lines of communications as "the practical routes between the different portions of the army occupying different positions throughout the zone of operations"[34]

The JCS Pub 1-02 Department of Defense Dictionary of Military and Associated Terms paraphrases Jomini on both definitions. A base of operations is an area or facility from which a military force begins its offensive operations, to which it falls back in case of reverse, and in which supply facilities are organized. Lines of communications are defined as all routes, land, air, and sea, which connect an operating military force with a base of operations, and along which supplies and military forces move.[35]

The capability of a base of operations is determined by its infrastructure. JCS Pub 1-02 defines infrastructure as all fixed and permanent installations, fabrications, or facilities for the support and control of military forces.[36] Infrastructure consists of ports, airfields, roads, railways, and storage facilities. Combat and supporting logistics activities rely on an underlying infrastructure system.[37]

The heart of any logistics system is the distribution system. The distribution system is complex of facilities, installations, equipment, methods and procedures designed to receive, store, maintain, issue, and move materiel to using activities and units. Lines of communications connect the critical points of this system. Both logistical and combat operations rely on an effective and efficient system. Effective and efficient distribution of logistics along lines of communications is critical.[38]

The infrastructure and distribution systems of the logistical component of a line of operations constrain the scale of the forces for combat operations and determine the tempo of their operations. Areas selected for the concentration of forces for major operations require sufficient road space and railheads to facilitate rapid assembly. Limited clearance capacities of ports and airfields and limited inland transportation networks substantially constrain the ability to concentrate forces and to sustain combat operations.

Depending on the geography of the theater, the availability of transportation assets, and the threat, air lines of communications (ALOC) and sea lines of communications may have to supplement ground lines of communications to overcome logistics shortfalls.[39]

The logistics characteristics of continuity and anticipation, and the principles of agility and security are critical to the success of a line of operations. FM 100-5 states that continuity of support is the lifeblood of

combat operations at all levels. A dependable and uninterrupted logistics system helps commander's seize and maintain the initiative.[40]

Anticipation allows the commander to seize and maintain the initiative. Opportunities on the battlefield are fleeting. Anticipation and preparation for unforeseen events save valuable time and allows one to act on these opportunities. Time is the most critical resource on the battlefield.

As has been pointed out, agility allows the commander to seize opportunity and set the tempo by quickly seizing the initiative. Logistics must be highly mobile and organized to maneuver. Ideally, the location of lines of operations allow shifts in operational direction without major adjustments to the sustaining effort. Shifts in lines of operations require corresponding changes in lines of communications. Such a change may also be necessary to compensate for damage to or an interruption of an existing line of communications.[41]

Depending on the capabilities of the enemy, the base and the lines of communications may be vulnerable to enemy action. Security operations are critical in safeguarding the continuity of logistics. Protecting lines of communications must be balanced with other operational commitments. One important tactical task is clearing enemy forces from the lines of communications in order to sustain the force and tempo of the operation. It may be necessary to conduct a major combat operation to secure the lines

of communications required to support later phases of the campaign.[42]

To summarize, a line of operations has a logistics component: a base of operations and lines of communications. It is this component that moves and sustains a concentration of force. Logistics determine the feasibility and set the limits of an operation. The infrastructure and distribution systems of the logistical component of a line of operations constrain the scale of the forces for combat operations and determines the tempo of their operations.

Having examined the logistics component of a line of operations, the following section will examine its maneuver component.

IV. On Lines of Maneuver

The other half of a line of operations is the maneuver component. The maneuver component consists of the area of concentration and lines of maneuver. Both posture the force in a position of advantage for decisive combat operations.

The area of concentration is where the forces assemble and prepare for operations.[43] The area generally allows dispersion; provides cover and camouflage; is beyond medium artillery range, and has a good transportation infrastructure. Deception operations mask its locations and

the activities of friendly forces in the area of concentration.

Jomini made the distinction, often overlooked, between a line of maneuver and a line of operations. According to Jomini:

> strategic (operational) lines of maneuver...differ essentially from lines of operations. The term strategic is also applied to all communications which lead by the most direct or advantageous route from one important point to another, as well as from the strategic front of the army to all of its objective points. It will be seen, then, that a theater of war is crossed by a multitude of such lines, but that at any given time those only which are concerned in the projected enterprise have any real importance. This renders plain the distinction between the general line of operations of a whole campaign, and these strategic (advantageous), which are temporary and change with the operations of the army.[44]

Jomini distinguished between a general line (the operational axis) that connects the base of operations and the objective points, and temporary lines that deviate from this line. The general line orients the force; the temporary lines provide the force a tactical maneuver advantage. This tactical advantage facilitates the advance along the general line (operational axis).

Lines of maneuver stem from the general line of operations. Jomini wrote,"It would have upon its zone a single line of operations, or, at most, a double concentric line, upon interior, or perhaps exterior, directions, which it would have successively perhaps twenty strategic lines as its enterprises were developed."[45] The general line is the operational axis along which the

line of operations is centered, and which the lines of communications must follow through to the objective in order to sustain the force. Obviously, this line is determined by the infrastructure between the base and the objective -- roads and railways.

Lines of maneuver, however, are not confined by infrastructure. Lines of maneuver stem from the area of concentration. They may use roads but are not bound to them. Lines of maneuver exploit terrain and mobility corridors in order to gain a positional advantage against the enemy. Lines of maneuver may abandon the lines of communications to gain a tactical advantage. How far and long a force can maneuver without a line of communication is dependent on its organic logistics capability and the tempo of operations.

For example, an armored division has an organic fuel storage capacity 1,031,300 gallons of fuel.[46] Assuming 12 hours of movement per 24 hours due to rest, maintenance, and refueling operations, and a movement rate of 10 km per hour cross country, the division could move 75 miles per day for two days on its organic fuel. Unable to move further and out of fuel, it would be critical that the lines of communications be reestablished by the end of the first day. This argues that the distance a division can prudently maneuver off its lines of operations is about 75 miles; the distance away being equal to the distance to get back.[47]

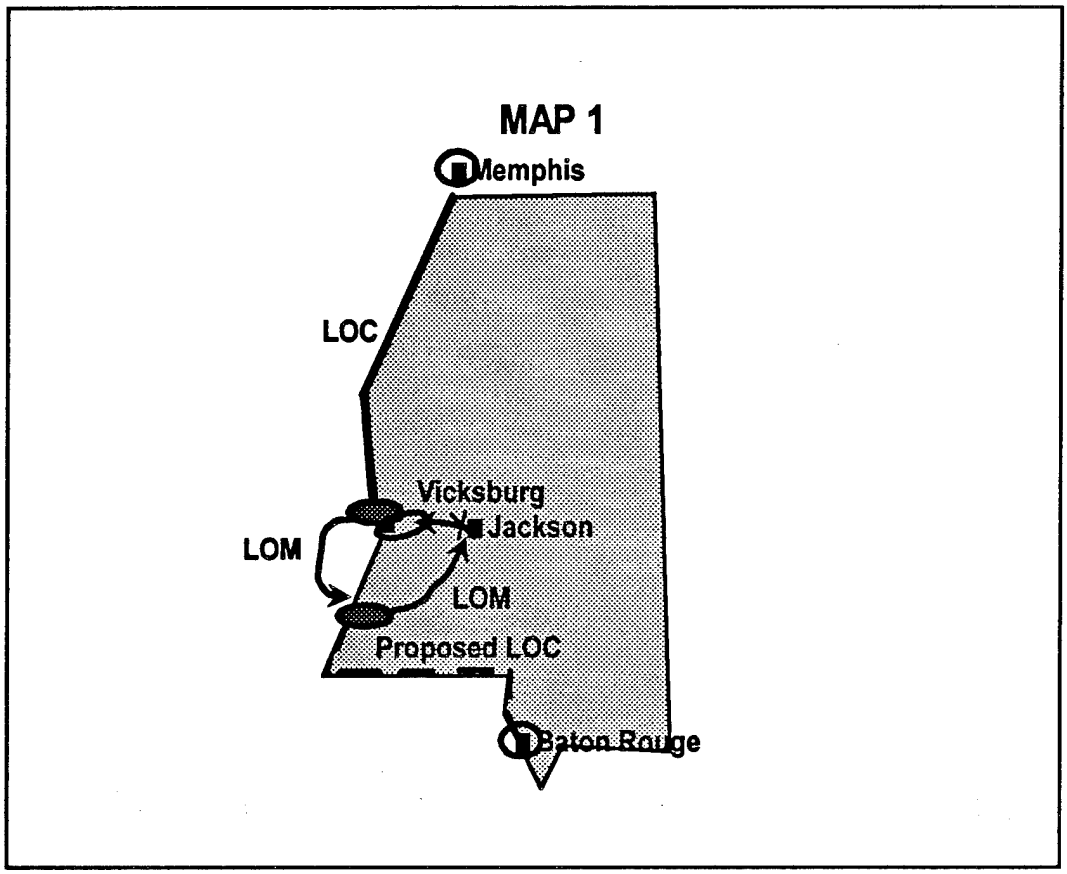
Although Jomini never made the distinction, one can distiguish two types of lines of maneuver: tactical and operational. Tactical lines of maneuver are oriented on enemy formations. Operational lines of maneuver are oriented on cutting the enemy's lines of communications and facilitating the establishment of new lines of operation. In force entry operations, operational lines of maneuver secure bases for the establishment of lines of operations.

Whereas tactical lines of operation facilitate destruction of enemy units, operational lines of maneuver are used to dislocate the enemy. When situations permit the combination of both tactical and operational lines of maneuver, the effects of destruction and dislocation result in the enemy's annihilation -- the *Kesselschlacht* in German military terms.[48]

Military forces are in a state of balance when their logistics support is aligned with their maneuver forces. The shorter and better protected the distance between a force and its base the faster it can be supplied and the easier it is to protect the lines of communications -- Lloyd's first maxim. This is analogous to a center of gravity in physical mechanics. An object with a low center of gravity is more stable than an object with a high center of gravity. Thus, a force with shorter lines of communications (lower center of gravity) is harder to dislocate than one with longer lines of communications. Liddell Hart wrote, "Able strategists have frequently

gained a decisive advantage previous to battle by menacing the enemy's line of retreat, the equilibrium of his disposition, of his local supplies.[49]

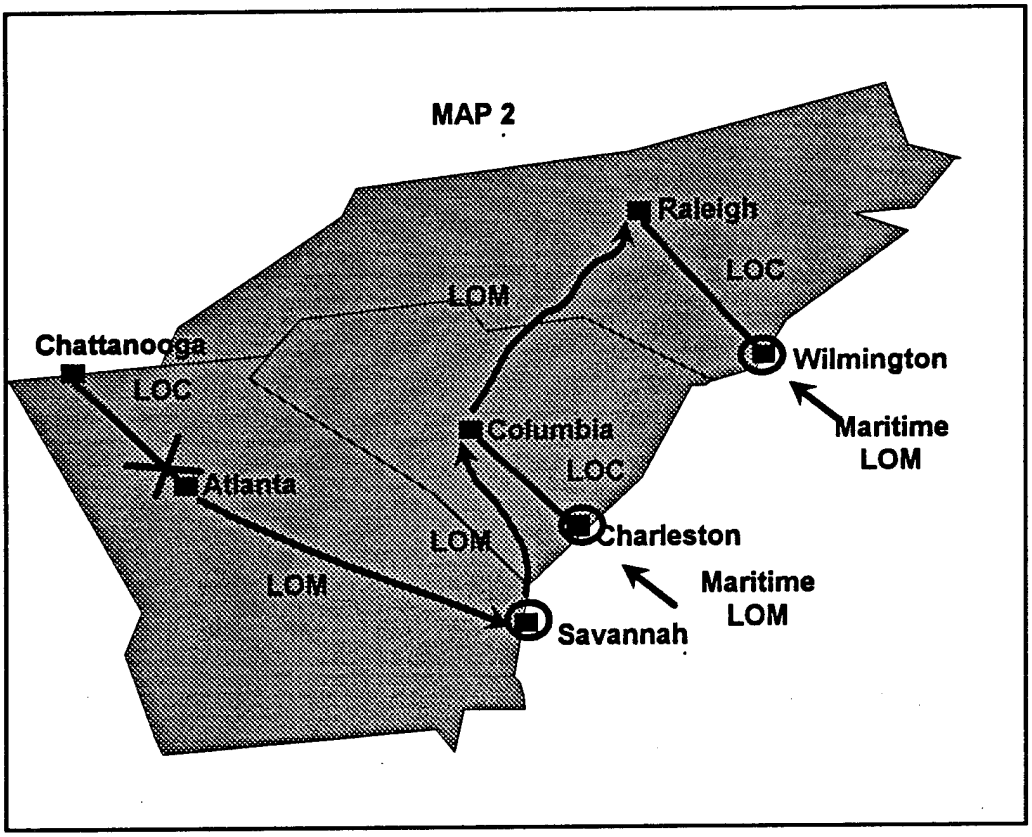
Interdiction is directed at severing the enemy's lines of communications and attacking enemy reinforcing units, indirectly and directly weakening the enemy's ability to sustain a fight. This does not imply that one can win without a fight. The enemy's ability to sustain a fight is inversely proportional to the intensity of the fight. If the intensity of the fight is high, his ability to sustain the fight against effective interdiction will be low. Where one cuts the enemy's lines of communications is also an important factor. Liddell Hart wrote, "In general, the nearer to the force that the cut is made, the more immediate the effect, the nearer to the base, the greater the effect."[50] Operational lines of maneuver also allow a commander to exploit an opportunity. Jomini identified these opportunities as accidental lines of operation. (Refer back to Figure 1) Accidental lines of operation were "...those brought about by events which change the original plan and give new direction to operations."[51] Operational lines of maneuver allow a commander to establish new lines of operations. As Napoleon points out in Maxim XX, Jomini affirms that such a change in lines of operations can be decisive. More important than Jomini, history provides striking examples of decisive accidental lines of operations. Historical operations such as Vicksburg, Sherman's March to the Sea, and Inchon provide ample evidence



of the potential generated by accidental lines of operations.

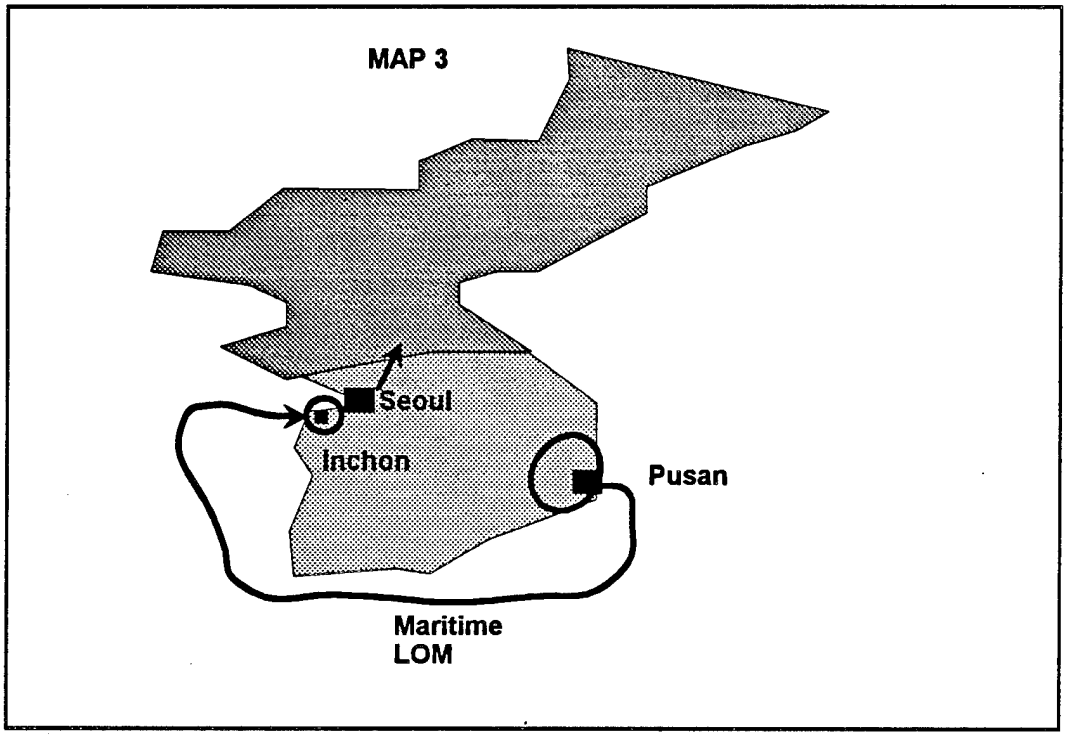
During the Vicksburg campaign, General Grant maneuvered down the west bank of the Mississippi river, marching fifty miles south to Bruinsburg where he recrossed to the east bank. His plan was to establish new lines of communications with Baton Rouge, but the enemy control of Port Hudson prevented this establishment. General Grant marched on to Jackson, Mississippi, cutting the Confederate line of communications, and in a series of battles besieged Vicksburg. At Vicksburg, General Grant reestablished

his north-south lines of communications, having maneuvered full circle. (Map 1)



During the march to the sea, General Sherman abandoned his lines of communications with Chattanooga and attacked using an operational line of maneuver from Atlanta to Savannah. At Savannah, he established new base of operations supported from the sea. General Sherman then continued to attack along new operational lines of maneuver, seizing Columbia and Raleigh. To logistically support his maneuver, additional bases along the Atlantic seaboard were successively seized and lines of communications

were advanced inland to Sherman's army. (Map 2)



During the Inchon operation, General MacArthur withdrew forces out of the hard-pressed Pusan perimeter, and by using a maritime line of maneuver, turned the North Korean army by conducting an amphibious assault at Inchon. This established a new line of operation that cut the North Korean lines of communications and forced them to abandon their offensive. (Map 3)

Although risk is inherent to maneuver, lines of maneuver should not be so reckless as to make the line of operations catastrophically vulnerable to enemy action. Jomini wrote, "It is important generally, in the selection of these temporary strategic lines, not to leave the line of operations exposed

to the assaults of the enemy."[52]

To summarize, the maneuver component consists of the area of concentration and lines of maneuver. Both posture the force in a position of advantage for decisive maneuver. The area of concentration is where the forces assemble and prepare for operations. Lines of maneuver are temporary, exploit terrain to gain a positional advantage against the enemy. Lines of maneuver may abandon the lines of communications to gain a tactical advantage dependent on the unit's organic logistics capability. Tactical lines of maneuver are oriented on enemy formations. Operational lines of maneuver are oriented on cutting the enemy's lines of communications (interdiction), and establishing new lines of operations through operational maneuver.

Having reviewed the theory of a line of operations and its components, the next section will attempt to expand the theory of a line of operations from its Nineteenth Century past into the present.

V. Expanding the Theory

A New Perspective

A line of operations in Jomini's day was based on a two-dimensional geometrical relationship between its objective and its base. Warfare today,

however, is fully dimensional. From the concept of a line of operations, one can derive a new concept: the vector of operations.

The concept of a vector of operations is based on physical mechanics and is applicable to fully dimensional operations. The Webster's Dictionary defines a vector as, "a quantity that has magnitude, direction, and sense and that is commonly represented by a directed line segment whose length represents the magnitude and whose orientation in space represents the direction."[53] One can readily adapt a line of operations to this definition. The magnitude reflects the combat power moved and sustained; the direction orients the combat power on objective points and through this direction postures the force in a position of advantage, and the sense reflects the purpose of the operation (aim).

One can draw an analogy to a vector of operations by using the elements of a line of operations and physical mechanics. The concentration of a force (center of gravity) has the physical property of mass. Mass in a state of rest has inertia. Force provides motion and overcomes inertia resulting in momentum. Momentum is sustained further along the path of least resistance. As the mass slows to a rest, more force is required to continue its momentum. In addition, if the mass is acted on from an outside force it will change direction.

Similarly, the logistics support along the lines of communications

provides the means that initiates and sustains the motion of the concentrated force (mass) and thus gives it momentum. Security forces prevent outside forces from altering the direction of motion. The lines of maneuver guide the force over the path of least resistance (mechanical advantage). As attrition and resistance reduce the momentum by reducing the mass of the force and slowing its motion, logistics support restores the mass and motion of the force, thus sustaining its momentum. This process of restoring and sustaining the momentum of a force sets the tempo of an operation. By applying the concept of a vector of operations to combat operations, one can envision a literal line of operations: logistics operations, security operations, operational maneuver, and operational fires. (Figure 2) Each of these operations require an apportionment and allocation of forces and means, and each has a unique mission. These operations are synchronized to move, sustain, and protect a concentration of force, and orient and posture that force in a position of advantage to achieve its objectives through decisive combat operations. The integration and synchronization of these distinct operations combine to create a synergistic effect that overwhelms the enemy in depth. Since vectors can be applied fully dimensionally, they are also relevant air and maritime (surface and subsurface) operations.

When Jomini wrote his Precis de l'art de la Guerre, man had not

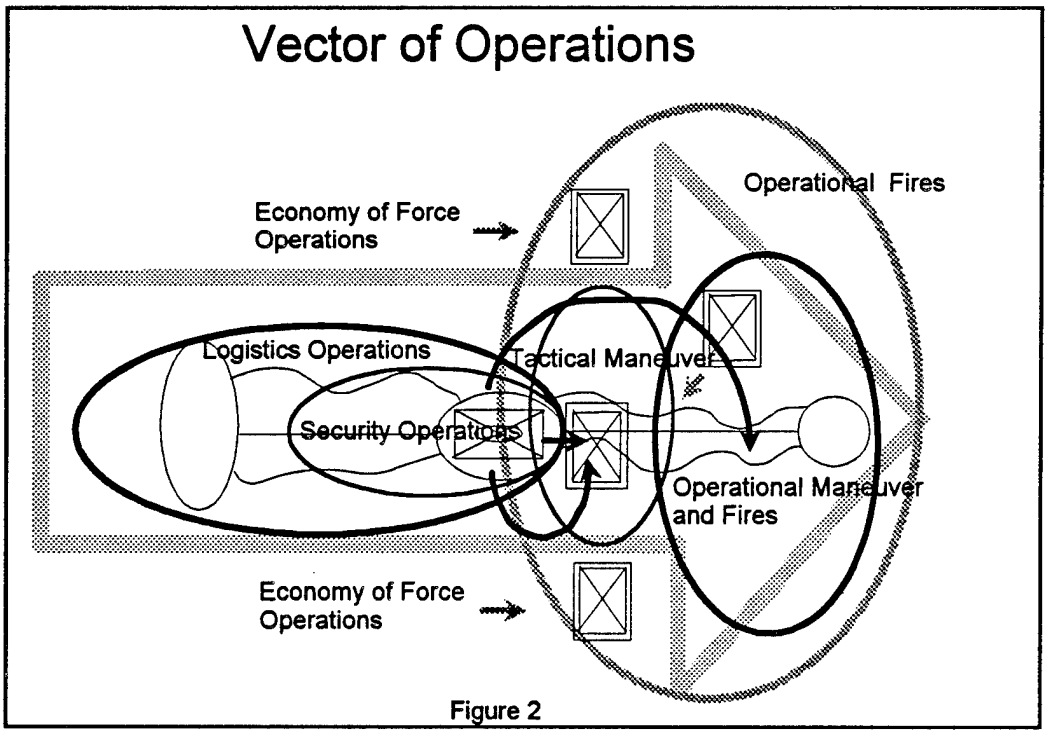


Figure 2

conquered flight and he navigated the oceans powered by the wind. Armies and navies generally operated in a state of mutual exclusion. The concept of lines of operations was only applied to the land warfare. The concept, however, is readily adaptable to the air and sea medium with slight variations and interpretation. Given the premise that armies and navies concentrate combat power against an opponent and that both are sustained by bases, one can draw the conclusion that they too function along lines of operation.

An air line of operations has a base on which its aircraft are concentrated. It has no separate area of concentration. An air line of operations has a zone of communications and a zone of maneuver instead of

lines of communications and maneuver. The "zone" reflects the lesser impact of terrain on air operations than is the case with land operations. Dependent on altitude and enemy surveillance capabilities, terrain does restrict flight routes. The zone of maneuver stems directly from the base (area of concentration) to the objective. The zone of communications extends into the zone of maneuver to provide support to the aircraft, e.g. aerial refueling. (Figure 3-1)

A maritime line of operations has a similar structure to that of a land line of operations, except that a maritime line of operations has a zone of communications and a zone of maneuver. Again this reflects the lesser impact of terrain. Littoral areas, depth, and subterranean features do restrict navigation. At times maritime zones may become a lines, especially when navigating through canals and straits. (Figure 3-2)

Having established that the concept of a line of operations is applicable to air and maritime forces, the concept of a vector of operations is equally applicable. In both air and maritime operations: logistics, security, maneuver, and fire support operations must be integrated to apply effective combat power against the enemy. For example, to strike a target, strike aircraft are supported by aerial refueling (logistics), combat air patrols (force protection), and SEAD (interdiction fires).

Today joint operations combine land, air, and maritime forces against the

NAVAL AND AIR LINES OF OPERATIONS Figure 3

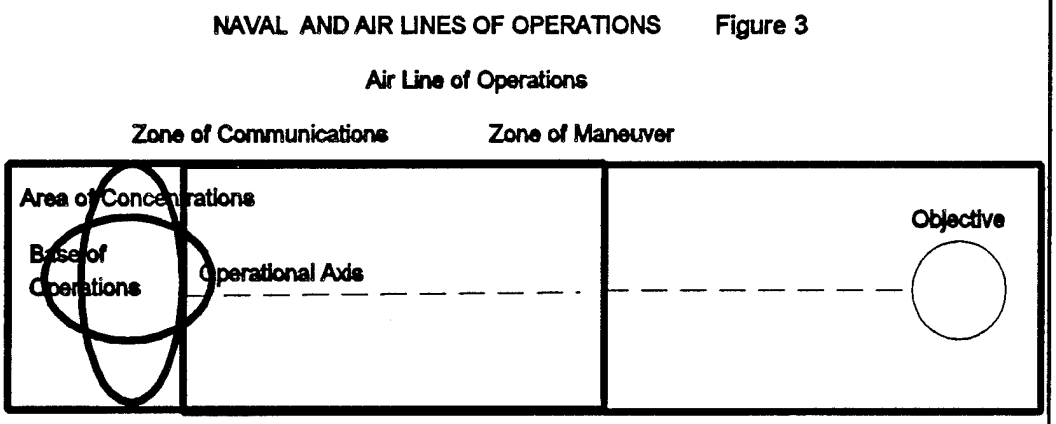


Figure 3-1

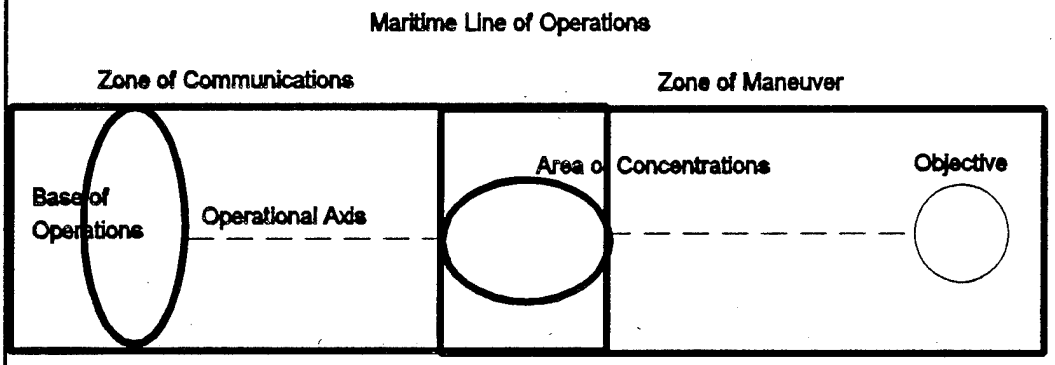


Figure 3-2

enemy's center of gravity. These combinations are the basis for joint operational maneuver and fires. The joint application of fully dimensional land, air, and maritime vectors of operations combine synergistically to overwhelm the enemy in tempo and depth, securing the initiative and sustaining the momentum of the operations.

Having expanded the theory of a line of operations into the present, the next section will examine Jomini's concepts of interior and exterior lines to determine their validity and relevance to the present.

VI. On Interior and Exterior Lines

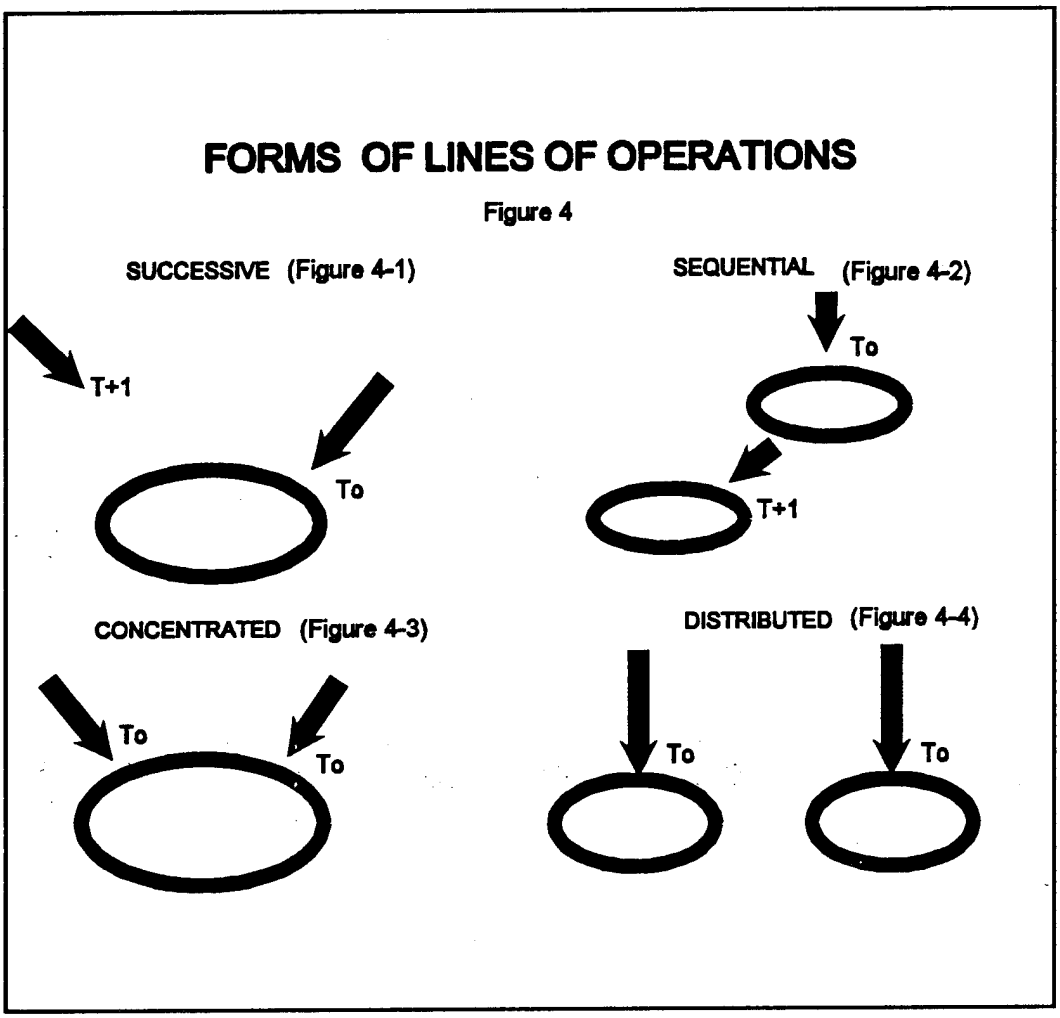
Jomini's introduction of the concepts of interior and exterior lines was a major departure from the static concept of Lloyd, who saw a line of operations as a simple line connecting the army with the depot. Jomini, by contrast, saw a line of operations as embracing the enterprises of the army in its seizure of decisive points that controlled the enemy. This led him to compare the relative advantages and disadvantages of the friendly line of operations in time, space, and concentration (mass) with that of the enemy. From inductive logic emerged the concepts of interior and exterior lines of operations.

Jomini's dynamic approach provided a model linking operational movements to battles. The experience of the Napoleonic Wars convinced Jomini that interior lines were the superior form. He concluded, "that simple and interior lines enable a general to bring into action, by strategic movements, upon the important point, a stronger force than the enemy."[54] The rare victory on exterior lines, for example, Leipzig, made little impression on Jomini. Captured by his own experience, Jomini developed these concepts through induction. Had he tested his premises through deduction, he would have concluded that his concepts were incomplete and too narrowly confined.

To compare the opposing lines of operations, one must focus on the dynamic relationship between space, mass, and time. These are the same dynamic factors that Clausewitz uses to define the theater of operations, the army, and the campaign in Chapter Two, Book Five of On War. Both of Jomini's concepts start from a position of strength. With interior lines of operations, the weaker belligerent exploits a temporary position of strength by defeating the stronger opponent in detail over time, but before the stronger opponent can concentrate his superior strength. With exterior lines the stronger belligerent must dominate the weaker belligerent in both space and time.

The problem with Jomini's concepts were his choice of words. Interior and exterior imply form over substance. Both concepts reflected Jomini's observations and experience, and the geostrategic position of Napoleon on whom his work was based. If one selects words that reflect the substance and dynamics of the relationship between space, mass, and time, one can clearly determine four distinct forms of lines of operations.

Four variants exist between space, mass, and time: mass in space over time, mass in space in time, mass against over space over time, and mass over space in time. Four words aptly fit these relationships: successive,



concentrated, sequential, distributed. (Figure 4)

1. Successive lines of operations are lines that concentrate against the same space at different times.

This is not addressed by Jomini, but is historically supported by the Vicksburg Campaign (1863) and Inchon (1950). (Figure 4-1)

2. Sequential lines of operations are lines of operation that concentrate

against a series of spaces at different times. This reflects Jomini's concept of interior lines: Campaign of (1805), Ulm and Austerlitz. (Figure 4-2)

3. Concentrated lines of operations are lines of operation that concentrate against the same space at the same time. This reflects Jomini's concept of exterior lines: Leipzig (1813). (Figure 4-3)

4. Distributed lines of operations are lines of operation that concentrate against several spaces at the same time. This is not addressed by Jomini, but is historically supported by operations such as the Union Campaign of 1864. (Figure 4-4)

When one considers the opposing lines of operations using these forms any number of combinations can arise, each with their own advantages and disadvantages. Jomini tried to fix this relationship, and for this he was criticized. Each situation should be judged separately. These forms, however, give one a framework of reference from which to perceive the dynamics of mass, space and time. From this perception one can determine the advantages and disadvantages of a given situation.

The Pervasive Battlefield

As stated above, when Jomini introduced his concepts of interior and exterior lines, warfare was two dimensional on two mediums: land and sea. The relationship of lines of operations to each other and relative to the

enemy's was based on a two-dimensional geometric relationship between the dynamics of time and space. Today warfare is fully dimensional: length, width, altitude, depth; conducted through four mediums: land, sea, air, and space.

The exploitation of the aerospace has substantially changed the dynamics of opposing lines of operations. Whereas belligerents in the past opposed each other superficially in two dimensions; today they oppose each other pervasively in four dimensions. In fact, the pervasive exploitation of the air medium allows one to prevent the concentration of enemy forces -- counterconcentration. By counterconcentration, one means that an opponent is prevented from concentrating dispersed forces, or repositioning concentrated forces. Strategic attack and interdiction allow one to prevent the concentration of enemy forces setting the conditions to destroy him in detail with ones own concentration protected by air superiority. Deep battle theory and doctrine was born of necessity, but it nevertheless appears logical in the evolution of warfare.

Having explored and expanded the concepts of a line of operations, vector of operations, and the forms of lines of operations, the next section will address their application to campaign design.

VII. Application to Campaign Design

Joint Pub 5-00.1, Doctrine for Joint Campaign Planning, states that campaign design describes the military conditions that must be produced to achieve campaign objectives; the sequences of actions most likely to produce that condition; and how resources should be applied to accomplish that sequence of actions. During the planning process, the joint force commander (JFC) uses operational art, beginning with his assessment of the theater strategic situation. From this assessment and his strategic objectives, and using operational art, the JFC designs his campaign.[55]

Joint Pub 5-00.1 lists the elements of operational art to assist the JFC to apply operational art: center of gravity, lines of operation, culminating point, indirect approach, positioning advantage, deception, and concentration and risk.[56] In fact, lines of operations embraces every one of the other elements of operational art.

The essence of a line of operations is moving, sustaining, and posturing a concentrated force (center of gravity) -- *Schwerpuntk.* Logistics operations give this force momentum and work to prevent the force from culminating. In order to move in the direction of objective, the force moves along direct and indirect lines of maneuver that provide the force positional advantage. During the process of concentrating the force, deception operations attempt

to mask its location from the enemy and conceal from them the more vulnerable sectors conducting economy of force operations. Since risk is inherent to concentrating forces, the audacity of maneuver is carefully balanced with the vulnerability it presents to the line of operations.

Operational warfighting requires one to focus on greater distances and depths than just tactical zone of operations. The Soviets equated depth and distance with the levels of war. Currently, deep operations are planned to support the close (tactical) fight. Close operations, however, are not extended in depth to exploit the deep fight. Current doctrine describes maneuvering to combine the effects of fires, but warfare still requires one to conduct decisive ground maneuver in the two dimension to exploit the effects of fire -- Desert Storm.

The expanded concept of a vector of operations, and the four forms of lines of operations provide one effective tools to plan operations in depth. Just as in the defense, one cannot defend everywhere, so in the offensive one cannot attack everywhere. Seldom will the resources to conduct a frontal attack on an operational scale be available. Combat power must be concentrated to penetrate to great depth. The problem is one of a tendency to look at the trees and not through the woods. Being able to see through the woods is described in the survival manual as "jungle eye." Military theory speaks to it as *coup d'oeil.*

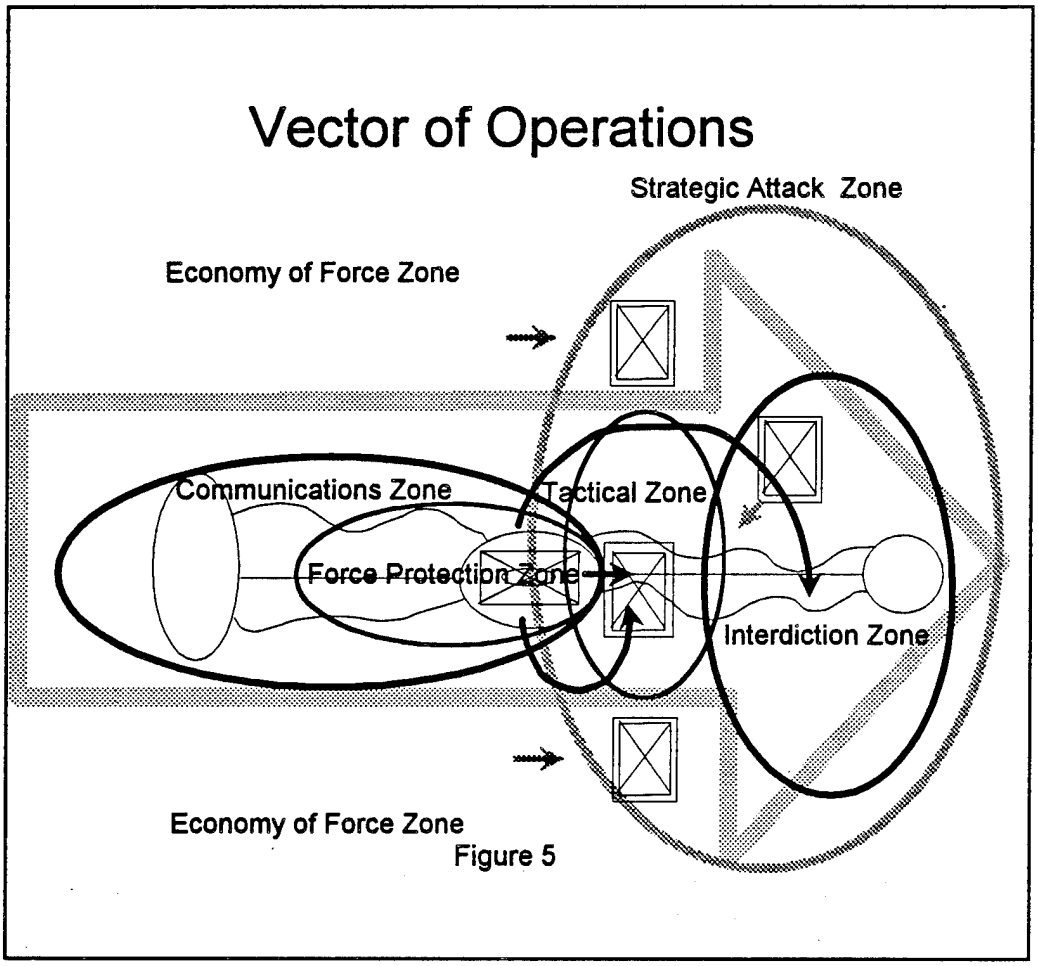


Figure 5

The elements that comprise a Jominian line of operations help one to focus and see through the theater battlespace -- *coup d'oeil*. The elements provide the planner an effective tool for the intelligence preparation of theater battlespace from which vectors of operations are constructed. By identifying and synthesizing the elements, one can determine feasible and suitable vectors of operations. These vectors of operations orient on the enemy's center of gravity, and the areas of battlespace that provide positional advantage against the enemy or allow one to control the enemy's

freedom of action. Having identified potential vectors of operations, the planner can plan operations using the operational framework inherent to a vector of operations.

The concept of a vector of operations with its literal line of operations provides one an operational framework for the synchronization of operations along a given operational axis. The operational framework consists of five zones: the communications zone, the force protection zone, the tactical zone, the interdiction zone, and the strategic attack zone. (Figure 5) The communications zone is that portion of the lines of communications free of enemy interdiction. The force protection zone is the portion of the lines of communications to include the area of concentration under the direct threat of enemy interdiction. The tactical zone focuses on combat operations against enemy forces along lines of maneuver. The interdiction zone is focused on cutting enemy lines of communications, isolating the battlefield. The strategic attack zone focuses on counterconcentration operations against the enemy.

Although separate operations are conducted in each zone, these zones are not fixed; they expand and contract with the situation. For example, the force protection zone expands into the tactical zone as enemy forces are bypassed. The tactical zone may extend into the interdiction zone during an exploitation phase. As stated above, the planner writes the concept of the

operation using the operational framework. It functions in the same manner as the battlefield framework is used for tactical concepts of operations: deep, security, close, rear, and reserve. The operational framework assists the planner to apportion, allocate, and apply resources in order to achieve operational objectives.

Having identified feasible and suitable vectors of operations, courses of action are developed that combine various vectors of operations. Combinations of vectors of operations are developed to produce the desired effects against enemy formations in key areas of theater battlespace. These effects were identified from mission analysis, the commander's intent, and the intelligence preparation of the theater battlespace. The forms of lines of operations provide the planner an effective tool for sequencing and synchronizing vectors of operations to achieve these aims. Combining these vectors of operation in time and space create synergistic effects.

The concept of a vector of operations, and the forms of lines of operations are effective tools one can apply to campaign design. Their application to the intelligence preparation of the battlespace, and course of action development allow the planner to effectively perceive the battlespace, synchronize combat operations, and produce synergistic effects that achieve operational objectives and strategic aims.

VIII. Conclusion

This study has examined the enduring concept of a line of operations in great depth. The concept is applied to orient a force on operational objectives; to move and sustain a concentration of force, and to posture the force in a position of advantage to achieve its objectives through decisive maneuver. Eight principles guide its application: objective, unity of effort, maneuver, agility, concentration, continuity, anticipation, and security. A line of operations has two components: logistics and maneuver.

Logistics capabilities set the limits of the campaign and determine the feasibility of an operation.

Operational maneuver with effective interdiction sets the conditions for decisive combat operations. Counterconcentration and the exploitation of accidental lines of operations through operational maneuver allow a commander to gain surprise and to destroy the enemy piece meal.

The expanded concept of a vector of operations is very adaptable to modern warfare and is an effective and relevant concept for application towards operational art, embracing all of the elements of operational art outlined in JCS Pub 500.1, Doctrine for Joint Campaign Planning. The author, however, recommends that the concepts of interior and exterior lines be removed from current doctrine. The concepts only present a partial

view of the dynamics between space, time, and concentration. The four forms presented in section seven are more useful: concentrated, successive, sequential, and distributed.

The elements comprising a Jominian line of operations provide an effective framework for the intelligence preparation of battlespace from which vectors of operations are constructed; the expanded concept of a vector of operations provides an operational framework for campaign design, and the four forms of lines of operations provide a commander and planner the means to synchronize and sequence joint operations in time and space. All provide the commander and planner effective tools for designing a campaign.

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