

*United States Marine Corps
School of Advanced Warfighting
Marine Corps University
2076 South Street
Marine Corps Combat Command Development Command
Quantico, Virginia 22134-5068*

FUTURE WAR PAPER

TITLE:

**The Fluidic Metaphor:
A View into the Nature and Future of War**

**SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF OPERATIONAL STUDIES**

AUTHOR:

Geoffrey F. Weiss
Major
U.S. Air Force

AY 07-08

Mentor: Dr. Wray Johnson

Approved:_____

Date:_____

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 2008		2. REPORT TYPE		3. DATES COVERED 00-00-2008 to 00-00-2008	
4. TITLE AND SUBTITLE The Fluidic Metaphor: A View into the Nature and Future of War				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) United States Marine Corps,Command and Staff College, School of Advanced Warfighting,Marine Corps University, 2076 South Street,Quantico ,VA,22134-5068				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 43	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

DISCLAIMER

**THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF
THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY
REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND
AND STAFF COLLEGE OR ANY OTHER GOVERNMENTAL AGENCY.
REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING
STATEMENT.**

Introduction

We see the world as increasingly more complex and chaotic because we use inadequate concepts to explain it. What has become the dominant language of our time produces only a partial understanding of our reality...not the whole of it. We need a holistic language...that will allow us to see through chaos and understand complexity.

- Jamshid Gharajedaghi, *Systems Thinking: Managing Chaos and Complexity*

What is war? Is war irregular or regular, conventional or unconventional, hybrid or guerrilla, positional or mobile, net-centric or generational, asymmetric or symmetric, or something else? The nature of war is obscured by labels and buzzwords concocted to describe its character. Adding to this complexity is the idea that war is ever-changing, driven by technology or tactical innovation in a globalized, non-linear world.¹ In the endeavor to understand war (past, present, and future), is there any way or even reason to intellectually embrace war's nature (what war *is*) or is it enough to focus on war's character (what war is *like*)?²

Many agree that, with respect to comprehending the nature of war, Carl von Clausewitz was preeminent; however, the oft-quoted Prussian, as Alan Beyerchen has said, is "too philosophical to appear practical" and has so thoroughly engaged war's complexity that even his most learned and articulate partisans often fail to agree about what *On War* really says.³ This inscrutability has resulted in an avoidance of reasoned consideration of both nature and character in examining war and especially in making conjecture regarding war's future.

Deducing the character of future war is often undertaken by studying history, identifying trends, and then combining that analysis with current circumstances to project likely future conditions. But this method can produce faulty conclusions because it does not include any contemplation of war's nature. Indeed, the character of war is something that only emerges fully

with comprehension and consideration of both the *nature of war* and the *circumstances of the times*, with future war adding the examination and analysis of history and trends to the formulation (See Figure 1).⁴ But how can one make sense of war's nature through the complexity? Is there a mental model and a language which can provide that insight?

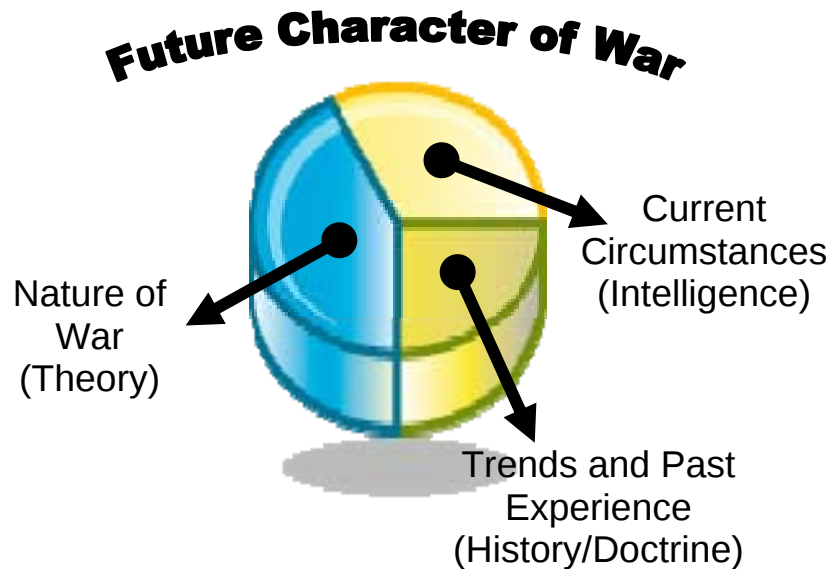


Figure 1. The Character of Future War

The great 20th century Austrian philosopher Ludwig Wittgenstein was deeply interested in the problem of how language fails so often to convey meaning in important cases.⁵ He believed that experience could “induce comprehension where it had previously not existed.”⁶ In cases such as war, where most have minimal or widely varying experience, understanding can be facilitated by metaphor which employs a commonly shared language to clarify complex or abstract subjects. Perhaps a physical metaphor, one based upon something as chaotic and complex as war itself, could be the key to grasping war's nature and character.

This paper introduces a comprehensive metaphorical theory for war based on the properties of fluids, a *fluidic metaphor*. This theory is intended to clarify the nature of war and to reconcile the seemingly disparate realms of regular and irregular warfare within a broad

“continuum” of war. Furthermore, it refines, redefines, and unifies many of the terms associated with war. After war is defined and the theory explained, it is discussed as a form of validation in comparison to various concepts of war, existing war theory, and historical case studies. Finally, the metaphor is applied to the practical matter of revealing the character of future war and how the U.S. should prepare for it.⁷

Defining War

Defining war concisely is a difficult proposition, especially in light of all the apparent variations of war. If one asked ten experts, there would no doubt be ten diverse answers. However, creating a useful metaphor for war without first defining the subject itself would cast doubt upon the entire effort.

The complexity of war entices metaphoric treatment. Clausewitz compared war to a duel, a wrestling match⁸, and a card game.⁹ War is a distinctly human phenomenon, a clash, an infernal dialogue of wills in the language of violence. While intellectually evocative, such metaphoric definitions are of little value here, for using metaphor to explain metaphor strains credibility. Therefore, in an honest attempt to capture war’s essence in words, war is defined here as *a conflict between two organized groups sustained by individual or collective will, characterized by combat, and where each side actively seeks to achieve a political outcome reflecting its considered interests.*¹⁰

This definition is constructed to be specific enough to rule out non-political, crime-related conflict, but broad enough to include, for example, non-state actors that seek to promote political outcomes through use of terror and violence. War must include combat to distinguish it from other forms of competition between opposing groups or states.¹¹

Figure 2 is a representation of the context of war, illustrated as an open system where all variables and inputs cannot be controlled by a given side. Each side seeks to influence the other with diplomacy, information, military, or economic instruments of power (DIME).¹² Opposing sides employ DIME to add “energy” to the system in an attempt to drive it to a desired end state.¹³ The combination of human and material assets used to do this are defined here as “forces.” External factors include other nations, the global economy, global media, international laws, treaties, and so forth. Internal factors include domestic politics, economy, media, religion, etc. The DIME emanating from each side is *intended* to influence the other; however, it is really more of a “radiation” that, while perhaps affecting the adversary, also affects the external and internal environment.¹⁴ It is this definition and concept of war that serves as the basis for development of the fluidic metaphor.

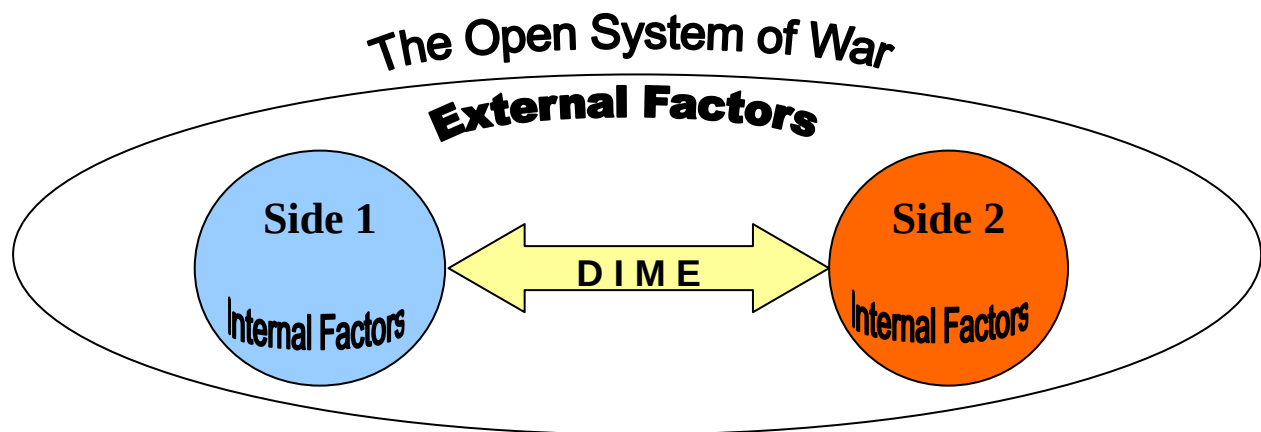


Figure 2. The Open System of War

The Fluidic Metaphor

...but suppose they were an influence, a thing invulnerable,
intangible, without front or back, drifting about like a gas?
- T.E. Lawrence

Much recent thinking on war, fueled by such vexing current events as the insurgency in Iraq and the war on terror has framed war's nature in very Clausewitzian terms, i.e., complex, non-linear, and chaotic. Clausewitz himself used the metaphor of the random motion of an object suspended between three magnets to represent this condition.¹⁵ A better metaphor for war would be based upon the characteristics of fluids.

Because humans think in pictures, not words, the aim of the fluidic metaphor (M_f) is to induce familiarity and greater understanding of war by framing war in a way that is easier to *visualize* and to introduce a common language for war derived from fluidic properties. All people are familiar with fluids, living as such at the bottom of a vast sea of fluid gas, the world itself two-thirds covered in fluid water. Certainly the dynamics and terminology of fluids describe nothing perfectly except for fluids. Yet there are many significant similarities between war and fluids. Like war, the behavior of fluids may be predicable in special cases and in others unpredictable, non-intuitive, and chaotic.¹⁶ Understanding fluids requires a holistic perspective and language. The M_f adapts this to war.

The association of war with fluids is not new.¹⁷ Frequently the term “fluid” is used to describe war. Military forces are characterized as “fluid” when they are flexible and adaptable to circumstances. T.E. Lawrence described his Arab guerrillas of WWI as forces that “added fluidity to speed...in a real sense maximum disorder was our equilibrium.”¹⁸ Mao Tse-tung's style of mobile war was known for its “flexibility and fluidity.” Mao himself described the “fluidity of guerrillaism [*sic*]” as difficult for Nationalist foes to counter with conventional force with such attempts causing “an extraordinary and immense fluidity,” i.e., the Long March.¹⁹ David Galula depicted the insurgent as “fluid” and the counterinsurgent as “rigid.”²⁰ He added that the insurgent can often refuse to accept a fight from the counterinsurgent “because of his

fluidity.”²¹ Indeed, military and scholarly minds, when characterizing war, often employ fluidic metaphor, but in limited ways usually addressing war’s character more than its nature.

Fluids—defined as substances that can flow (liquid or gas)²²—are mathematically represented by the non-linear Navier-Stokes (N-S) equation.²³ Except in special cases, e.g., incompressibility or zero viscosity, it is unsolvable.²⁴ Science treats a fluid as “an infinitely divisible substance, a *continuum*,” and the behavior of individual molecules cannot be accounted for mathematically due to the overwhelming complexity.²⁵ The M_f likewise characterizes war as a complex continuum that cannot be understood by decomposition and analysis of single combatants.²⁶ All types of war are part of the continuum.²⁷

War and fluid interactions are chaotic in addition to being complex. In both cases, complex interactions at the micro level can result in chaotic behavior where identical initial conditions yield widely differing outcomes. Indeed, modern chaos theory traces its origin to the effort to predict weather in the fluidic atmosphere.²⁸

Though complex and chaotic, fluids have macroscopic properties that are measurable. One example is viscosity, which is defined as the tendency of a fluid to have a cohesive consistency due to molecular attraction.²⁹ Highly viscous fluids like molasses flow slowly, while less viscous fluids like water or air flow easily. In a way analogous to conventional and unconventional war, viscous fluid properties are easier to describe and model than less viscous.³⁰

Two warring sides can be thought of as interacting fluids. While it may be impossible to determine the outcome or exact form of a war by examining individuals, examining macroscopic traits like viscosity can be revealing. The M_f adapts viscosity to the continuum of war.

Within the M_f , *war is understood as a continuum characterized by the viscosity of the opposing sides*. Viscosity in the M_f is defined as the extent to which the forces of a side are

cohesive, rely upon concentrated movement or actions, and are constrained by rules and conventions. Traditional, conventional forces such as a professional, disciplined army are termed “viscous.” By contrast, unconventional, dispersed forces such as guerrilla insurgents are “inviscous.”³¹

Viscosity in war is an *emergent* property that arises from the *characteristics of the conflict* and the *will of the participants* (see Figure 3).³² The characteristics of the conflict are defined by the *context* (physical/political/economic environment) and the *capacity* (quality and quantity of forces plus resources, *relative to the enemy*). The will of the participant or combatant fuels the desire to initiate or sustain war. A fluid, like any other thing, is put in motion (motivated) only if acted upon by an unbalanced force. Similarly, in war, the will exerts the force to motivate by acting with or against external forces and influences (from the enemy, for example) to create an imbalance, a desire for action to initiate political change by combat.³³

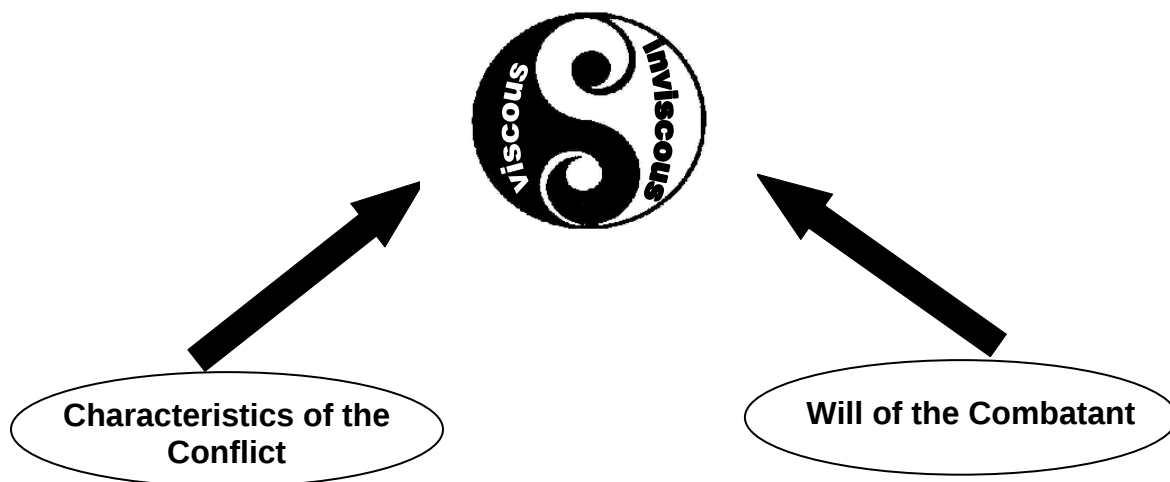


Figure 3. Emergent Viscosity.

In the continuum of war, there is no sharp dividing line between viscous and invisicous. Western tradition favors clear distinctions where shades of grey are undesired. But viscosity is more of an Eastern concept, like the yin and yang, an idea more harmonious with the nuances of

the natural world—within which, though chaotic and unpredictable, are to be found patterns and themes. In war, these patterns can appear as discontinuous “types” of war but are actually *natural manifestations* of war with differing viscosities.³⁴ There is no “good” or “bad” viscosity. Furthermore, viscous and inviscous forces have their own distinct strengths and weaknesses and neither is more normal or regular than the other.

In general, viscous forces conform to laws of war, prescriptive principles, doctrine, rules of engagement, international convention, and are highly organized. These conditions are the “glue” that binds the individual elements of the force together making it viscous. The strength of a viscous force lies in its ability to mass and sustain concentrated power in an organized way through the cohesion of its elements.

To impose will upon an enemy, it seems logical to mass as much power as possible given resource and political constraints and destroy the enemy’s desire and capacity to resist.³⁵ However, this type of force can be ineffective against an inviscous force. For example, Americans “naturally consider military predominance to be a major strength. But...there is an inherent weakness to it.”³⁶ That “inherent weakness” is vulnerability to inviscous forces. Before a viscous force, an inviscous force will part, retreat, and evade, flowing into any seam or gap.³⁷

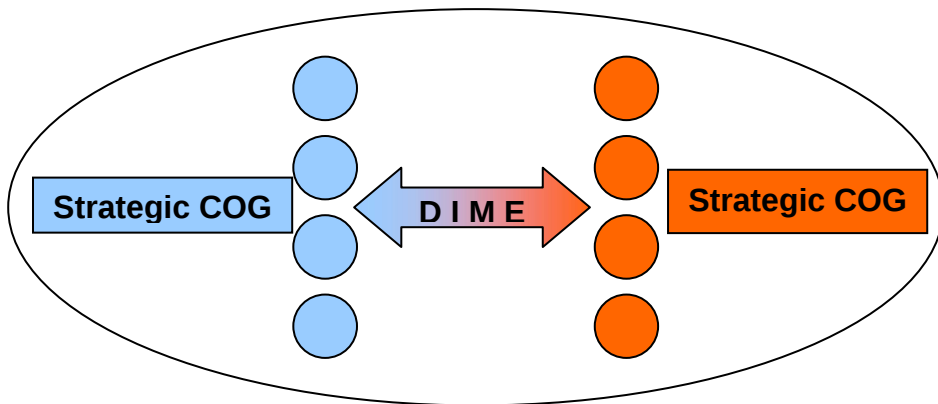
Inviscous forces are not powerful in the sense that viscous forces are; yet, they are survivable, flexible, and adaptable. They may reject adherence to strict doctrines, laws of warfare and civilization which are restrictive.³⁸ As Alan Beyerchen opined, “one’s opponent is not always playing by the same rules, and is often, in the effort to win, attempting to *change* what rules there are.”³⁹ T.E. Lawrence described his forces as “odd” with “no base machinery, no formal staff, no clerks, no government, no telegraphs...no honour, no conventions.”⁴⁰

But inviscous forces are *not* dissolute forces. They are bound in a common purpose through ideology or cause sustained by the will to fight, but may not require close coordination or command and control. Clausewitz contended that the weak can use “people’s war” against the strong provided the will and soul are there to sustain them.⁴¹ He went on to note that destruction of physical forces alone is often not enough when, in fact, the *moral* factor in war, such as that which motivates, inspires, and fuels the will, “is the most fluid element of all, and therefore spreads most easily to affect everything else.”⁴² Inviscous forces exploit their enemy’s adherence to conventions for their own gain.⁴³

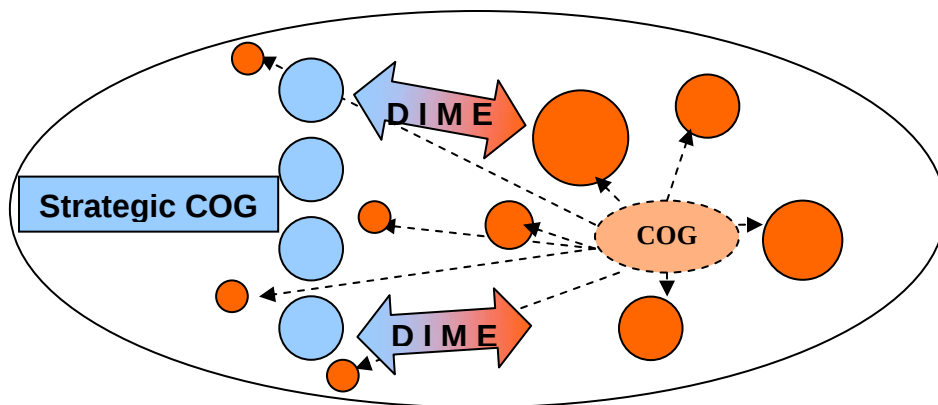
As a brief aside, there is an inherent inviscous quality to a retreating force. A viscous force that is routed may not have the capacity to reorganize and counter-attack; but if it maintains its collective will to continue the fight, it may survive to attack another day or in another way.⁴⁴

Now that the properties of viscosity are defined, force interactions within war’s continuum of viscosity can be classified in four basic forms; (1) viscous versus viscous (V-V); (2) viscous versus inviscous (V-I); (3) inviscous versus inviscous (I-I); and (4) hybrid, i.e., when at least one side employs both viscous and inviscous forces. Figure 4 is an abstract representation of the first three forms.

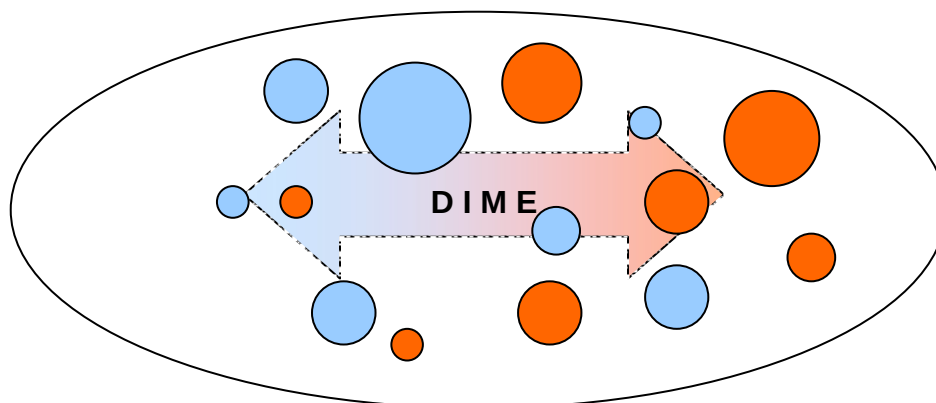
V-V interaction is the “hard science” of war where established theories of the likes of Fuller and Jomini best apply, i.e., applying force to destroy the enemy’s capacity and will to resist. The strategic center of gravity (COG) is the will that sustains a side’s war effort. This may be the will of the people or a leader, whoever has the power to continue or terminate the war. The end of V-V conflict (as in any war) is achieved when neither side desires to continue the fight—often determined militarily by such factors as numerical size, training, leadership, equipment/technology, strategic, operational, or tactical prowess, and proper application of



Viscous v. Viscous (V-V)



Viscous v. Inviscous (V-I)



Inviscous v. Inviscous (I-I)

Figure 4. Viscosity Interactions

various principles of war.

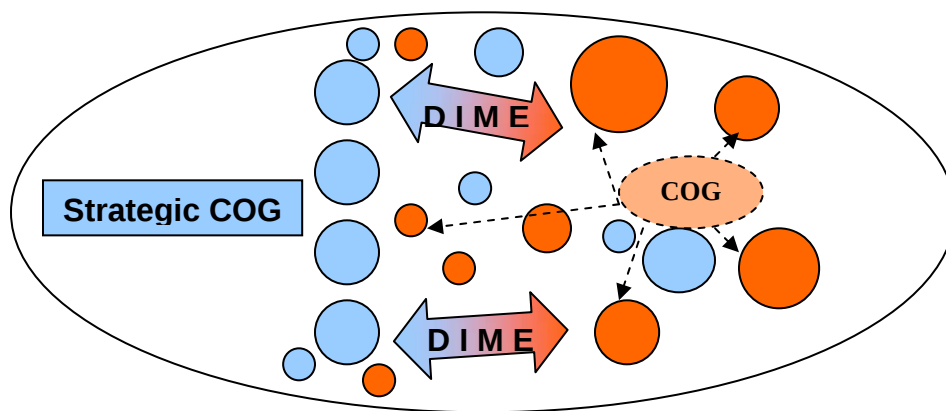
In V-I interaction, one side is not constrained by convention. Its forces may be less visible or cohesive. It may use guerrilla or terror tactics to influence the opposing side's military or strategic COG.⁴⁵ Like a fluid's, its own COG may be difficult to identify or affect.⁴⁶ The inviscous side's ability to sustain the will to fight depends upon the resonance and sustained viability of this COG within the group as well as the fighting forces themselves.⁴⁷ For example, the Vietnamese were motivated by communism and nationalism. Islamic terrorists rally around religion, whereas Afghans fighting the Soviets in the 1980s needed nothing more than the cause of throwing out the invader.

Viscous forces have difficulty countering inviscous forces because they are hard to pin down. Like a dispersed fluid, the inviscous forces can reposition, disappear, only to coalesce at a different time and place.⁴⁸ The strategy for a strong viscous force is to contain an inviscous force and get it to fight on viscous terms.⁴⁹ Of course, the viscosity of forces can change, sometimes unexpectedly, depending upon the circumstances and will of the warring sides.

Pure I-I conflict is somewhat of an abstraction because the transition to or adoption of an inviscous strategy is often a resort in the face of superior viscous forces. Inviscous forces may have a relatively large "surface area." Energy applied to an inviscous force by another inviscous force reaches more of that surface area than a pure viscous force can.⁵⁰ Clausewitz said of "people's war" (inviscous): "the greater the surface and the area of contact between [the resistance] and the enemy forces, the thinner the latter have to be spread, the greater the effect of a general uprising....[It] consumes the basic foundations of the enemy forces."⁵¹ Also, the energy may not be all military. Strategic communications, economic, and diplomatic efforts have the potential of altering the environment and COG of the inviscous side, perhaps containing

it by separating it from its sources of strength, supply, or inspiration. The I-I case may appear as a battle for “hearts and minds,” or information operations, for example. Viscous opponents often learn the hard way that the best manner to counter an inviscous force is with a like force, and this compels the viscous side to change to a “hybrid” state.

Within the M_f , “hybrid” is used to define the combination of viscous and inviscous forces within a side’s war effort.⁵² Figure 5 is an abstract representation of the interaction of a hybrid force and an inviscous force (H-I).⁵³



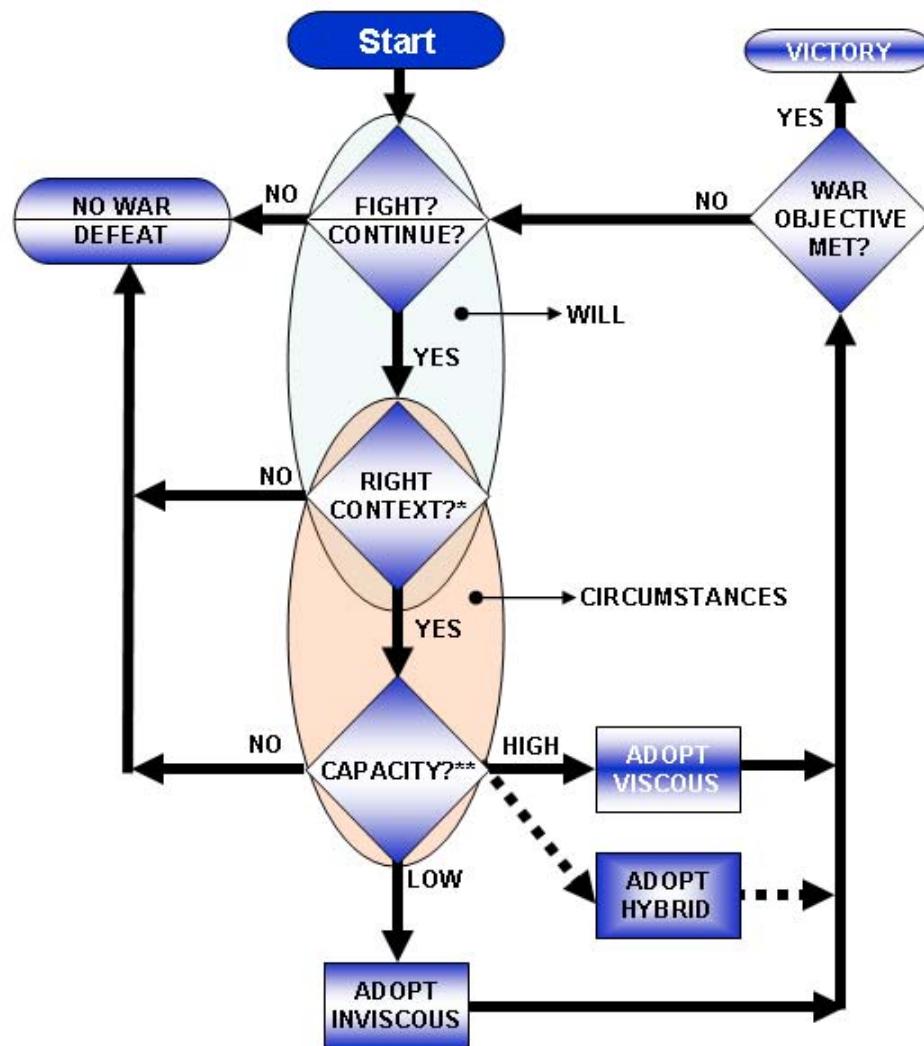
Hybrid v. Inviscous (H-I)

Figure 5. Hybrid Interaction

The hybrid force retains viscous capabilities but employs inviscous forces as well. A hybrid force, like a composite material, can have the strengths of both viscous and inviscous forces. However, a side that would field such a force effectively needs significant resources and the employment would require a degree of delicacy. Furthermore, inviscous forces by their nature are unconstrained and their activities can yield effects that are counterproductive to the strategic goals of the side which employs them.⁵⁴

Viscosity in war is not static. The initial state of viscosity and the transition from one state to another occurs by means of an act of will, informed by the circumstances of the conflict.

The War-Viscosity Algorithm



*CONTEXT = Physical / Political / Economic Environment

**CAPACITY = Military Forces + Resources *relative to the enemy*

Figure 6. The War-Viscosity Algorithm

Figure 6, the *war-viscosity algorithm*, illustrates how these factors figure into the decision making process of waging war and determining viscosity. As the war progresses, each side re-evaluates whether or not to continue the fight, with the interplay of will and circumstance affecting the viscosity of the forces employed. If a side lacks the will, proper context, or capacity to fight, then there is no war, or if the war has already begun, defeat. If the will and context are right but capacity is low relative to the enemy, then an inviscous strategy is likely. If the capacity is greater than the enemy's then a viscous strategy is likely, unless the war aims remain unmet in which case a decision to adopt a hybrid strategy might be made. Of course, human decision making in the full reality and complexity of war often yields decisions and outcomes that defy logic. In these cases, forces are deemed "irrational."⁵⁵ Furthermore, recognition of the process itself can alter the result: for example, a side that anticipates opposition employment of inviscous force could counter by initially adopting a hybrid strategy.

Clausewitz was on to something similar when he said that overcoming an enemy depended upon overcoming his resistance which was the "product of two inseparable factors...*the total means at his disposal and the strength of his will.*"⁵⁶ "Total means" is similar to "capacity" and the strength of will determines whether or not the fight will continue; however, Clausewitz linked his factors to a theoretical escalation of effort (ultimately to be governed by political restraint) rather than a concept similar to viscosity change (which, according to the definition for war, presupposes political influence).⁵⁷

Interestingly, the nature of war, and thus the M_f , is fractal. Fractal is a term that applies to chaotic, irregular systems and roughly means the degree of irregularity remains constant at different scales.⁵⁸ One of the pioneers of chaos theory, Edward Lorenz, discovered that within the unpredictability of chaotic systems he had found patterns and "discovered suggestions of

structure amid seemingly random behavior.”⁵⁹ Figure 7, though not a true fractal, represents how elements of the nature of war might be found at different scales, i.e., the “levels” of war: strategic, operational, and tactical.⁶⁰

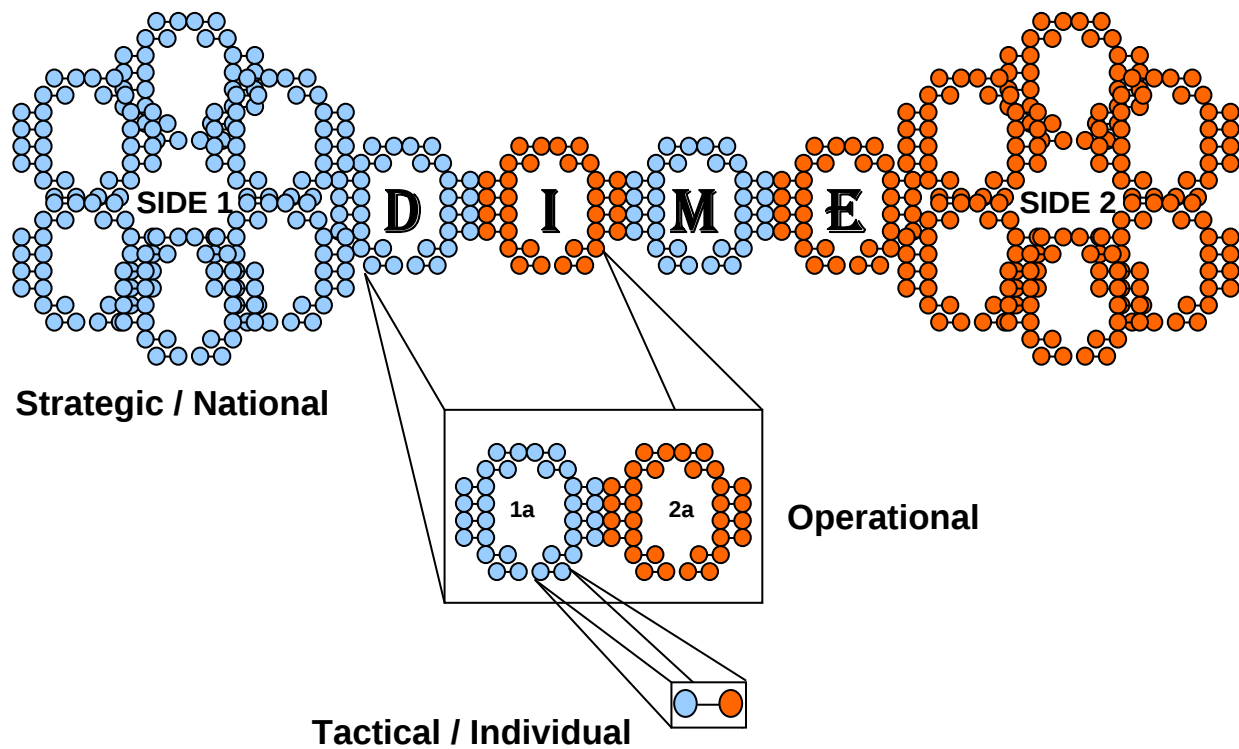


Figure 7. The Fractal Nature of War

Not strictly applicable to any one level, the M_f has meaning and application for national-strategic, operational, or individual/tactical forces. For example, civilized democracies that adhere to the rule of law and international treaties can be considered strategically viscous; in contrast, a country like North Korea or Iran that flouts international law would be less viscous. At the operational level, traditional military forces are viscous while insurgents and guerrillas are inviscous. Tactically rigid, doctrinaire forces in battle are more viscous than flexible, adaptive

forces. Even at the individual level, the differences can be like those between a boxer (viscous) and a street fighter (inviscous).

One additional term central to the M_f requires discussion. A fluid influenced by an unbalanced force will move or flow unless contained, i.e., the container balances the force, restraining the fluid's movement.⁶¹ Likewise, fluidic forces can be “contained,” thus restricting their ability to “flow” and thus their fluidity. “Containment” in the M_f is defined as the condition, either imposed or contextual, that inhibits a force's fluidity, in effect increasing viscosity and thus vulnerability to superior viscous force. Figure 8 is an abstract representation of the containment concept.⁶² A viscous force that contains an inviscous force renders it more

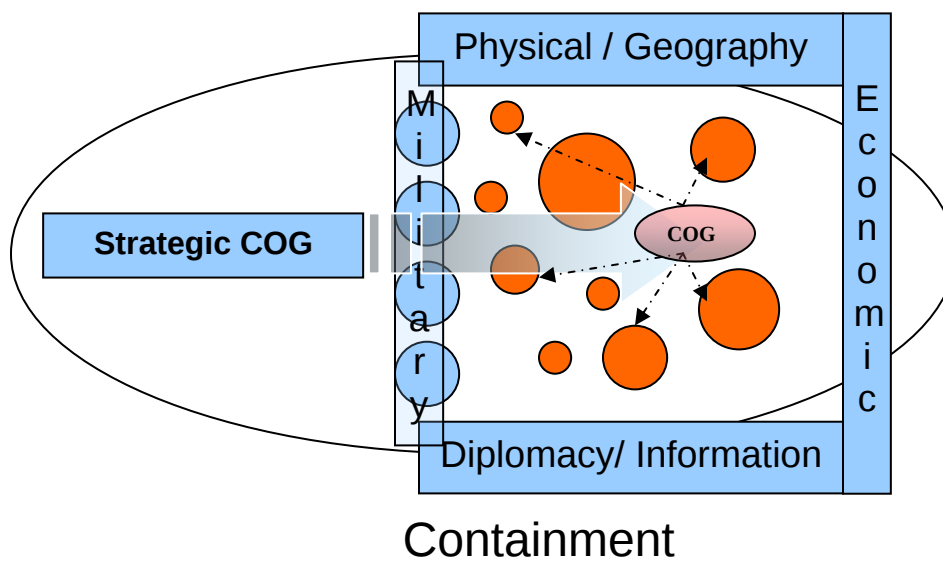


Figure 8. Containment

vulnerable to viscous influence. Strategically, the viscous force must find a way to neutralize the inviscous side's COG which prevents it from dissolving. As discussed previously, the will is the “force” that motivates the fluid and also keeps the inviscous force coherent in the face of other influences. An inviscous force without its COG dissipates like gas released into space.

Inviscous forces can be “contained” by a number of factors. For example, limits in geography, funding, infrastructure, or communications could serve to contain a force. This principle applies across all levels of war. In V-V, containment can take the form of envelopment or pinning a force against a geographic barrier. In some cases, a viscous force may be “contained” by its own adherence to stale doctrine, tactics, or outdated technology.⁶³ Containment in V-I or H-I conflict is employed by the viscous force to compel an inviscous force to fight viscously. T.E. Lawrence noted that guerrilla (inviscous) forces can be obligated to fight at a disadvantage “by lack of land-room, or by the need to defend a material property dearer than the lives of soldiers.”⁶⁴ Examples of strategic containment include economic sanctions, treaties, cyberspace operations, or threat of military action.⁶⁵ Operationally, a force can contain another with border security, via maneuver, or air and naval superiority.⁶⁶ At the tactical level, containment could include efforts to provide civil affairs and humanitarian support or pursuit of a hostile force into restrictive terrain. Speed and surprise can be key enablers of containment because they exploit the inherent inertia of an opposing force.

Fluidic Metaphor and Warfare Concepts

A theory is an idea systematically prepared for authentication.
- Thomas Sowell

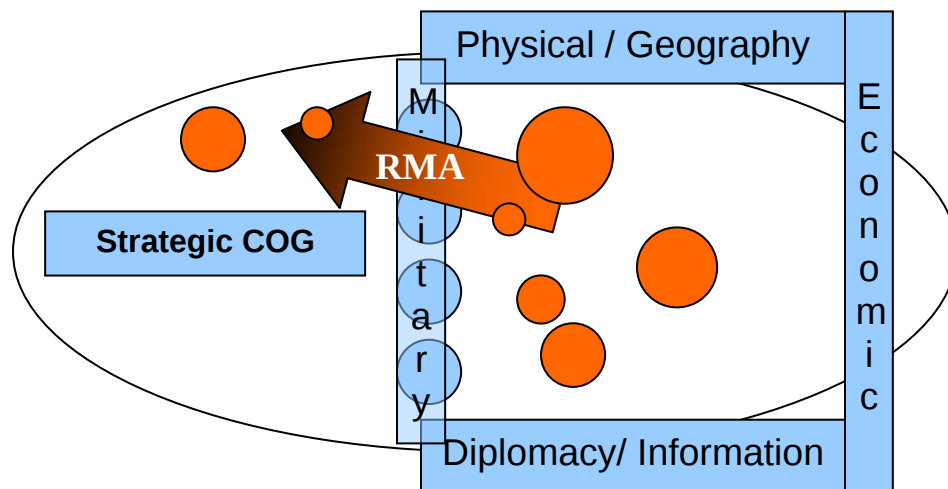
This section briefly examines the following concepts vis-à-vis the M_f: nuclear war, revolution in military affairs (RMA), irregular war, fourth generation war (4GW), and asymmetric war.

Martin van Creveld declared that, after the bombing of Hiroshima, “the nature of war had changed, presumably forever.”⁶⁷ The idea that any technology can change the nature of war is nonsense. Nuclear weapons are tools that can be used by viscous or inviscous forces, but are *more* likely to be used by inviscous forces because they are unconstrained by contextual

considerations.⁶⁸ The war-viscosity algorithm shows that the calculus for war includes consideration of context. Nuclear weapons changed the political and economic *context* for war, not its nature. A nuclear power with capacity and will to fight has to factor in the political, economic, and physical fallout of nuclear war. The fact is, since WWII, the contextual consequences of employing nuclear weapons have been at odds with grand strategic goals. No rational nation would initiate a war where the likely result would be its own annihilation or complete condemnation and opposition from the rest of the world. In contrast, Al-Qaida has will and context, but not capacity. States like Iran and North Korea are troubling because their rationality is not guaranteed, thus if they have the will and capacity, the context may be irrelevant. In any case, nuclear weapons, while profoundly influencing the character and calculus of war, have not altered its nature, and the side that gains the capacity and will to use nuclear weapons may use them if it deems the context satisfactory (e.g. al-Qaida).

The validity or existence of RMA's is a debated issue. Certainly there are examples in history where some technological or doctrinal development has given one side a distinct if not decisive advantage in the next war. The advantage afforded by an RMA lasts only *for a period of time* equal to that required by the opposing side to match or surpass it, and then, perhaps, only for one part of the war continuum. Indeed, an RMA pertaining to V-V conflict may have its *potency* diminish or disappear owing to inviscous circumstances. For example, information technology coupled with precision guided munitions helped lead to dominance over Iraq in the first Gulf War, yet is much less decisive against 21st century Iraqi terrorists. Austrian and Prussian generals likely considered Napoleon's mastery of the *Grand Armée* revolutionary; however, it had minimal effectiveness against Spanish insurgents.

At the strategic level, one can think of an RMA as a phenomenon that enables a side to defeat the other's ability to *contain it* (See Figure 9). Indeed, the ability of a global insurgency to coordinate via wireless and internet means, provide command and control, and sustain long term operations and planning across international boundaries could be considered an inviscous RMA.



Inviscous RMA

Figure 9. RMA and Containment

The side countering the effects of the RMA finds itself in a race, as it were, to “plug the hole” before its own will to resist is compromised.

As for “irregular” war, there is little use for such a term in the M_f .⁶⁹ If one accepts the premise that war is chaotic and non-linear, then how can war be called “irregular” at all? In contemporary parlance, irregular war is what inviscous, fluidic forces wage. Dr. Wray Johnson of the USMC’s School of Advanced Warfighting describes irregular war as “fluidic” and “dispersed” and associated with a “strategy of erosion.”⁷⁰ However, the M_f defines inviscous forces as those that act outside of norm and custom; thus, it is perfectly “regular” for inviscous forces to behave this way. Furthermore, since war is a continuum, no one manifestation is any

more “regular” than another.⁷¹ Such terms only serve to perpetuate the destructive fallacy that some forms of war are more common, more desirable, and more regular than others. “Irregular” should be scrapped and the term “irrational” used to describe any strategy or tactic that defies logical explanation vis-à-vis the nature of war and the war-viscosity algorithm—for example, a side that, despite overwhelming disadvantage in capacity, opts to fight viscously.⁷²

Some theorists have argued that warfare progresses in generations based upon its character (4GW). While perhaps useful to describe the form that warfare is taking, this approach is dangerous in that it implies that the characteristics of past conflicts have faded into history.⁷³ The M_f contradicts this notion. The nature of war as a continuum has not changed. Regardless of the times or technologies, warring sides have and will adopt an approach which is characterized by the viscosity of its forces as determined by will and circumstances.⁷⁴

What of “asymmetric” war? Asymmetry is a term that has been used to describe nearly everything and thus signifies almost nothing. Some believe that asymmetry exists when one viscous force is larger or more capable than another, for example when one side has airpower and the other does not. Others use the term to describe war between unconventional and conventional forces. In this sense asymmetric attack might occur when guerrillas or terrorists ambush convoys, or snipe, or infiltrate and suborn security forces. Steven Lambakis declared that asymmetry as a term is rendered irrelevant by its ubiquity and that it appears “this term is nothing more than a Beltway buzzword...nearing the end of its life.”⁷⁵ It regains its meaning and potency if tied back to the unchanging nature of war within the M_f . “Asymmetric” war is defined here as war between viscous and inviscous forces (V-I).

Fluidic Metaphor, Sun Tzu, and Clausewitz

This section provides a very brief look at how the M_f relates to some key aspects of the ideas on war of Sun Tzu and Clausewitz. Sun Tzu's most famous dictum, "know the enemy and yourself," is clearly evident in the war-viscosity algorithm.⁷⁶ In addition, Sun Tzu said "flexibility is the key to properly exercising combat power" (fluidity).⁷⁷ He also noted that in dominating an enemy's action "those sophisticated at actuating the enemy contain them, and the enemy will surely follow" (containment).⁷⁸ In dominating enemy strength "those...sophisticated at command contain the adversary but are free of containment."⁷⁹ Sun Tzu was a proponent of the idea that smaller forces should be "dynamic" (fluidity) while larger forces should "ensnare" (containment).⁸⁰ Sun Tzu also emphasized that victory cannot be created by one side, because the decision to resist, the will is always an option for the adversary (viscosity change).⁸¹ Finally, Sun Tzu himself used a fluidic metaphor when he said, "the control of forces is like water: do not fight rigid battles, water's movement avoids the high and runs downward...avoids superiority and strikes inferiority...water conforms to terrain in determining movement and forces conform to the enemy in determining victory."⁸²

The M_f is consistent with many of Clausewitz's ideas including his major argument that the defense is the stronger form of war. A defender maintains the initiative to resist and energize the collective will that can allow a side to become inviscous without dissolving. A defender buys time, creating a contest of determination as opposed to raw force, allowing domestic politics to wear a viscous opponent down. When this occurs, an inviscous force may counterattack the weak points of a viscous force and strike its strategic COG. This can propel the defender to the offense (counterattack), decisive action, and perhaps victory.

Clausewitz intuitively understood the fluidic nature of inviscous forces in the context of his chapter on insurgency and elucidated the dangers of such forces if compelled to fight them viscously. Of inviscous “people’s war” he noted, “by its very nature, such scattered resistance will not lend itself to major actions, closely compressed in time and space. Its effect is like that of evaporation: it depends on how much surface area is exposed.”⁸³ He suggested insurgents should be “nebulous and elusive” and never “materialize as a concrete body.”⁸⁴ With respect to war, Clausewitz had transcended the Newtonian predilection for idealistic modeling and absolute laws, but did not yet have the benefit of chaos theory and the N-S equation which might have led him to embrace a fluidic metaphor of his own.

Fluidic Metaphor and History

In the American Revolution, the British fought with a European-style (viscous) army. Washington attempted and failed to match that force. To survive, he had to flee and build his viscous force until his capacity exceeded Cornwallis’ (at Yorktown). In the southern colonies, the British destroyed two patriot armies (viscous). Yet the will of the colonists persevered, and the British could not contain them (a difficult proposition against any indigenous force). Militias (inviscous) kept the fight alive and disrupted the British. The combination of viscous and inviscous forces (hybrid) fielded by the colonies ultimately succeeded.

General Allenby employed a hybrid force in the Palestine campaign of 1917. Allenby meshed his (viscous) Egyptian Expeditionary Force with Lawrence’s Arab (inviscous), rebels to win impressive victories.⁸⁵ As Lawrence described, viscous armies were “like plants, immobile, firm-rooted” whereas his inviscous forces were “a vapor, blowing where we listed.”⁸⁶

Small wars and insurgencies frequently exemplify V-I (asymmetric) or hybrid conflict in which the principle of containment is evident. Physical containment was used successfully in the

Algerian War (Morice Line), less successfully in Vietnam (McNamara Line) and Rhodesia (South African *cordon sanitaire*).⁸⁷ The British and Filipinos employed resettlement as a form of containment successfully in the Malayan Emergency and the Huk Rebellion, while the U.S. strategic hamlet program in Vietnam had mixed success.⁸⁸

During the French Indochina War, General Vo Nguyen Giap initially attempted to defeat the French with viscous forces and was soundly but not decisively beaten. With Chinese guidance on Maoist operational art, Giap “went inviscous,” mounting an attritional, guerrilla strategy to wear down the French will. At Dien Bien Phu the French were contained and forced to fight Giap’s now superior viscous force. Their crushing defeat was the Yorktown-like last straw that toppled France’s strategic COG.⁸⁹

The mobile war strategy of Mao Tse-tung and his three stages of people’s war illuminate the relation between the transitions from viscous to inviscous realms of the continuum. Initially fighting Chang Kai-shek’s nationalists viscously, Mao was beaten. But Mao as figurehead and champion of communist ideology sustained the will to fight and transitioned to inviscous strategy. In the language of the M_f , his three stages are inviscous (guerrilla), hybrid (mobile war), and viscous (strategic offensive/conventional).⁹⁰ John Dederer described Mao’s use of mobile war as a “bridge between guerrilla and conventional strategy” and “innovative.”⁹¹ The M_f would call such methods a *natural consequence* of the circumstances of the conflict and Mao’s sustained will to fight.

In the Philippine War of 1899 -1902 the leader of the Philippine nationalists, Aguinaldo, initially created a “European-style” army (viscous) organized along modern, conventional lines.⁹² He then established a “decentralized guerrilla organization in the provinces,” making his overall force structure hybrid.⁹³ A hybrid force has advantages but is difficult to control and

resource, and such was the case for Aguinaldo. Aguinaldo's viscous forces were inferior to U.S. viscous power and crumbled quickly after the fall of Manila; however, Aguinaldo sustained the cause with himself as figurehead. As American forces feared, the insurgents took to the hills and interior affecting "a prolonged Indian-fighting style of campaign" (inviscous).⁹⁴ As U.S. forces moved to engage Aguinaldo, they recognized that viscous force in the form of rigid columns against the guerrillas was "worse than useless," and instead used a wide net to isolate, contain, and strike (containment to force V-V).⁹⁵ By November 1899, Aguinaldo had completely disposed of his viscous force and dispersed his army to begin guerrilla war (rational transition to inviscous by an act of will).⁹⁶ The U.S. implemented a naval blockade to isolate the insurgents (containment).⁹⁷ Then U.S. inviscous forces located and defeated the insurgency and its leaders—effectively negating its strategic COG. The war was won; however, the U.S. inviscous forces often exceeded the laws and conventions of war, resulting in atrocities that damaged U.S. honor and prestige.⁹⁸

In Vietnam, the U.S. encountered a hybrid force in the form of the Viet Cong (VC) (inviscous) and the People's Army of Vietnam (PAVN) (viscous). These forces outlasted the U.S., corrupted the American strategic COG, and then viscously defeated the inferior South Vietnamese. In the Gulf War of 1990, Saddam elected to fight the coalition viscously (irrational), erroneously deciding his capacity was sufficient relative to the coalition's to warrant this strategy. In OIF, the U.S. won the V-V fight quickly but was unprepared for the V-I conflict that emerged.

Even with all these historical examples, U.S. preparedness for war, especially inviscous, has been abysmal, perhaps because of the lack of a holistic theory for war that clarifies the relationship between war's nature and its various manifestations. The M_f could help strategists

and planners better understand these factors in assessing past and current circumstances and in prediction and preparation for war in the future.

The Fluidic Metaphor and Future War

If one agrees that war was, is, and will be a fluidic continuum of viscosity, then the M_f can aid in establishing how future war might *manifest* itself. The first two steps are to gauge, as accurately as possible, future circumstances and then to assess the will of the adversary. From these, future viscosity can be inferred with help from the war-viscosity algorithm.

With respect to future circumstances, the U.S. currently and for the foreseeable future maintains a position of viscous dominance, though there are many nations that retain significant viscous forces of their own. Judging the will of an adversary (before and during the war) to fight in the face of U.S. viscous superiority is an essential task. Where the will exists and the capacity and context permit, future adversaries will likely opt for inviscous counterforce against the U.S., perhaps even a hybrid approach for states that can afford it, e.g. North Korea and China.⁹⁹ They know that globalization and information ubiquity have made it difficult for the U.S. to contain inviscous forces, whether non-state actors such as Al-Qaida or state-sponsored, from Syria or Iran, for example.

Modern inviscous forces will exploit the information element of power and the vulnerability of civilized, viscous states to propaganda. Prior to the current information age, there was an absence of accurate, on the spot reporting that kept public awareness low and the disquiet of “civilizing” forces was ignored or mitigated. Now, accurate, real-time reporting—often by anti-government press sympathetic to the underdog—has a dramatic affect on the strategic COG of modern, liberal democracies.¹⁰⁰

How can the U.S. best meet this threat? To begin with, planners and strategists would be well served to employ the M_f . This should discourage the tendency to believe that war is composed of two disjointed “types,” irregular and regular, and to overemphasize one over the other based on current conditions and adversaries or service-based prejudice. Indeed, the M_f indicates that the best strategy is to develop and expand U.S. hybrid capabilities.¹⁰¹ Should it pursue this approach, the U.S. should keep in mind four crucial imperatives.

First, maintain a viscous force advantage, which is essential for national survival, countering viscous enemies, and defeating contained inviscous forces. The perishable nature of the expertise and technology required for modern, viscous forces (especially air, space, cyberspace, and naval power) as well as the lead time for training and materiel development and employment, demands that the U.S. continuously sustain and upgrade its viscous forces. Regardless of the character of the last war or the current war, war is a continuum where the viscosity of the threats might change and likely will. Just as U.S. viscous predominance has led savvy competitors to “go inviscous,” so will those same competitors “go viscous” if the U.S. shows weakness. Furthermore, the U.S. must not discount the possibility of facing a hybrid threat, especially from China.

Second, organize, train, and equip a *permanent*, credible, effective inviscous counterforce. As centuries of empirical data have shown, war in the inviscous realm is difficult. Forces trained and educated in viscous war are poorly prepared to succeed inviscously. The M_f illustrates that the idea of inviscous war as an abnormality is a false hope.¹⁰²

The U.S. counter-inviscous force must be something more than just special operations.¹⁰³ Rather than pursue current plans to increase the size of the Marines and Army, the U.S. should instead, transfer a slice of the best from each service. This force would merge with special

operations forces under USSOCOM and become a true counter-inviscous combatant command.¹⁰⁴ This new USSOCOM would have a smaller section dedicated to supporting viscous forces with the balance as the counter-inviscous force specialists. These specialists would be a dedicated cadre responsible for studying and preparing to execute and succeed in the inviscous domain of war, providing a nucleus of experience, knowledge, and expertise to immediately set U.S. response to an inviscous or hybrid enemy on solid footing rather than wasting years adapting a viscous force to do the same. Experience shows that the American people will not accept wars of indefinite duration. A true hybrid force could bring enough successes early on to strengthen the U.S. strategic will.

Third, prepare for the long term. War against any foe must seek to neutralize the will that sustains the opposition. War is a complex, chaotic system where results need not be proportional to means employed or resources expended, indeed, they may not even show any positive effect, especially against an inviscous enemy.¹⁰⁵ Getting to the will of an inviscous foe can call for a sustained effort perhaps over a great period of time. Time is the inviscous force's ally as the strategic will to fight is difficult to maintain in the absence of measurable progress. As Lawrence noted, "our cards were speed and time, not hitting power."¹⁰⁶ Clausewitz understood that belligerents need time, but that time favors the weaker side, which is often the inviscous side.¹⁰⁷ The containment strategy the U.S. used to defeat the Soviets took decades. The containment strategy the U.S. must pursue against inviscous, global insurgents will take decades as well until the appeal of their ideology decays. Like communism, Islamic radicalism will never die, but it can be isolated to pockets that render the movement dissolute.

Finally, strengthen intelligence gathering capabilities and analysis interfaces with decision-making at the highest levels. Inviscous forces are difficult to contain and influence—

impossible without good information upon which to base critical strategic, operational, and tactical decisions. Intelligence cannot be geared only to order of battle and assessments of viscous forces. It must gain insight into the extent and depth of opposition will to resist (and thus to potential for viscosity change). As Clausewitz said, “the will is not a wholly unknown factor; we can base a forecast of its state tomorrow on what it is today.”¹⁰⁸ This can be accomplished by detailed cultural study and gathering data in the form of interviews and polling. Human intelligence is paramount.

Conclusion

War is a complex and chaotic continuum; but it is not indecipherable. Applying to war the same holistic approach and language that science has provided for the chaotic behavior of fluids can yield surprising insight into war’s nature and by extension, its future. The M_f is an attempt to develop a more universal language and cognitive framework within which to examine and visualize the continuum of war. This is not a new theory of war meant to discredit or supplant the wisdom of others, but rather an aid to reconcile and unify the many useful but often discontinuous concepts prevalent in theory and discourse on war.

The M_f is a bridge between theory and the nature of war, a lens bringing into focus how war manifests itself as a continuum of viscosity. Current planners and strategists can employ the M_f as a schema that accounts for chaos and complexity and neutralizes the conceptual fallacy of the discontinuity of war. The terms “viscosity,” “containment,” “asymmetry,” and “hybrid,” are endowed by the M_f with more enduring meaning by securing them to the unchanging *nature* of war and insulating them from the oft-changing *character* of war. Ideally, the end product is a useful tool for examining past and current wars as well as informing the thinking of military professionals and civilian leaders in preparing for and anticipating the character of future war.

In as much as the M_f brings into better focus the nature of war itself, it becomes possible to glean at least some insight into what future war will be, arising as it were out of the immutability of war as a battle of human wills.¹⁰⁹ Returning to fundamentals makes it possible to properly weigh the immediate context that too often drives conclusions to be dominated by what is most proximate. The M_f shows that the character of the future war will depend upon the relative viscosity of the opposing sides.

As the U.S. moves ahead to prepare for future war, it should recognize that its best approach is to develop a hybrid force structure with strong viscous and permanent inviscous elements that will intelligently engage potential enemies holistically and never cede the 4th dimension.

In conclusion, the following are the ten essential propositions of the M_f :

1) War is a continuum where all the forms or types of war are natural manifestations given the conditions of the times and the will of the opponents.

2) The M_f , tied to war's unchanging nature, applies regardless of the passage of time, development of technology and tactics, or the level of war (strategic/operational/tactical).

3) The language of the M_f (viscous, inviscous, containment, asymmetry, irrational, and hybrid) facilitates thought and communication regarding war while still accounting for war's complex, chaotic nature.

4) Viscosity is an emergent phenomenon arising from the circumstances of the war and the will of the participants and reflects the degree of cohesion and adherence of a force to convention, law, and doctrine.

5) The war-viscosity algorithm represents the rational process a warring side follows to determine whether or not to fight as well as initial viscosity or viscosity change of forces.

6) “Irrational” describes forces that opt to fight a war in a manner inconsistent with the process illustrated within the war-viscosity algorithm.

7) Containment is the contextual or imposed condition that limits or reduces an opposing side’s fluidity.

8) Asymmetric refers to the state of war that exists when viscous forces contend with inviscous forces. Conversely, symmetric refers to the state of war when like forces contend.

9) Hybrid refers to the state of war that exists when one side exerts influence with both viscous and inviscous forces.

10) Insight on the nature of war gained from the M_f along with present circumstances, historical experience, and trends provide the basis for assessment of the character of future war.

Endnotes

¹ The Chinese military writers, Qiao Liang and Wang Xiangsui, have noted, “War is the most difficult to explain and understand. It needs support from technology, but technology cannot substitute for morale and stratagem; it needs artistic inspiration, but rejects romanticism and sentimentalism; it needs mathematical precision, but precision can sometimes render it mechanical and rigid; it needs philosophical abstraction, but pure thinking does not help to seize short-lived opportunities amid iron and fire.” Qiao Liang and Wang Xiangsui, Unrestricted Warfare (Beijing: PLA Literature and Arts Publishing House, February 1999), page 170.

² There is a difference between the “nature” and “character” of war. The nature of war is immutable; it does not change with time. The nature of war is uniquely human, a violent clash of wills. By contrast, the character of war changes with time as technology, tactics, and even human sensibilities evolve.

³ Alan Beyerchen, “Clausewitz, Nonlinearity, and the Unpredictability of War,” International Security, Winter 1992/1993: 59. Dr. Jon Sumida of the University of Maryland, in his unpublished manuscript, Engaging the Clausewitzian Mind, has opined that On War “poses great difficulties for readers” and “it is long, complicated, apparently inconsistent, in places seemingly obscure.” Dr. Jon T. Sumida, Engaging the Clausewitzian Mind. Unpublished manuscript, 2006, page 2.

⁴ In one of the best, most succinct descriptions of this concept, Harold R Winton opined that divining the future of war “dictates intellectual mastery of the nature of war in general as well as the various forms that war assumes in a given era. Such mastery requires firm grounding in the theory of war, informed historical study, close analysis of contemporary developments, and an ability to project trends into the future in order to anticipate requirements.” Harold R. Winton, To Change an Army: General Sir John Burnett-Stuart and British Armored Doctrine, 1927-1938, (Lawrence, KS: University Press of Kansas, 1988), pages 239-240.

⁵ Sumida, Engaging the Clausewitzian Mind, 48.

⁶ Ibid., 51.

⁷ Due to length limitations, this paper defines and explores the concept of a fluidic metaphor for war at a very broad conceptual level only. An entire paper could be written, for example, on how the metaphor relates to Clausewitz alone or in a more exhaustive analysis of applicability to past case studies, or in relation to complexity/chaos theory, for example.

⁸ Carl von Clausewitz, On War, eds./trans. by Michael Howard and Peter Paret, (Princeton, NJ: Princeton University Press, 1976), 75.

⁹ Ibid., 86.

¹⁰ There certainly can be more than one nation or adversary in war. However, as Clausewitz noted on page 596 of On War, “if two or more states combine against another, the result is still politically speaking a single war.” In the event that a side is at war with more than one side and for different political objectives, then the definition applies to each case separately but still remains valid. Also, though not part of the definition (which is purposely broad), in most wars at least one side is a state or state-like political entity.

¹¹ Combat in war is violence for political purposes; it does not occur when two groups “spar” or perpetrate isolated acts of violence that are not supported by the will to affect a change to the political status quo. There are a wide range of interests and political outcomes that could apply, not the least of which might simply be to ward off an attacker and survive.

¹² The term “DIME” here is inclusive of all ways a warring side might influence an adversary to include legal and political (which arguably fall within the “D” or “I” anyway). The “military” aspect of DIME need not refer solely to uniformed soldiers, but to any people that perpetrate violence in support of a strategy designed to achieve a political end state in the context of the war. For example, suicide bombers or gun-toting children may be considered part of a side’s military approach to war. Given the preceding definition for war, this system must have combat occurring at some time to truly be “war.” Furthermore, once combat is introduced to the conflict, the situation becomes “war,” but that does not mean the informational, diplomatic, economic, and non-combat military actions are not part of the war—they emphatically are.

¹³ Energy is properly defined as the capacity to do work. In the case of war, the use of instruments of power creates a capacity for influencing an adversary (the “work” of war) to succumb or adopt practices and policies that satisfy political war aims.

¹⁴ The end result is much like a child splashing in a pool—some water hits the target, but some falls outside the pool and the ripples spread across the entire surface—so called second and third order effects.

¹⁵ Clausewitz, On War, 89.

¹⁶ Frankly, chaos is an overused and misunderstood term. Neither war nor fluids are **purely** chaotic, but they can be highly disordered. If war were pure chaos (a state of complete disorder), there would be no way to make any logical sense of it, or to prepare for it, and outcomes would be completely unpredictable. Fluids can behave counter-intuitively, defying gravity through evaporation or molecular cohesion and changing state; and their dynamics can be extremely disordered and complex; however, they are not purely chaotic either.

¹⁷ Indeed, fluids have played a central role in war since the God of Abraham vanquished Pharaoh's army under the divinely cleaved waters of the Red Sea. The ability to master rivers and seas and to dominate the sky has often been decisive.

¹⁸ T. E. Lawrence, Seven Pillars of Wisdom: A Triumph, (New York: Doubleday, 1991), 338.

¹⁹ John M. Dederer, "Making Bricks Without Straw: Nathaniel Greene's Southern Campaign and Mao Tse-Tung's Mobile War," Military Affairs, Oct 1983: 116.

²⁰ David Galula, Counterinsurgency Warfare: Theory and Practice, (New York: Frederick A. Praeger Publishers, 1964), 12.

²¹ *Ibid.*, 83.

²² David B. Guralnik, ed., Webster's New World Dictionary, (New York, NY: Prentice Hall Press, 1986), 537.

²³ Robert Fox and Alan T. McDonald, Introduction to Fluid Mechanics, 3rd Edition, (New York: John Wiley & Sons, 1985), 231. James Gleick described analyzing fluids with the non-linear N-S equations as "like walking through a maze whose walls rearrange themselves with each step you take." James Gleick, Chaos: Making a New Science, (New York, NY: Penguin Books, 1987), 24.

²⁴ *Ibid.*, 33. Fluids with viscosity = 0 are called "inviscid."

²⁵ *Ibid.*, 18.

²⁶ The continuum of war is vastly different than the "spectrum of conflict" which characterizes military operations from peace to major war. The fluidic metaphor concept applies to war, not a spectrum of conflict. Viscosity in the fluidic metaphor is an amalgamation of the real world physical properties of viscosity and density. In natural fluids, viscosity and density are separate characteristics. When the term viscous is used in the fluidic metaphor it means high density and cohesion/order. Conversely, inviscous means low density and less cohesion/order.

²⁷ In Unrestricted Warfare Qiao Liang and Wang Xiangsui note that "war which has undergone the changes of modern technology and the market system will be launched even more in atypical forms...however, regardless of the form the violence takes, war is war." Liang and Xiangsui, Unrestricted Warfare, 6.

²⁸ James Gleick, Chaos: Making a New Science, (New York, NY: Penguin Books, 1987), 16.

²⁹ Guralnik, Webster's New World Dictionary, 1587.

³⁰ For example, video game programmers find it very difficult to model and present realistic moving water effects in their games whereas they describe "high viscosity" modeling as "easy to do." Bjorn Carey, "The Hard Science of Making Videogames," Popular Science, October 2007, 70.

³¹ The term "inviscous" is used as opposed to "inviscid" because inviscid means zero viscosity. In truth no fluid has zero viscosity, and in the fluidic metaphor no side in war has zero viscosity either. So the term "inviscous" is used purposefully to describe a force that has *relatively* low viscosity.

³² The concept of emergence is a "creative principle" that means "the parts of a complex system have mutual relations that do not exist for the parts in isolation," Herbert Simon, The Sciences of the Artificial, 3d ed. (Cambridge, MA: The MIT Press, 1996), 170. Viscosity is a property that has no meaning when addressing the individual molecules of a fluid. It is not computable by reductive analysis of isolated elements. It only has meaning in the interaction of the whole. Likewise, viscosity in the context of war cannot be predicted or induced from the characteristics of the individual.

³³ With respect to the fluidic metaphor, forces are the human and material assets a side employs to influence the other. These "forces" could be the government, the army, the people, or a combination. Most examples here refer to the military aspect because war includes combat.

³⁴ Just as fluids may exist as liquid or gas and with a variety of viscosities depending upon their essential properties and the energy of the system/environment—so too can war exist in many different forms (as indeed, history has shown).

³⁵ Historically this has been the opposing army or even population. The caveman wants a bigger club, the platoon leader wants the more accurate rifle, the army wants the fastest tanks and longest range artillery, the government wants the biggest, best trained army, and so on.

³⁶ P.H. Liotta, "Chaos as Strategy," Parameters, Summer 2002: 4.

³⁷ Viscous power is what the U.S. does best. Reliant on technological superiority, firepower, training, and education to field highly disciplined, organized forces, the U.S. hopes to find a similar if less capable force to vanquish in every situation.

³⁸ Qiao Liang and Wang Xiangsui wrote: “The direct result of the destruction of rules is that the domains delineated by visible or invisible boundaries which are acknowledged by the international community lose effectiveness. This is because all principals without national power who employ non-military warfare actions to declare war against the international community all use means that go beyond nations, regions and measures. Visible national boundaries, invisible internet space, international law, national law, behavioral norms, and ethical principles, have absolutely no restraining effects on them. They are not responsible to anyone, nor limited by any rules, and there is no disgrace when it comes to the selection of targets, nor are there any means which are not used. Owing to the surreptitious nature of their movements, they have very strong concealment, create widespread damage because of their extreme behavior, and appear unusually cruel as a result of their indiscriminate attacks on civilians.” Liang and Xiangsui, Unrestricted Warfare, 132.

³⁹ Beyerchen, “Clausewitz, Nonlinearity, and the Unpredictability of War,” 75.

⁴⁰ T. E. Lawrence, “The Evolution of a Revolt,” Army Quarterly and Defence Journal (Oct 1920), 55-69, repr. Combat Studies Institute, 1999, 21.

⁴¹ Clausewitz, On War, 483.

⁴² Ibid., 97. Along these same lines, after Appomattox in the Civil War, R.E. Lee eschewed a resort to guerrilla war because he did not have the will to fight on and perhaps knew that an inviscous war in the South would have scant chance of achieving its political goals with no motivated lower class invested in the fight.

⁴³ Some ploys of an inviscous force could include guerrilla tactics, disregarding conventions (such as truces or evacuation of the dead/wounded), using hospitals and religious sites as military assets, exploiting children or civilians, as well as using information, media, and politics to circumvent traditional military force.

⁴⁴ For example, the North Korean Army broke apart after Inchon and dispersed in its retreat from Pusan in a manner that MacArthur was unable to counter and contain. The result was an avoidance of decisive defeat at the hands of MacArthur’s viscous force. North Korea survived politically long enough for the introduction of the Chinese to tip the balance of viscous power back to its own side.

⁴⁵ To secure its own aims, the inviscous force will often use time and information to get past viscous defenses and exploit, for example, global media to strike directly at viscous COG’s. Open societies and static military forces provide many gaps and seams inviscous forces can compromise.

⁴⁶ The COG might be an ideology, a common cause, or a dynamic leader/figurehead. Keith Bickel in Mars Learning: The Marine Corps’ Development of Small Wars Doctrine does a superb job detailing the role of dynamic leaders in “small wars” and how the capture or death of these men contributed to the dissolution of the inviscous forces. These cases are far easier to resolve than those requiring action against an inviscous force with an intangible COG, for example religious or ideological. Keith Bickel, Mars Learning: The Marine Corps’ Development of Small Wars Doctrine, 1915-1940, (Boulder, CO: Westview Press, 2001).

⁴⁷ Though it rarely occurs, inviscous forces can be defeated by attrition where their strategic COG remains intact but there are no forces left to carry on the conflict. This was essentially the case in Nicaragua during Sandino’s insurgency in the 1920s and 1930s where the USMC and Nicaraguan Guardia dismantled Sandino’s inviscous forces while simultaneously attacking their cause by means of popular elections (Bickel, 178).

⁴⁸ For example, if a foot kicks the water (viscous fluid) in a tub, the waves will spread the energy to the whole fluid. However, a hand waved on one side of a room will have some impact on the air (inviscous fluid) closest to the hand but negligible impact on the majority of the air in the room. So it is with viscous versus inviscous forces.

⁴⁹ This can be done any number of ways, e.g., by occupying an area or location of value to the inviscous forces or threatening logistics or other sources of support the inviscous force might be compelled to stand and fight for survival.

⁵⁰ By way of example, a glass of ice water in one location does little to cool a hot room, but cool air pumped into the room at separate locations will disperse and spread, eventually lowering the temperature of the entire room.

⁵¹ Clausewitz, On War, 480.

⁵² Colonel Margaret Bond defined the term “hybrid war” to reflect the requirement for ground forces to “support the political, informational, and economic projections of national power, in addition to conventional military force.” Colonel Margaret S. Bond, “Hybrid War: A New Paradigm for Stability Operations in Failing States,” USAWC Strategy Research Project, (Carlisle Barracks, PA: US Army War College), 3.

⁵³ Note: hybrid versus hybrid (H-H) or hybrid versus viscous (H-V) interactions are definite possibilities in war but should be easy to conceptualize from the information given. In some ways the American Revolution could be considered an H-H war with inviscous militia and Tarleton's dragoons augmenting the Colonial and British continental viscous armies respectively. Modern war between viscous powers may have an inviscous element in the form of special operations.

⁵⁴ This aspect will be discussed in more depth later. The inviscous element of a hybrid force will usually be more viscous than its inviscous adversary. Otherwise, if it flaunts the laws and conventions of civilization that support and sustain its viscous element, the outcome could undermine its strategic COG—to wit, the French in the Algerian War.

⁵⁵ Based upon the war-viscosity algorithm, there are two types of irrational forces: those that fight while lacking the appropriate context required for victory; and those that adopt irrational viscosity strategies (inviscous strategies against a viscous force while having a significant viscous advantage or viscous strategies against a viscous force while having a significant viscous disadvantage.) If a side has no capacity, it simply cannot fight. This is the “brain in a bottle” case—all will, zero capacity. Even one unarmed person can cause significant havoc, but the definition for war requires more than an individual actor. Irrational forces can only achieve victory by becoming rational (if it is not defeated before it can change) or if opposed by another irrational force (“war of the incompetents”).

⁵⁶ Clausewitz, On War, 77.

⁵⁷ *Ibid.*, 77.

⁵⁸ Gleick, Chaos: Making a New Science, 98.

⁵⁹ *Ibid.*, 44.

⁶⁰ If the concept of the fluidic metaphor were not to hold at all levels of war, then there would have to be real concern about its fundamental validity since it is based upon the unchanging nature of war of which all levels of war are part.

⁶¹ This does not apply to the *internal* motion of the fluid. Fluids can move or roil while being contained, but are limited in their ability to change location (transit) or influence any other fluid. In war, the internal motion of fluidic forces is embodied by the internal factors which can manifest themselves, for example, as domestic or military politics at the strategic level, *esprit de corps* at the operational/unit level, and even as matters of conscience or angst for individuals.

⁶² Qiao Liang and Wang Xiangsui note in Unrestricted Warfare regarding boundaries: “It does not matter whether they fall into the category of physical, spiritual, or technical, or if they are called ‘limits’ ‘defined limits,’ ‘constraints,’ ‘borders,’ ‘rules,’ ‘laws,’ ‘maximum limits,’ or even ‘taboos.’ Speaking in terms of war, this could mean the boundary between the battlefield and what is not the battlefield, between what is a weapon and what is not, between soldier and noncombatant, between state and non-state or supra-state. Possibly it might also include technical, scientific, theoretical, psychological, ethical, traditional, customary, and other sorts of boundaries. In summary, it means all boundaries which restrict warfare to within a specified range.” They emphasize that victory in modern war requires the ability to “go beyond limits,” in other words, to exceed boundaries or containment. Liang and Xiangsui, Unrestricted Warfare, 180.

⁶³ For example, in WW2 the Germans and French both fielded viscous forces; however, the French were more viscous, preferring to put faith in static defensive schemes devised in the aftermath of WW1. The Germans, in contrast, had developed a more flexible doctrine using the mobility and punch of mechanized forces and airpower which were more difficult to contain. Two “viscous” forces may in fact have distinct differences in overall viscosity relative to each other.

⁶⁴ T. E. Lawrence, “Guerrilla,” (UK: Encyclopedia Britannica, Ltd., 1932), 952.

⁶⁵ A recent example would be the Libyan renunciation of weapons of mass destruction (WMD) programs in the face of U.S. resolve against such actions as exemplified in Iraq.

⁶⁶ For example, the U.S. attempted and failed to contain insurgent forces in Vietnam who continued to cross international borders and obtain supplies externally. Whereas, in the Civil War, Grant contained Lee's army in Richmond by attacking through Petersburg and severing his southern lines of communication.

⁶⁷ Martin van Creveld, “War and Technology,” Foreign Policy Research Institute Newsletter, Volume 12, No. 25, October 2007, retrieved on 5 February 2007 from the World Wide Web <<http://www.fpri.org/footnotes/1225.200710.vancreveld.wartechology.html>>, 3.

⁶⁸ Indeed, the weaker side in terms of capacity might want to use nuclear weapons (or any WMD) to try and balance the war. This would be an irrational proposition if the opposing side also has nukes. However, a very inviscous force like a terrorist organization may have no reservations about employing them because retaliation

would be extremely difficult, like using a baseball bat to strike a gnat. Fortunately, WMD require tremendous resources to create, resources that have exceeded the means of inviscous forces, so far.

⁶⁹ Friedrich von der Heydte, in his work Modern Irregular Warfare: In Defense Policy and as a Military Phenomenon, trans. George Gregory, (New York, NY: New Benjamin Franklin House, 1986), takes pains to make sense of what exactly “irregular war” is. He finds no particularly convincing existing definitions and outlines the arguments about whether irregular war is real war, or something short or other than war, or a form of war, or a form of the conduct of war.

⁷⁰ Dr. Wray R. Johnson, <wray.johnson@usmc.mil> “RE: IRREGULAR WARFARE,” 14 April 2006, personal email. (5 October 2007). Dr. Johnson intuitively grasped the applicability of using fluidic metaphor in his word choice: “fluidic” and “erosion” (which is a consequence of the action of fluids upon solids). He also finds little utility in the use of the term “irregular” to describe war for the same reasons put forth in this paper.

⁷¹ Is water vapor any more “regular” than liquid water? Both are valid manifestations of water that exist in a state determined by the environment. Mere preponderance should not be grounds for determining regularity, especially since, if examined historically, one could make the argument that conventional war is less common and therefore more “irregular” than unconventional war.

⁷² An example is Iraq in DESERT STORM.

⁷³ Antulio Echevarria goes farther in saying 4GW as a theory has “incoherent supporting logic” that is “irredeemably flawed.” This should not come as a surprise from a theory that is founded in the ever changing character of war and not on its nature. COL Antulio J. Echevarria II, USA, *Fourth Generation War and Other Myths* (Carlisle Barracks, PA: Strategic Studies Institute, 2005), 16-17.

⁷⁴ Currently the global distribution of power and resources that so heavily favors the U.S. necessitates its adversaries pursue an inviscous counter strategy. There’s nothing generational about it. This has always been the case historically where the conditions were similar. What is different, is the technology, proliferation, and globalization has served up a toxic mixture of nasty means for inviscous forces to exploit.

⁷⁵ Steven J. Lambakis “Reconsidering Asymmetric Warfare,” Joint Forces Quarterly, (December 2004): 108.

⁷⁶ Sun Tzu: The New Translation, The Art of War. ed./trans. J. H. Huang (New York: William Morrow Company, Inc., 1993), 52.

⁷⁷ Ibid., 61.

⁷⁸ Ibid., 60.

⁷⁹ Ibid., 64.

⁸⁰ Ibid., 50.

⁸¹ Ibid., 53.

⁸² Ibid., 67, 68.

⁸³ Clausewitz, On War, 480.

⁸⁴ Ibid., 481. There is much more within this short chapter in On War that the reader is encouraged to explore with the concept of the fluidic metaphor in mind.

⁸⁵ Jeremy Wilson, Lawrence of Arabia, (Phoenix Mill, U.K.: Sutton Publishing, 1998), 55.

⁸⁶ Lawrence, Seven Pillars of Wisdom, 192.

⁸⁷ The French tactic of “quadrillage,” or partitioning an insurgent region into manageable bits, used for example in the Algerian War, is a good representation of containment where elements of an inviscous enemy are isolated to the micro-scale where they can be handled and compelled to act more viscously.

⁸⁸ Ian F. W. Beckett and John Pimlott, Armed Forces & Modern Counterinsurgency, (New York: St. Martin’s Press, Inc., 1985), 11.

⁸⁹ Beckett and Pimlott, Armed Forces & Modern Counterinsurgency, 51.

⁹⁰ Dederer, “Making Bricks Without Straw...,” 115. Mao’s final stage did not have to be hybrid because the Nationalists did not have an inviscous force. The fluidic metaphor would predict that, had Nationalist forces the will to transition to an inviscous approach after Mao’s last stage, Mao would have had to revert to a previous stage to ultimately gain victory.

⁹¹ Dederer, “Making Bricks Without Straw...,” 115.

⁹² Brian McAllister Linn, The Philippine War 1899-1902, (Lawrence, KS: University Press of Kansas, 2000), 35.

⁹³ Linn, The Philippine War 1899-1902, 58.

⁹⁴ Ibid., 64.

⁹⁵ Ibid., 81.

⁹⁶ Ibid., 148. Looking at this from the perspective of the war-viscosity algorithm, Aguinaldo still had the will to fight and believed the context adequate; however, he saw his capacity relative to U.S. forces as low and adopted the inviscous approach.

⁹⁷ Linn, The Philippine War 1899-1902, 131.

⁹⁸ This is a theme that repeats itself throughout much of the U.S. history of using inviscous forces to counter like forces. From the Philippines, to Haiti, to Vietnam and Iraq, there are specific examples of atrocities or gross illegality on the part of U.S. forces that have been damaging. Far from being simply an issue for the U.S., similar circumstances ultimately cost France the war in Algeria when, in large part, the tactical and operational campaigns had been won. The current real-time news cycle and global sensibilities coupled with pervasive anti-U.S. sentiment have caused recent examples of this to be especially harmful to the national will and international cooperation. U.S. adversaries understand this phenomenon and willfully incorporate tactics designed to inflame and provoke U.S. forces into actions detrimental to their overall campaign.

⁹⁹ The momentum after the first Gulf War to refine and perfect the technologies and techniques that won that war make little sense if considered within the fluidic metaphor concept. Indeed, that dominance would force a rational adversary to look to asymmetric (V-I) methods for countering overwhelming U.S. viscous strength.

¹⁰⁰ Beckett and Pimlott, Armed Forces & Modern Counterinsurgency, 49.

¹⁰¹ Unless faced with national extinction at the hands of an invader, the U.S. would never desire nor be able to become a purely inviscous force.

¹⁰² Regrettably, evidence of this outlook is abundant in the failure of the U.S. Army to codify small wars doctrine after the Philippine and Cuban experiences of the early 20th century and then again after Vietnam. To their credit, the USMC did gather their own lessons and those of the Army into their Small Wars Manual; however, this was also neglected after the interwar period as the Marines became more focused on amphibious warfare. Bickel, Mars Learning, 49.

¹⁰³ Since their inception, special operations forces have performed many roles varying from inviscous to viscous on a smaller scale. The U.S. was on the right track when it designated USSOCOM as the lead combatant command for the war on terror and boosted it with the MARSOC. However, special operations forces are still too small, too focused on direct action missions, and lack the clout to compete with U.S. viscous forces for resourcing within DoD and on Capitol Hill.

¹⁰⁴ This idea was intelligently proposed by D. Robert Worley. See “A Small Wars Service,” Joint Force Quarterly, (1st quarter 2007), in which he advised that the entire USMC be subsumed within SOCOM to form our nation’s Small Wars Force. Sean Naylor recently reported on a similar concept of standing up “an unconventional warfare command” that focused on standing up a new service to “handle the nagging, intractable political-military challenges” that don’t require conventional force to solve. Sean D. Naylor, “A Special Debate: Support grows for standing up an unconventional warfare command,” Armed Forces Journal, (November 2007), 30, 34.

¹⁰⁵ The Western or American view is often one that believes desired outcomes can be achieved in half the time if twice the effort is expended—the more money and resources applied, the faster and better the result. This linear view is often flat wrong in war. Achieving a desired end state in war can be more like growing a tree. One cannot grow a tree twice as fast by giving it twice as much sun, water, and fertilizer. In fact, such an approach might indeed kill the tree. An Eastern balance is more often effective, especially for inviscous adversaries, to influence the system holistically towards the political goal.

¹⁰⁶ Lawrence, Seven Pillars of Wisdom, 196.

¹⁰⁷ Clausewitz, On War, 597. Of note: the American Revolution lasted longer than both world wars of the 20th century combined. The Huk Rebellion and Algerian Wars lasted eight years, the Malayan Emergency twelve, and Mao’s revolution decades.

¹⁰⁸ Clausewitz, On War, 78.

¹⁰⁹ Since it is tied to the nature of war, the fluidic metaphor applies across time and is independent of the march of technology and science as well as the evolution of doctrine and tactics. As this work has shown, examples of war as viewed with the language of the fluidic metaphor abound from the earliest times until today.

Bibliography

- Baumann, Robert F. (1997, March-April). Historical Perspectives on Future War. Military Review.
- Beckett, Ian F. W. and John Pimlott. (1985). Armed Forces and Modern Counterinsurgency. New York: St. Martin's Press, Inc.
- Beyerchen, Alan. (1992/93, Winter). Clausewitz, Nonlinearity, and the Unpredictability of War. International Security, 59-90.
- Bickel, Keith B. (2001). Mars Learning: The Marine Corps' Development of Small Wars Doctrine, 1915-1940. Boulder, CO: Westview Press.
- Bond, COL Margaret S. (2007, 30 March). Hybrid War: A New Paradigm for Stability Operations in Failing States. Carlisle Barracks, PA: US Army War College Research Paper.
- Bullock, LT COL Mike. (2007, January). Unconventional Thinking. Armed Forces Journal, 22, 23.
- Carey, Bjorn. (2007, October). The Hard Science of Making Videogames. Popular Science, 68-72.
- Chandler, David G. (1966). The Campaigns of Napoleon. New York: MacMillan.
- Clausewitz, Carl Von. (1976). On War. (Michael Howard & Peter Paret, Trans., Eds.). New Jersey: Princeton University Press.
- Danzig, Richard. (2007, August). What's America's grand plan? Armed Forces Journal, 16-20.
- Dederer, John M. (1983, October). Making Bricks Without Straw: Nathanael Greene's Southern Campaigns and Mao Tse-Tung's Mobile War. Military Affairs.
- Echevarria, COL Antulio J. (2005). Fourth Generation War and Other Myths. Carlisle Barracks, PA: Strategic Studies Institute.
- Fox, Robert and Alan T. McDonald. (1985). Introduction to Fluid Mechanics, 3rd Edition. New York: John Wiley & Sons.
- Galula, David. (1964). Counterinsurgency Warfare: Theory and Practice. New York: Frederick A. Praeger Publishers.
- Gharajedaghi, Jamshid. (1999). Systems Thinking: Managing Chaos and Complexity. Boston, MA: Butterworth Heinemann.

-
- Gleick, James. (1987). Chaos: Making A New Science. New York, NY: Penguin Books.
- Guralnik, David B. (Ed.). (1986). Webster's New World Dictionary. New York, NY: Prentice Hall Press.
- Heydte, Friedrich August Frhr. von der. (1986). Modern Irregular Warfare: In Defense Policy and as a Military Phenomenon. (George Gregory, Trans.). New York, NY: New Benjamin Franklin House.
- Jomini, Antoine Baron de. (1971). The Art of War. ed. G.H. Mendell and W.P. Craighill. Westport, CT: Greenwood Press.
- Lambakis, Steven J. (2004, December). Reconsidering Asymmetric Warfare. Joint Force Quarterly, Issue 36, 102-108.
- Lawrence, T. E. (1932). Guerrilla. UK: Encyclopedia Britannica, Ltd., 952.
- (1991). Seven Pillars of Wisdom: A Triumph. New York, NY: Doubleday.
- (1920, October). The Evolution of a Revolt. Army Quarterly and Defence Journal, 55-69, (repr. Combat Studies Institute, 1999).
- Liang, Qiao and Wang Xiangsui. (1999, February). Unrestricted Warfare. Beijing: PLA Literature and Arts Publishing House.
- Lind, William S. (2003, 8 March). 4th Generation Warfare and the Dangers of Being the Only Superpower: A Warning from Clausewitz. Counterpunch.
- Linn, Brian McAllister. (2000). The Philippine War 1899-1902. Lawrence, KS: University Press of Kansas.
- Liotta, P. H. (2002, Summer). Chaos as Strategy. Parameters, US Army War College Quarterly, 47-56.
- Moseley, GEN T. Michael. (2007, Fall). Airmen and the Art of Strategy. Strategic Studies Quarterly, 7-19.
- Naylor, Sean D. (2007, November). A Special Debate: Support grows for standing up an unconventional warfare command. Armed Forces Journal, 30-32, 34, 47.
- Pellegrini, LT COL Robert P. (1997, August). The Links between Science, Philosophy, and Military Theory: Understanding the Past, Implications for the Future. Maxwell AFB, AL: Air University Press.

-
- Petraeus, LT GEN David H. (2006, December). FM 3-24/MCWP 3-33.5 Counterinsurgency. Pentagon, Washington DC: Headquarters, Department of the Army.
- Power, Samantha. (2007, 29 July). Our War on Terror. The New York Times.
- Rosen, Stephen Peter. (2002, May-June). The Future of War and the American Military: Demography, technology, and the politics of modern empire. Harvard Magazine.
- Simon, Herbert. (1996). The Sciences of the Artificial, 3d ed. Cambridge, MA: The MIT Press.
- Sumida, Jon T. (2006). Engaging the Clausewitzian Mind. Unpublished manuscript.
- Tzu, Sun. (1993). Sun Tzu: The New Translation, The Art of War. (J. H. Huang, Trans.). New York, NY: William Morrow Company, Inc.
- Tzu, Sun. (1963). The Art of War (Samuel B. Griffith, Trans.). Oxford: Oxford University Press.
- van Creveld, Martin. (2007, 25 October). War and Technology. Foreign Policy Research Institute Newsletter. Retrieved from the World Wide Web on 5 February 2007. <<http://www.fpri.org/footnotes/1225.200710.vancreveld.wartechology.html>>.
- Van Riper, Paul and Robert H. Scales, Jr. (1997, Autumn). Preparing for War in the 21st Century. Parameters, US Army War College Quarterly, 4-14.
- Wilson, Jeremy. (1998). Lawrence of Arabia. Phoenix Mill, U.K.: Sutton Publishing.
- Winton, Harold R. (1988). To Change an Army: General Sir John Burnett-Stuart and British Armored Doctrine, 1927-1938. Lawrence, KS: University Press of Kansas.
- Worley, D. Robert. (2007, 1st Quarter). A Small Wars Service. Joint Force Quarterly, National Defense University Press, issue 44, 28-33.

GLOSSARY OF ACRONYMS

4GW – 4th Generation Warfare

COG – Center Of Gravity

CSAF – Chief of Staff of the Air Force

DIME – Diplomatic, Information, Military, Economic (Instruments of Power)

DOD – Department of Defense

FM – Field Manual

H-H – Hybrid versus Hybrid

H-I – Hybrid versus Inviscous

H-V – Hybrid versus Viscous

I-I – Inviscous versus Inviscous

IO – Information Operations

IOP – Instruments of Power

JP – Joint Publication

M_f – The Fluidic Metaphor

N-S – Navier-Stokes Equation

OIF – Operation IRAQI FREEDOM

PAVN – People's Army of Vietnam

RMA – Revolution in Military Affairs

SC – Strategic Communications

SOF – Special Operations Forces

US – United States

USA – United States Army

USAF – United States Air Force

USMC – United States Marine Corps

USSOCOM – United States Special Operations Command

VC – Viet Cong

V-I – Viscous versus Inviscous

V-V – Viscous versus Viscous

WWI – World War I