

The US Army War College Quarterly: Parameters

Volume 32
Number 1 *Parameters Spring 2002*

Article 10

5-6-2002

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Recommended Citation

Paul Murdock, "Principles of War on the Network-Centric Battlefield: Mass and Economy of Force," *Parameters* 32, no. 1 (2002), doi:10.55540/0031-1723.2082.

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Principles of War on the Network-Centric Battlefield: Mass and Economy of Force

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From *Parameters*, Spring 2002, pp. 86-95.

"Economy of Force: Allocate minimum essential combat power to secondary efforts."

"Mass: Concentrate the effects of combat power at the decisive place and time."

-- US Army Field Manual 3-0, *Operations*, 2001

Mass and economy of force are intimately related principles of war. This article explores the characteristics of this relationship and how new warfighting concepts and capabilities--in particular, network-centric warfare--are likely to change that relationship and even the principles themselves.

Economy of force has the distinction of being one of the most misunderstood and unappreciated principles of war.[1] The confusion as to its meaning is no doubt because of the connotations of the word "economy"; in particular, most of us associate the idea of economy with reducing cost--that is, "economizing." Hence, some believe that the principle encourages operational commanders to use as little combat power as possible to achieve the mission--that the commander should be frugal.

However, as Bernard Brodie once observed, when originally propounded the concept meant "to suggest shrewd husbandry or usage" of military forces.[2] The commander was to employ effectively *all* available combat power--massing forces to achieve the primary objective while allocating minimum, but all necessary and essential, power to secondary tasks. Hence, the true sense of the concept is well stated in the US Army's doctrinal Field Manual 3-0, *Operations*: "Economy of force is the reciprocal of mass. It requires accepting prudent risk in selected areas to achieve superiority--overwhelming effects--in the decisive operation. Economy of force involves the discriminating employment and distribution of forces. Commanders never leave any element without a purpose. When the time comes to execute, all elements should have tasks to perform." [3] Carl von Clausewitz was also adamant that all forces be used:

If a segment of one's force is located where it is not sufficiently busy with the enemy, or if troops are on the march--that is, idle--while the enemy is fighting, then these forces are being managed uneconomically. In that sense they are being wasted, which is even worse than using them inappropriately. When the time for action comes, the first requirement is that all parts must act.[4]

Shrewd and Judicious Effects

Justification for employing all forces, and in a calculated or "shrewd" manner, arises from the numerous instances where commanders lost battles at least partly because they failed to do so. For example, in the American Civil War, General Robert E. Lee's Confederate army defeated General Joseph Hooker's Federal force at Chancellorsville in 1863 despite Hooker's large numerical advantage--half the Northern troops never engaged. At sea, the World War II battle of Midway in 1942 is instructive. The Japanese theater commander, Admiral Isoroku Yamamoto, commanded over 160 warships to Admiral Chester Nimitz's 76; but some of them, including two light carriers, were thousands of miles away carrying out a needlessly elaborate distraction scheme.[5] Arguably, if Yamamoto had massed more assets and more

logically arrayed his total force, the Japanese would have won, despite the American signals intelligence advantage and strokes of luck.[6]

The straight fact is that massing forces is not always the best means to effectively employ them. Properly conducted economy-of-force operations can be just as important, or more so. For instance, an operational commander could "practice" economy of force in order to create opportunities. Traditionally, opportunities have been created by the shrewd and balanced dispersion of combat power; such dispersion can compel the enemy to do the same, or to at least adjust the disposition of his own forces. Ideally the enemy's response facilitates the execution of the commander's operational idea, making the main attack more effective by allowing a preponderance of combat power at the decisive time and place. In short, the units assigned economy-of-force missions may have as significant an influence upon the outcome of a battle as those actually massed at the decisive place. (To be fair to Yamamoto, his Northern [Aleutians] Force had been conceived as a distraction, to lure elements of the weakened US fleet from the Central Pacific, that is, Midway.)

Of course, inappropriate enemy dispersion can be encouraged by more means than just the clever disposition of one's own forces. For example, operational deception might help. During the Persian Gulf War, the United States and the United Kingdom operated amphibious ships and minesweepers in the northern Arabian Gulf, inviting the Iraqis to think there would be an amphibious landing on the beaches of Kuwait. This deception tied up several Iraqi divisions, which were therefore not well positioned to help resist the main coalition attack.

In a different vein, wise economy-of-force tactics can also be the basis of an indirect approach to the ultimate objective, as explained by the 20th-century military theoretician B. H. Liddell Hart.[7] One such option is an advance that employs all of one's forces in several simultaneous, mutually supporting thrusts that can threaten more than one intermediate objective, obliging the enemy to defend all of them. General William T. Sherman, in the American Civil War, called this placing the enemy "on the horns of a dilemma." If remarkable success is achieved or critical vulnerabilities are revealed or created, the commander can exploit them--by changing intermediate objectives, or by attacking a vulnerability. The commander would thereby proceed toward the ultimate objective by the actual, as opposed to the apparent, line of least resistance. This would be better than making the intermediate objectives obvious--as is likely if forces are concentrated against them--because the enemy can more easily defend them.

Economy of force, then, need not be a passive or defensive concept, with the true "action" happening elsewhere. Operationally it should have more profound dimensions--it is more than the employment of forces for limited attacks, delays, or retrograde operations.

Further, forces that attack at the decisive point need not be larger than those assigned economy-of-force missions. The words "mass" and "concentrate," and the idea that economy of force is the "reciprocal" of mass, may create the incorrect impression that combat power must be distributed in that manner. Instead, combat power concentrated for the decisive action must simply be more powerful than the enemy when and where battle begins, or at least at the crucial place and time. We have already noted that the commander should assign as small a proportion of the force as possible to secondary missions. That said, however, in some situations the larger the force used for secondary missions, the so-called "economy-of-force missions," the more likely is the enemy to compromise his defense against the main attack. Decisions pertaining to the strength of forces are not about frugality; they are about balance, effectiveness, and calculated risk.

Let us more thoroughly consider what is meant by "mass." Mass has traditionally meant the concentration of people, weapons, etc., where and when it mattered most. US Army doctrine in 1986 defined mass in an aphorism: "Concentrate combat power at the decisive place and time." [8] This familiar explanation was too limited; newer doctrine issued by the Army corrected that defect. [9] Current definitions refer to massing the *effects* of combat power. The effects massed are primarily those of "fires" (modes of delivering weaponry against an enemy, usually at long range and having an operational-level effect upon the enemy)--lethal and nonlethal, direct or indirect--seeking to disrupt, divert, delay, or destroy enemy forces or information systems. Still, the concept of mass encompasses even more: it embraces any resource that can increase power to influence the enemy--for example, logistics.

The effects are what is important. The goal of war is to achieve political goals by using organized violence to influence

the mind and behavior of the enemy leadership. Joint doctrine duly refers to massing effects "to achieve decisive results." The idea is to achieve such a strong impact as to compel the enemy to accept the political goals of one's government. To mass effects that do not contribute to this end is to practice poor operational art. For example, the German offensives of March 1918 did not contribute to ultimate ends. The operational commander, General Erich Ludendorff, frittered away his strength against "the line of least resistance," repeatedly changing both the axis and objective of offensives, with no operational design in view leading to the strategic defeat of the allies.[10] Ludendorff was eventually forced to recommend that Germany seek peace, partly because he had wasted combat power in strategically nonproductive tactical efforts. This illustrates why a good operational practitioner must know not just when and where to attack, but when and where not to.

The massed effects should produce results by attaining objectives that clearly contribute to the enemy's eventual defeat. For example, it would be proper to mass effects to control decisive points so that subsequent attacks can be made upon enemy centers of gravity. An illustration of this, and of a proper balance between mass and economy of force, is General Douglas MacArthur's World War II island-leapfrogging campaign in the southwest Pacific.[11] During the campaign, from Australia through the Philippines to Japan, MacArthur's South West Pacific Command fought on New Guinea and the Admiralty Islands to seize airfields or harbors, but it bypassed and isolated Japanese-held strongholds. By this formula MacArthur could pick the time and place of battle, using air and naval forces to protect his flanks while concentrating combat power for the next thrust. Confusing the enemy as to where he might strike did not even require tying up Allied forces in diversions. In some ways this island-leapfrogging was much like a naval campaign, with rapid maneuver in very large spaces, surprise, then the massing upon the enemy.

An important reason that mass is now defined in terms of effects is that it has become very dangerous to mass "platforms" and people. This is certainly true when facing weapons of mass destruction; however, some conventional weapons can be nearly as devastating--as was demonstrated in the Gulf War at Khafji and on the "highway of death" from Kuwait City to Basra.[12] New technologies are making it possible to mass even more destructive fires, and ways are being evolved to do so in the framework of an economy of force. What is that evolution likely to produce?

Network-Centric Mass

US joint vision statements have set forth what American forces are expected to be able eventually to accomplish.[13] One architecture proposed to implement these visions is what some have called "network-centric warfare." Such investigations as the Navy's "fleet battle experiments" and the Air Force's "expeditionary force experiment" suggest how the joint goals may be, or already are being, attained. We can draw from them some preliminary conclusions as to how economy of force may soon be practiced, and how the effects of combat power may be massed.

However, a disclaimer is appropriate: what will be described is a work in progress. Many technological problems have to be overcome before network-centric warfare can exist as an operational capability. Also, doctrine has yet to be developed for it--and this is probably a larger challenge than the technological.[14] Even so, we can expect the future to realize much of this vision.

Three Grids

The architecture for network-centric warfare will probably comprise three elements: the sensor grid, the information grid, and the transaction (or engagement, or "shooter") grid.[15] The *sensor grid* could be composed of diverse sensors such as radar of various types, radio-frequency-emission and infrared receivers, low-light-level and other optical devices, acoustic systems, and people. These sensors could be in orbit, in the air, on the ground, or at sea. Some would be permanently in place, others plugged in as and where needed and available.

The *information grid*, much of it permanently in place, would comprise, for example, communications satellites, data-transmission lines, microwave relays, computers, and command centers. The information grid would transmit sensor information, recommendations and orders, intelligence, and real-time information about operations, logistics, and other functions--information needed by leaders at all levels to plan, monitor, and control operations more effectively, efficiently, and responsively.

The *transaction grid* would draw upon the sensor and information grids to pair weapons incorporated into it with

targets and then guide weapons to targets as necessary. Some of the weapons available would require guidance all the way. Others (like sensor-fused weapons, "brilliant" submunitions, and wide-area munitions) are autonomous, needing only to be guided into the general area of action, where they find and identify targets with their own sensors (typically employing infrared for vehicles, acoustic for armor, seismic for personnel) and then attack them on their own "initiative."

The number of weapons and weapon systems that could be plugged into the transaction grid is large and growing. On land, examples include the Army Tactical Missile System, which can dispense brilliant antitank submunitions; artillery-fired, sense-and-destroy-armor, sensor-fused weapons; and tanks such as the M1A2. Ships would also join the grid, with weapons like the five-inch/62-caliber gun (firing projectiles with Global Positioning System [GPS] or inertial guidance up to 63 miles), the Tomahawk cruise missile (several versions), and land-attack Standard missiles. Fixed-wing aircraft would be able to deliver many types of precision weapons--the Joint Standoff Weapon (dispensing sensor-fused weapons), the Standoff Land-Attack Missile (Expanded Response), and Joint Direct-Attack Munitions. Helicopters would also attach to the grid, shooting Hellfire or other missiles, as would information warfare assets.

The transaction grid should represent an extremely lethal and responsive precision-engagement capability, out to hundreds of miles from a shooter. This should be true for several reasons. One is that weapons will be very accurate, because of the guidance provided by GPS, laser-designation, and inertial systems. Another is that some sensors and many weapon systems will be "retaskable," able to locate and destroy suddenly appearing or time-sensitive targets.[16] Additionally, many weapon platforms will have the range and versatility to be used against almost any target within the battle space, while autonomous weapons, as noted, can find and attack targets without outside intervention, once in the vicinity. Furthermore, the transaction grid, buttressed by GPS, digital maps, computers, and display systems, should be able accurately to merge data from sensors. All these things, and more, will make it common for ships, aircraft, and other weapon-launching platforms to have engagement-quality information about targets that their own sensors have not detected.

Parallel Warfare

What implications might network-centric warfare have for these two principles of war, mass and economy of force? First, network-centric warfare could permit a geographically dispersed force to operate as a system--in effect, as a "dispersed mass." That is, such a force, though its elements might be spread over a large area, should be able to concentrate precision weapons rapidly upon targets hundreds of miles away. Further, its units may be able to mass fires not only with decisive effect but without needing to maneuver--without, that is, having to get closer to targets, avoid geographical constraints, or achieve some positional advantage. Moreover, network-centric warfare offers the flexibility, operational reach, and battlespace awareness needed to operate on the strategic, operational, and tactical levels at once. It will enable disparate and distant forces to attack targets of various kinds--centers of gravity, critical vulnerabilities, operational functions, tactical forces--simultaneously. In short, combat would no longer have to proceed in the traditional step-by-step, or serial, manner; neither would there be any single axis of effort or point of main attack. Combat would instead be multidimensionally and comprehensively joint.

Punishing and threatening the enemy at all three levels of war at once can achieve substantial and beneficial results, particularly, for instance, if one's own ground forces can make the enemy operate where he can be subjected to precision strikes. Such "parallel war" can produce the systematic disruption of the enemy's operational functions.[17] Comprehensive attacks would be, arguably, especially effective if enemy leadership were targeted.[18] Parallel war might be able to "lock out" (preclude) options, create despair, even lead the enemy to give up.[19] The point is that to achieve results of such magnitude, fires must often be distributed, coming from diverse locations, killing the enemy not with one massive blow but by "a thousand vital cuts" that collectively induce a paralyzing hemorrhage of will. This could be a more significant blow to the enemy than would normally be achieved through the traditional massing of fires.

Furthermore, network-centric warfare, by making a force capable of concentrating fires precisely where desired, may be able to influence enemy actions and perceptions of options in ways that once only forces on the spot, and usually on the ground, could achieve. That is, the capabilities offered by a network-centric warfare force should produce operational advantages and second-order consequences that once required the tangible presence, and particular

physical dispositions, of combat power--that is, those examined in discussions of economy of force.

However, balance requires us to minimally acknowledge that induced changes in an enemy's behavior--that is, the effects of network-centric operations--may present either new opportunities or new challenges. How enemy behavior might be changed by network-centric warfare in itself is necessarily speculative. Nonetheless, the concept of "effects-based operations" is a fundamental part of the network-centric concept; the following is illustrative of the kinds of behavioral effects envisioned.

Adversaries confronting a network-centric warfare force will probably risk massing power only at the specific time and place of their main attack. They may do so, further, in a tentative and covert manner, rightfully fearful that the open movement of forces will draw massed fires, as at Khafji in 1991. This should make operationally significant surprise difficult for the enemy to achieve, and it should lessen the effectiveness of any attack delivered. Enemy forces may also feel constrained to intermittent raid-like operations, perhaps down to the terrorist level, though these may be conducted on a broad geographic scale. Tactical actions will probably be sharp and high in tempo; enemy units will be trying to "merge and grapple" as rapidly as possible with US forces in order to escape precision fires. At the same time, a foe's ability to disperse and build up power, so as to create subsequent operational opportunities, will be substantially less than in the past; enemy commanders will probably decide, correctly, they must fight with what they have on hand, knowing that follow-on forces and logistical support likely would be decimated. While the enemy's opportunity to employ the economy-of-force principle may be physically less than in the past, beware his attempts to do so on other levels, such as through operational deception.

An attacking force employing network-centric concepts could expect to see attempts at "mobile defense," such as have been used to defend against the uncertain impact of amphibious assaults.[20] That is, the defenders may have to wait to see what the network-centric warfare force does, where it concentrates its effort, before they can react. The physical disposition of the attacking force need no longer be shaped with respect to the intended objective, and thus perhaps reveal it; the enemy would be confronted by a "shapeless" threat force, possibly hundreds of miles across, that could strike anywhere in a vast area. Of course, reliance on a mobile defense abandons the initiative--another principle of war--and a force waging network-centric warfare is uniquely able to exploit such a situation.

A final significant implication of network-centric warfare is that a force may be able to simultaneously perform missions associated with economy of force and with massing. For instance, an *Arleigh Burke*-class destroyer should be able to help escort a battle group while participating (with its long-range gun and cruise missiles) in a main attack against the shore. The Army Tactical Missile System should have the same versatility. One result would be a substantial reduction in the resources once reserved exclusively for such missions as force protection.[21]

How Much Mass Is Required?

Does the principle of mass require a commander to try to concentrate "overwhelming combat power"?[22] It can be difficult to determine how much force is necessary to achieve an objective, but somehow the commander must decide how much should be dedicated to the decisive attack. A rule of thumb has evolved for estimating the force ratio an attacker on land needs over a defender--the "three-to-one rule," possibly first written about by President Abraham Lincoln in 1863.[23] This "rule" has become so much a part of military culture in the United States that few question it; many assume it can be applied to other situations, such as war at sea. In fact, however, it is not of much use even on land. At best it is most appropriate for static, attritional warfare situations; it does not attend well to asymmetrical combat, where disparate forces contest. Even if the three-to-one ratio might have validity for infantry opposing infantry, what if infantry is attacked by tanks? The "rule" is virtually useless in contemporary contexts; it will be even less relevant in the future.

All this may explain in part why Clausewitz was so circumspect about numbers and their implications for combat. To be sure, he felt that numbers were important; if all things between opposing forces except numbers were equal, he held, numbers would determine the result. However, Clausewitz argued that other factors, particularly leadership and maneuver, affected the outcome of battle just as profoundly, citing historical examples in which smaller forces defeated larger.[24] Such inherent complexity is one reason that we speak of operational "art" instead of "science." In spite of all efforts to reduce such matters to calculation, they come down to the intuition, the *coup d'oeil*, of the

commander. Mass can not be understood simplistically--nor can economy of force.

If it is a complicated matter to determine how much force is needed to defeat an enemy, part of the problem is that US doctrine calls for "overwhelming" the enemy. While this is not a bad goal in itself, more is not always better. At some point the law of diminishing returns asserts itself, and the addition of combat power does not contribute at all to the final outcome.[25]

Having too much power does not sound like a problem; but, in fact, adding more force when one already has enough to prevail decisively--and the word "overwhelming" creates a predisposition always to seek greater numerical advantage--can have negative consequences. First of all, it may make execution more difficult: envision all the elements of a very large force trying to do the same thing in the same place at the same time.

Another problem with assembling overwhelming combat power is that it becomes more difficult to surprise the enemy, at least above the tactical level. Even network-centric warfare--which relies upon technology, precision fires, training, doctrine, and maneuver--may also require, or at least benefit from, surprise to defeat an enemy with initial advantages of numbers and position. To be sure, technologies like stealth can increase the chances of tactical surprise, but a large force is still harder to hide than a smaller one. Fortunately, in network-centric operations the initial attack elements need not be near the intended area of operations; even if detected, their operational reach and maneuverability should conceal where their concerted main effort will fall.

There is, then, no simple formula for concentrating combat power, especially (as in traditional warfare concepts) platforms and people. Tomorrow's commander must have a correct understanding of what economy of force actually entails, especially how it can help create operational opportunities, and what the application of mass does (and does not) require. He will need to think in terms of "decisive" power, and of balance and economy--assembling a force that is large enough to achieve the mission with near certainty, and so disposing it that all of its elements are usefully employed and effectively proportioned. There is an element of "shrewdness" in both massing combat power and in practicing economy of force--as is to be expected, since the two are intimately related.

NOTES

1. The principles of war are objective, offensive, mass, economy of force, maneuver, unity of command, security, surprise, and simplicity. US Army, *Operations*, Field Manual (FM) 3-0 (Washington: GPO, 14 June 2001), pp. 4-11 to 4-15; US Joint Staff, *Doctrine for Joint Operations*, Joint Pub 3-0, (Washington: GPO, 1 February 1995), app. A., p. A-1.
2. Bernard Brodie, "The Worth of the Principles of War," lecture delivered 7 March 1957 to the US Army Command and General Staff College, Fort Leavenworth, Kans. See also C. R. Brown, "The Principles of War," *US Naval Institute Proceedings*, 75 (June 1949), 621-33.
3. FM 3-0, p. 4-13.
4. Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton, N.J.: Princeton Univ. Press, 1989), p. 213.
5. Samuel Eliot Morison, *The Two-Ocean War* (Boston: Little, Brown, 1963), p. 148. On this tendency see David C. Evans and Mark R. Peattie, *Kaigun: Strategy, Tactics, and Technology in the Imperial Japanese Navy, 1887-1941* (Annapolis, Md.: Naval Institute Press, 1997), pp. 447-517.
6. For an excellent new interpretation of that battle, see Dallas Isom, "The Battle of Midway: Why the Japanese Lost," *Naval War College Review*, 53 (Summer 2000), 60-100.
7. B. H. Liddell Hart, *Strategy* (New York: Penguin Books, 1991), pp. 332-37. Hart's ideas about maneuver war and the indirect approach are still valid and exciting. They may be useful for those writing doctrine for network-centric warfare.

8. US Army, *Operations*, FM 100-5 (Washington: GPO, May 1986), p. 174. In this version of the US Army's principles of war there is no reference to the massing of effects: only of concentrating combat power. There is also no mention of "overwhelming" combat power, though the explanation of mass does refer to employing "a predominate of national power" in certain situations.
9. FM 3-0, p. 4-13.
10. John Keegan, *The First World War* (New York: Random House, 1999), p. 404.
11. Morison, p. 282. See "Summary of RENO III, Outline Plan for Operations of the Southwest Pacific Area to Reoccupy the Southern Philippines, Prepared by the GHQ, SWPA, 20 October 1943," as collected in Milan Vego and Robert Strahan, comps., *Operational Art Historical Companion* (Newport, R.I.: US Naval War College, September 1998), pp. 140-45. Nimitz's Central Pacific operations contributed to MacArthur's South West Pacific successes.
12. Richard P. Hallion, *Storm over Iraq* (Washington: Smithsonian Institution, 1992), pp. 220-21, 235-36.
13. US Joint Staff, *Joint Vision 2020* (Washington: GPO, 2000), pp. 3-45.
14. Paul Johnston, "Doctrine Is Not Enough: The Effect of Doctrine on the Behavior of Armies," *Parameters*, 30 (Autumn 2000), 30-39. Doctrine is a serious issue; too many military personnel have a cavalier attitude about it. Incorrect doctrine has killed millions.
15. Arthur Cebrowski and John Garstka, "Network Centric Warfare: Its Origin and Future," *US Naval Institute Proceedings*, 124 (January 1998), 28-35; Office of the Secretary of Defense (Net Assessment), Arlington, Va.; David S. Alberts, John J. Garstka, and Fred Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, internet, <http://www.dodccrp.org/NCW/nw.html>, accessed 15 May 2001; and Frederick Stein, "Observations on the Emergence of Network Centric Warfare," in *1998 Command and Control Research and Technology Symposium Proceedings*, June 1998, internet, <http://www.dodccrp.org/steinncw.htm>, accessed 14 December 2001.
16. For the potential, see Commander Second Fleet and Maritime Battle Center draft paper, "Fires/Precision Engagement Concept of Operations (CONOPS) for Fleet Battle Experiment Hotel," draft, 15 June 2000, internet, <http://www.nwdc.navy.mil/mbchome/hotel/files/HotelFiresPEconopsDraft1.doc>, accessed 15 May 2001.
17. See Antulio J. Echevarria II, "Fusing Airpower and Land Power in the Twenty-first Century," *Airpower Journal*, 13 (Fall 1999), 66-74.
18. John A. Warden, "The Enemy as a System," *Airpower Journal*, 9 (Spring 1995), 40-55.
19. Cebrowski and Garstka, pp. 28-35.
20. Theodore L. Gatchel, *At the Water's Edge* (Annapolis, Md.: Naval Institute Press, 1996), p. 5.
21. Planners, though, must make provision for such requirements. For example, if the commander does not allocate a portion of available combat power exclusively to the mission of force protection, he or she should make it clear to the entire force how force protection is to be accomplished.
22. Actually, recent doctrine refers to massing decisive force to "overwhelm an adversary" or "combat power to overwhelm enemies." See Joint Chiefs of Staff, *1997 National Military Strategy of the United States*, (Washington: GPO, 1997), executive summary; and FM 3-0, p. 4-13.
23. T. N. Dupuy, *Understanding War* (New York: Paragon House, 1987), pp. 31-37.
24. Clausewitz, pp. 194-201.

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