

Assessing the Conventional Balance

John J. Mearsheimer

The 3:1 Rule and Its Critics

The conventional balance in Europe has lately become the focus of intense debate. Until now participants in this debate have concentrated on the substance of the issue—whether NATO forces can defend successfully—while leaving aside methodological questions. Specifically, although analysts use widely different methods, there has been little debate about which methods are most reliable.

Recently, however, Joshua Epstein published a criticism of others' work that raises important methodological questions that merit close scrutiny.¹ One of Epstein's principal criticisms is directed against the well-known and widely accepted 3:1 rule of thumb.² This rule posits that the attacker needs a local advantage of at least 3:1 in combat power to break through a defender's front at a specific point. Epstein purports to offer historical evidence that disconfirms the 3:1 rule.

The 3:1 rule applies to just one aspect of a campaign, namely, breakthrough battles in which the attacker attempts to pierce the defender's forward defenses. It does not bear on other important events that affect the outcome of the campaign. Specifically, it is not relevant to analyzing each side's ability to concentrate forces at main points of attack before and during the breakthrough battle, and it has little relevance to the attacker's ability to execute a deep strategic penetration following a breakthrough.³

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John Mearsheimer is a Professor in the Political Science Department at the University of Chicago. He is the author of Conventional Deterrence (1983) and Liddell Hart and the Weight of History (1988).

1. See Joshua M. Epstein, "Dynamic Analysis and the Conventional Balance in Europe," *International Security*, Vol. 12, No. 4 (Spring 1988), pp. 154–165.

2. In this article Epstein also criticizes other approaches to conventional net assessment. His four principal targets are "bean counters," proponents of the 3:1 rule, the Attrition-FEBA Expansion Model devised and explicated by Richard Kugler and Barry Posen, and proponents of Lanchesterian approaches, such as William Kaufmann.

3. A synopsis of these and other factors that would decide a European campaign is found in

However, breakthrough battles would be crucial in a European war, and NATO's success would ride on its ability to win these battles. Many analysts use the 3:1 rule to assess these battles; the rule thus underpins many assessments of the European conventional balance,⁴ and is central to many estimates of NATO force requirements and evaluations of conventional arms control proposals. Hence if Epstein's criticisms of the 3:1 rule were correct, they would have important policy implications.

His criticisms, however, are not valid. When the 3:1 rule is evaluated against the proper evidence it appears quite reliable. Epstein's case against the rule rests on misuse of a historical data base which is itself flawed. Epstein also fails to report better historical data, presented by Colonel Trevor Dupuy in one of the studies that Epstein relies upon. Had he presented this data his case would largely have collapsed.

Epstein also claims that he has developed a model for breakthrough battles that overcomes the deficiencies of the 3:1 rule and the other models he criticizes. An examination of Epstein's model, however, indicates that it is seriously flawed, as is the manner in which he has used it to measure the conventional balance in Europe. His analysis rests on a false picture of a modern armored offensive, and the tactics available for defense against it.

Epstein and I are in broad agreement on the state of the European balance—both of us are qualified optimists who believe that NATO has better-than-even chances to defend successfully if NATO forces are promptly mobilized. However, Epstein reached a conclusion I think is correct using unsound methods.

The section immediately following outlines the case for the 3:1 rule. The next section explains how the rule should be used in analysis. The following section presents the case against the rule and the flaws in this case, and the final section evaluates Epstein's model.

my "Numbers, Strategy, and the European Balance," *International Security*, Vol. 12, No. 4 (Spring 1988), pp. 174–185.

4. Two recent examples are Frances M. Lussier, *U.S. Ground Forces and the Conventional Balance in Europe* (Washington, D.C.: Congressional Budget Office, June 1988); and *Operational Minima and Force Buildup of the Warsaw Pact and NATO* (Bonn: Ministry of Defense, March 1988). Also see John J. Mearsheimer, "Why the Soviets Can't Win Quickly in Central Europe," *International Security*, Vol. 7, No. 1 (Summer 1982), pp. 3–39; Barry R. Posen, "Measuring the European Conventional Balance: Coping with Complexity in Threat Assessment," *International Security*, Vol. 9, No. 3 (Winter 1984/85), pp. 47–88; and in fact Epstein's own work; see note 45.

The Case for the 3:1 Rule

A rule of thumb is a proposition based on experience or practice. It is not derived by deduction from basic principles, nor from an all-encompassing survey of relevant evidence, nor from a scientific sample of that evidence. Rather, it derives from evidence that an individual or organization accumulates in the normal course of business. As such, a rule of thumb is based on data; it is not simply a haphazard guess. This data is used because it is readily available, not because it perfectly represents the wider universe of relevant cases. In scientific stature, a rule of thumb therefore lies somewhere between an estimate based on an author's informed intuition (hereafter an "author's estimate"), and a relationship proven by testing with a representative data base.⁵ The reliability of a rule of thumb depends on whether the experience that forms its basis is in fact representative of the wider universe of cases. Rules of thumb deserve greater credence the more they can plausibly be said to rest on representative experience. They approach scientifically established axioms in stature if the representative nature of this experience can be established.

Although they are not derived deductively, rules of thumb gain greater credence when a sound deductive case can be made in their favor. Thus, deductive as well as empirical evidence can be used to evaluate rules of thumb.

Epstein maintains that proponents of the 3:1 rule must carefully examine a "respectable sample of historical breakthrough operations . . . and . . . demonstrate the statistical relationship they claim."⁶ While this is desirable, a rule of thumb, by definition, is not derived from a cross-sectional sample of relevant cases. Rather, it is given credibility by showing that experience and deduction do support the rule, and that the experience that forms its support is representative of the total set of relevant cases.

What experience would demonstrate the 3:1 rule? Those who use the rule have not precisely defined the rate of success that they expect defenders to enjoy when attackers lack a 3:1 advantage. However, they have used the rule in a manner suggesting a high, but not perfect, rate of success for

5. It is important to emphasize that an informed author's estimate, although based on substantially less evidence than a rule of thumb, is superior to uninformed guesswork.

6. Epstein, "Dynamic Analysis and the Conventional Balance," p. 155.

defenders in this situation. Thus, it seems reasonable to predict that, if the rule holds, the defender will win most, but not all, breakthrough battles when the attacker's advantage is below 3:1. Therefore, experience should show the defender winning a large majority—perhaps 80–90 percent—of breakthrough battles waged under conditions where the rule applies. In those cases where the defender loses, the attacker's advantage should rarely be far below 3:1. Otherwise the rule is disconfirmed.

Why not go beyond experiential evidence to evaluate the 3:1 rule against a scientific sample of all breakthrough battles? This would be ideal, and I hope future scholars do it. However, the data on breakthrough battles, as on many military questions, is scattered and incomplete. No reliable comprehensive data base on breakthrough battles has been compiled, and to do so would require an effort of several years by several scholars. In the meantime we must rely on experiential evidence, and hence on rules of thumb; where these do not exist, we must rely on informed authors' estimates. Without these tools analysis would not be possible.

Both deductive and empirical evidence support the 3:1 rule. This evidence is now considered.

THE DEDUCTIVE BASIS FOR THE 3:1 RULE

The 3:1 rule derives from the premise that in a breakthrough battle the defender can inflict more casualties than the attacker.⁷ This premise follows from the nature of the battle itself. The defender can fight from prepared positions, where he will be partially concealed and protected from the attacker's fire. He can choose these positions to locate fighting in killing zones that maximize the attacker's exposure to fire. Furthermore, he can create obstacles such as ditches or minefields to impede and channel the attacker's advance toward killing zones. The attacker, on the other hand, must move forward, frequently over open terrain where he will be exposed to the defender's fire. He will have difficulty acquiring the defender's concealed targets, and his fire will lose accuracy from the well-known problems associated

7. The following discussion is based on my reconstruction of the 3:1 rule, inferred from its use by American, Soviet, German, and other military authors. No one has previously explicated the rule in the detail presented here, but nothing in my reconstruction conflicts with how others have used it.

with firing while moving.⁸ For these reasons the casualty-exchange ratio should favor the defender.⁹

As a result, in a combat between forces of comparable quality, the attacker requires a large numerical superiority; otherwise he will collapse before the defender does, and the breakthrough attempt will be beaten. A combat unit collapses when battlefield losses destroy its cohesion, leaving it unable to execute its combat functions.¹⁰ The key to victory is to insure that the other side's forces reach that threshold of losses first.¹¹ If there is rough parity in the size and quality of opposing forces, the attacker will collapse first because the attacker takes heavier losses. He will then be forced to break off his attack. To overcome this problem, the attacker needs a force ratio advantage that is at least as large as the defender's inherent advantage in capacity to inflict casualties. This allows the attacker to suffer the same or fewer casualties per capita, and hence to outlast the defender and overrun his positions, despite taking greater losses.

Thus it can be deduced from the dynamics of combat that an attacker will need a significant advantage in combat power to make a breakthrough.

8. This discussion should not obscure the fact that the attacker can fire from behind obstacles as he moves forward. "Fire and maneuver," as this practice is commonly known, has limited benefits, however, since the attacker must eventually abandon cover and move forward in the open.

9. For a good discussion of the casualty-inflicting advantages that accrue to defenders in breakthrough battles, see *FM 100-5: Operations* (Washington, D.C.: U.S. Department of the Army, July 1, 1976), chaps. 2, 3, and 5.

10. This discussion assumes that the combat skills of the two opponents are basically equal and that therefore both sides disintegrate at the same casualty threshold, that is, after losing the same percentage of their fighting forces. However, one side is sometimes qualitatively inferior to the other and thus collapses at a lower threshold. Adjustments should be made when applying the 3:1 rule in such cases. This discussion also assumes that the disruption of command and control is not a relevant factor, because the breakthrough battle is essentially a contest of attrition in which command and control usually cannot easily be destroyed, and the effects of destroying it are unlikely to be decisive. However, breakthroughs are part of a larger theater-wide blitzkrieg in which destroying the defender's command and control is vitally important.

11. The chemistry of battlefield collapse is not understood in detail. As noted above in note 10, my analysis assumes that both sides collapse at a similar threshold. Two possible qualifications of this assumption seem plausible. First, offense is more demanding than defense and may require greater cohesion. Therefore, the attacker may collapse at a lower threshold than the defender, mandating a force ratio superiority that significantly exceeds his casualty-inflicting disadvantage. Second, it may be easier for the attacker than the defender to break off the engagement. An attacker who finds his losses intolerable can reduce his casualties simply by stopping his forward movement. In contrast, a defender must retreat to break off the engagement. However, this involves moving from a hidden to an exposed posture, and probably from well-known to less-known terrain. As a result, the defender may take even greater losses if he retreats; hence he may choose to stand and fight, even if his losses are very high, where retreating might not improve his situation, and could make it worse.

Specifically, the ratio in combat power must favor the attacker by roughly as much as or more than the casualty-exchange ratio favors the defender. It is not possible, however, to deduce that the necessary ratio is 3:1, rather than 1.5:1 or 10:1, since we cannot establish the defender's exact casualty-exchange advantage by deduction. The attacker's required combat power advantage must therefore be established empirically.

THE EMPIRICAL BASIS FOR THE 3:1 RULE

The empirical case for the 3:1 rule rests largely on the wide belief in the rule within professional militaries, and the experience that led them to endorse it and employ it in planning.

Military experts have long maintained that a key ingredient of battlefield success is to concentrate one's forces at a weak point along the adversary's front, thus creating an overwhelming local superiority in numbers.¹² This principle of war has gained wide usage in the twentieth century, mainly because penetrating an adversary's lengthy front, not turning his flank, has become the central concern of military commanders.¹³

Many military experts have further specified that the local superiority required is on the order of 3:1 or more when an attacker seeks to pierce a defender's front. They drew this conclusion from peacetime analysis and from their own wartime experience in a large number of conflicts. Over time, this 3:1 rule of thumb has achieved widespread acceptance among professional militaries, including the armies of most modern great powers.¹⁴

12. See John I. Alger, *The Quest for Victory: The History of the Principles of War* (Westport, Conn.: Greenwood, 1982).

13. Regarding the distinction between penetration and flanking movements, see John J. Mearsheimer, *Conventional Deterrence* (Ithaca: Cornell University Press, 1983), pp. 30–31. This emphasis on penetration and the need for marked force advantages to accomplish that end is reflected throughout twentieth-century Western military literature. Among the best examples are General Kraft von Dellmensingen, *Der Durchbruch: Studie an der Vorgänge des Weltkrieges, 1914–1918* (Hamburg: Hanseatische Verlagsanstalt, 1937); Colonel Hermann Foertsch, *The Art of Modern Warfare*, trans. Theodore W. Knauth (New York: Oskar Piest, 1940); General Waldemar Erfurth, *Surprise*, trans. Stefan T. Possony and Daniel Vilfroy (Harrisburg, Pa.: Military Service Publishing Company, 1943); General Colmar von der Goltz, *The Conduct of War: A Short Treatise on Its Most Important Branches and Guiding Rules*, trans. G.F. Levenson (London: Kegan Paul, Trench, Trubner, 1908); and Ivan S. Bloch, *The Future of War*, trans. R.C. Long (Boston: Ginn, 1902).

14. The 3:1 rule apparently emerged in Europe during the period between the Franco-Prussian War and World War I. Brigadier General James E. Edmonds implies that this was the case in Germany. He writes in the Official British History of World War I that "It used to be reckoned in Germany that to turn out of a position an *ebenbürtigen* foe—that is a foe equal in all respects, courage, training, morale and equipment—required threefold numbers. Certainly in the battles of 1870 . . . with about equal numbers, no tactical decision was obtained; in all the early battles

American and Soviet military thinkers of the Cold War era have been strong proponents of the 3:1 rule. A survey of American military writings turns up many endorsements of the rule. During World War II it was featured in the umpire manuals for the Army's main training exercises. It was later prominently featured in all the important Army field manuals of the 1970s, including *FM 100-5*, the Army's principal field manual. Moreover, the writings of army officers clarify that support for the rule has not been based on mere faith but rather on examination of wartime experience, peacetime exercises and war games. For example, General William E. DePuy, the driving force behind the development of American army doctrine in the mid-1970s, reports that war games and analysis conducted over a long period at the Army's Combined Arms Center at Fort Leavenworth demonstrate that the defender can cope with a disadvantage of up to 3:1.¹⁵ He also reports that the Army Matériel Systems Analysis Agency at the Aberdeen Proving Ground uses a threshold of 2.6:1, but he concludes that "3 to 1 is a good round figure."

Likewise a mid-1970s study performed by V Corps, one of the U.S. Army's two forward-deployed corps in Germany, confirmed the 3:1 rule based on detailed analyses of 150 potential battle scenarios in its sector, and in addition, a separate array of past tank battles.¹⁶ The study incorporated analysis of actual Warsaw Pact advance maneuvers and intelligence on likely Pact tactics and routes of attack. It then explored battle situations in detail, considering a wide array of basic factors, including: ratios of opposing forces by troop strength and weapon type, rate of enemy advance, visibilities across terrain, best ranges of fire by weapon type, comparative rates of fire, number of

against the French army [where the Germans won victories] the proportion of German infantry to French varied from 5 to 1 down to 2 to 1, and in artillery the Germans were immensely superior." *Military Operations, France and Belgium, 1917*, Volume 2 (London: His Majesty's Stationery Office, 1948), p. 386. Edmonds' various writings and the sources cited in the previous footnote also suggest that the rule gained its currency mainly as a result of experiences on the Western Front in World War I.

15. General William E. DePuy, "Technology and Tactics in Defense of Europe," *Army*, April 1979, pp. 14–15. The principal manifestation of DePuy's influence was the 1976 *FM 100-5*, which has many references to the 3:1 rule. For a good discussion of the development of doctrine under DePuy, which describes in some detail the analysis that underpinned the 1976 *FM 100-5*, see Paul H. Herbert, "Toward the Best Available Thought: The Writing of Field Manual 100-5, Operations by the United States Army, 1973-1976" (Ph.D. dissertation, Ohio State University, 1985).

16. See John L. Romjue, *From Active Defense to AirLand Battle: The Development of Army Doctrine, 1973-1982* (Fort Monroe, Va.: Historical Office, U.S. Army Training and Doctrine Command, June 1984), pp. 23–24.

opportunities to fire, number of commander decisions, and time required to call for and receive attack helicopter support and Air Force close air support. The study concluded that "large attacker-to-defender ratios (5:1 or greater) would be required to overcome an organized, determined defense."¹⁷

The Soviet military has strongly endorsed the 3:1 rule over the past few decades, based on its study of its own experience in World War II. For example, A.A. Sidorenko, drawing on this experience, defines the required superiority to be 3:1 or more in a wide range of weapons and personnel. Specifically, he suggests that attackers require ratios of 5:1 in personnel; 8:1 or 9:1 in artillery; and 3:1 or 4:1 in tanks and self-propelled artillery.¹⁸ The Soviets' belief in the 3:1 rule is also highlighted by the prominence assigned to it in the soon-to-be-published lecture materials from the Voroshilov General Staff Academy in Moscow.¹⁹

Military bias cannot account for the military's endorsement of the rule, because the rule does not advance the military's organizational interest. Militaries are often accused of seeking to maximize their budgets, and of doing this by exaggeration of the feasibility of offensive operations, which bolsters arguments that larger forces would be required to defend successfully. However, the 3:1 rule bolsters arguments that defenders can succeed even when outnumbered; it thus undercuts arguments for larger budgets.

17. This support for the rule notwithstanding, the American army's interest in the 3:1 rule has waned somewhat in the 1980s. This point is clear from an examination of the 1982 and 1986 versions of *FM 100-5*, neither of which makes reference to the 3:1 rule. However, neither version of the manual challenges the rule; in fact, both make frequent references to the importance of achieving overwhelming superiority at the point of attack. The apparent explanation for this reduced emphasis on the 3:1 rule is that the American army decided in the early 1980s to place less emphasis on fighting a war in Europe from prepared positions (where the 3:1 rule applies) and instead to rely more on maneuver. This amounts to an offensive tactic, and deprives the defender of the defensive advantages that underpin the 3:1 rule. See Herbert, "Toward the Best Available Thought," pp. 226–230.

18. A.A. Sidorenko, *The Offensive: A Soviet View* (Moscow, 1970), trans. U.S. Air Force (Washington, D.C.: U.S. Government Printing Office [U.S. GPO], 1976), p. 29. For other evidence of Soviet interest in the 3:1 rule, see John Erickson, Lynn Hansen, and William Schneider, *Soviet Ground Forces: An Operational Assessment* (Boulder, Colo.: Westview, 1986), pp. 162–163, 210; V. Ye. Savkin, *The Basic Principles of Operational Art and Tactics* (Moscow, 1972), trans. U.S. Air Force (Washington, D.C.: U.S. GPO, 1976), pp. 113–166, 201–229; and Major H.F. Stoeckli, *Soviet Operational Planning: Superiority Ratios vs. Casualty Ratios* (Sandhurst, U.K.: Royal Military Academy, Soviet Studies Research Centre, March 1985).

19. The Voroshilov Academy is the Soviet military's senior academic institution, and the relevant lecture materials from that school date to the early 1980s. They will be published in the near future by National Defense University Press. The best available discussion of what these lecture materials have to say about the 3:1 rule is John G. Hines, "Soviet Front Operations in Europe—Planning for Encirclement," in *Spotlight on the Soviet Union*, Report No. 1/86 of the Alumni Association of the Norwegian Defence College (Oslo, 1986), pp. 74–101.

For example, NATO armies could claim larger budgets if they replaced the 3:1 rule with a 1.5:1 or 2:1 rule for breakthrough battles. Thus the rule cuts against the central bias that militaries are accused of holding. Nevertheless, I know of no case where an important military figure or the official doctrine of an army challenges the 3:1 rule.

In sum, the 3:1 rule has not been proven by a scientific survey of a representative sample of relevant cases, but it does have substantial evidentiary support. Deduction strongly supports the rule: the nature of combat dictates that an attacker must have a substantial advantage in combat power over a prepared defender; this leaves open only the question of how large that advantage must be. Professional military experience also supports the rule, and that experience probably represents the total universe of cases quite well, since the relevant armies were involved in most of the major land combats of this century. Moreover, a cursory look at the past reveals many cases that support the rule, as its critics acknowledge.

How to Use the 3:1 Rule

There are three principal strictures on the application and use of the rule. First, the rule applies only to *local* force levels along the attempted breakthrough sector—usually an area on the order of 20–50 kilometers wide. It does not apply to *overall* force levels in the larger theater.²⁰ Attackers that lack significant theater-wide superiority can still win if they can gain superiority of above 3:1 on a main axis of attack. Specifically, this requires a 3:1 advantage in the forces that will be directly engaged in the breakthrough effort.

Second, the rule applies only to *breakthrough battles*, in which the attacker strikes head-on against a defender who occupies an extended and well-defended front. The offensive, in other words, must be a frontal attack aimed at penetrating an organized defensive position. The rule does not apply to the engagements more characteristic of the fluid exploitation phase that follows a breakthrough. These include *envelopments*, where an attacker maneuvers to turn an adversary's flank and wins by hitting the defender's

20. The only exception to this stricture would lie in a case where the attacker struck with equal force along the entire front, creating, in effect, one giant breakthrough battle. There would then be no meaningful distinction between local and overall force levels. Although commanders have rarely organized offensives in this fashion, Epstein models the battle as if they did so, as discussed below.

exposed forward deployed forces on their flank or rear, and *meeting engagements*, where the defender encounters the attacker on an open battlefield, with neither side in fixed positions. Meeting engagements, in effect, represent the clashing of two offensive forces. The rule is not relevant in these two types of combat because the defender is not fighting from prepared positions and thus surrenders his defensive advantage.

Third, during the breakthrough battle the defender must fight largely from prepared positions and not rely heavily on counter-attacks as his means of defense. Otherwise he surrenders the defensive advantages outlined above.²¹

Four additional considerations should be borne in mind when applying the 3:1 rule to specific combat situations. First, the force ratio should be expressed in a measure that captures the combat power inherent in the forces of the opposing sides. Combat power is the ability to perform combat missions. This ability is a function of the firepower, self-protection, and mobility of the forces in question. Measures of relative combat power should capture these capabilities by measuring four principal factors: the number of troops on both sides, their quality, the number of weapons on both sides, and their quality.²² The quality of both weapons and manpower should be measured by assessing their ability to generate firepower, protection, and mobility, as these are the essential elements of combat power. If the two sides differ in the quality of their troops or their weaponry, the analyst should account for this by adjusting for quality in measuring the force ratio between the two sides. An adjustment of this sort is often necessary, since armies often differ significantly in the quality of their troops and weapons.²³

There is no universal agreement on the best measures of relative combat power for assessing both historical and present cases, but there is fairly wide agreement in the open source literature on the sort of measures that best express the NATO-Pact balance. The most popular measure, and the one that both Epstein and I have used in our work, has been the Armored Division Equivalent (ADE), a Defense Department measure that reflects the

21. See John J. Mearsheimer, *Liddell Hart and the Weight of History* (Ithaca: Cornell University Press, 1988), p. 68.

22. The quality of troops should be understood to include their level of basic fighting skills and their level of discipline and morale.

23. Quality of troops affects the outcome of the battle in two principal ways. First, because it fights poorly, the lower-quality force will inflict fewer casualties and take more casualties than the higher-quality force. Second, the lower-quality force will tend to collapse at a lower casualty threshold. See note 10. The lower-quality force will therefore more quickly approach a lower threshold.

firepower, mobility, and protection of each force. The ADE does not capture differences in the quality of troops, but this does not significantly distort analyses of the European balance because the fighting skills of the troops in NATO and Warsaw Pact armies are roughly equal. However, it does mean that ADE scores must be adjusted before they can fairly represent the relative combat power of opposing forces having unequal fighting skills, such as the Arabs and Israelis. Other measures that are used include the division equivalent firepower (DEF), a still-classified linear descendant of the ADE; firepower scores, which come in several varieties; and simple comparisons of manpower and weaponry.

Second, if the attacker achieves surprise, the analyst should take this into account when estimating the balance of forces between the two sides. Surprise allows the attacker to catch the defender's forces in some degree of unpreparedness. This amounts to a shift in the ratio of strength between the two forces, and the analyst should adjust for its effect by bonusing the combat power ascribed to the attacker.²⁴

Third, the analyst must consider the force ratio over the entire course of the breakthrough battle, since both sides may bring reinforcements to bear, thereby changing the force ratio in the battle area. The rule predicts success for the defender only if he prevents the attacker from gaining a 3:1 advantage for a significant time period at any point in the battle. Holding the ratio below 3:1 at the start of the battle is not enough by itself.

Fourth, the rule should not be read to predict invariable success for the attacker if he gains an advantage of more than 3:1. The attacker may, in some

24. There are four principal types of surprise, of which only the first two require adjustments in the actual balance of forces. First, the attacker can catch the defender off guard, hence unprepared for action. This can reduce the physical and psychological readiness of the defender's forces, reducing their combat effectiveness. Second, the attacker can employ an innovative tactical doctrine for which the defender is unprepared. This increases the combat effectiveness of its personnel. This variety of surprise is rare. Third, the attacker can achieve technological surprise by introducing a new and unexpected weapon. No adjustment is needed to account for this kind of surprise since it should be accounted for when considering the quality and quantity of weaponry on each side. Fourth, the attacker can strike the defender at an unexpected location that the defender has left thinly defended. The effects of such a surprise need not be adjusted for, since the rewards it provides are directly expressed in a favorable force ratio at the point of attack. The seminal work on surprise is Richard K. Betts, *Surprise Attack: Lessons for Defense Planning* (Washington, D.C.: Brookings, 1982). It is difficult to quantify the effects of surprise, hence it is difficult to adjust for its effects when applying the 3:1 rule. Betts notes that some analysts maintain that the combat effectiveness of an attacker that achieves surprise should be doubled or even quintupled. Betts, *Surprise Attack*, p. 5. Both these figures are much too high in my estimation, although it is certain that surprise does matter somewhat and must be considered in any assessment of the 3:1 rule of thumb.

cases, fail even if he enjoys an advantage of more than 3:1. This is most likely when the battlefield has many obstacles or when the defender occupies especially formidable fortifications. Thus the rule defines the minimum, not the maximum, ratio that the attacker requires to succeed. To falsify the rule, therefore, one must demonstrate that attackers can win with less than a 3:1 advantage. The rule is not disproved by cases where attackers lost with an advantage of above 3:1.

The Case Against the 3:1 Rule and Why It Fails

Epstein and other critics of the 3:1 rule admit that many historical cases can be found that support it. Their case against the rule rests on the contention that a substantial number of cases also refute it. This would be lethal to the rule if these cases number a sizeable share of the total—perhaps one-fifth—since we assumed above that the rule should predict defender success rates of roughly 80–90 percent at combat power ratios below 3:1. These cases that allegedly refute the rule thus become the critical test for the rule. If they stand up to scrutiny, the rule falls. If they do not stand up, however, the only argument offered against the rule is defeated.

Epstein points to two studies to support his claim that many historical cases refute the rule. The first of these is a 1986 U.S. Army Concepts Analysis Agency (CAA) study of 598 battles.²⁵ This study, which relied on a data base created by Colonel Trevor Dupuy, tested the 3:1 rule by simply comparing the number of soldiers engaged on each side—troop quality and the numbers and quality of weapons were not compared.²⁶ It found that the attacker succeeded in 74 percent of battles in which the attacker's advantage lay above 3:1, and, more relevant to the 3:1 rule, that the attacker succeeded in 59 percent of the battles in which the force ratio favored the attacker by less

25. *Combat History Analysis Study Effort (CHASE): Progress Report for the Period August 1984–June 1985*, Report No. CAA-TP-86-2 (Requirements and Resources Directorate, U.S. Army Concepts Analysis Agency [CAA], August 1986). The key pages are pp. 3-19–3-22. Hereafter cited as *CHASE Report*.

26. Colonel Trevor N. Dupuy, et al., *Analysis of Factors That Have Influenced Outcomes of Battles and Wars: A Data Base of Battles and Engagements*, Vols. 1–6, Report No. CAA-SR-84-6, Prepared for U.S. Army Concepts Analysis Agency (Dunn Loring, Va.: Historical Evaluation and Research Organization, September 1984). Hereafter cited as *Dupuy Data Base*. There are actually a total of 601 battles in the *Dupuy Data Base*, but only 598 were used for the analysis concerning force ratios, apparently because data were incomplete for three of the battles. Regarding CAA's exclusive focus on numbers of soldiers in testing the 3:1 rule, see *CHASE Report*, pp. 1-5–1-6, 3-22.

than 3:1.²⁷ Epstein maintains that the study refutes the rule because it shows attackers winning so often without a 3:1 advantage.

Second, Epstein claims that the rule is further disconfirmed by a survey of nine well-known breakthrough battles. This survey was done by Colonel Dupuy and the results were published in his book, *Understanding War*. Eight of the nine cases in his survey are drawn from the same 598-battle data base he provided to the CAA. Epstein extracts two comparisons from Dupuy's data for each of the nine cases—a personnel ratio and a firepower ratio—that show the attacker winning with an advantage of less than 3:1 in all nine cases.²⁸ On this basis he claims that the 3:1 rule fails in all nine cases.

If valid, these arguments would cast serious doubt on the 3:1 rule. However, they are without merit for two reasons. First, the data base on which both studies rely is unreliable. Second, even if the data used by the CAA and Epstein were reliable, the tests they perform would not evaluate the rule fairly.

An outside review cast serious doubt on the accuracy of the 598-battle data base used by the CAA study.²⁹ The CAA randomly selected eight battles from that data base and sent the relevant information to four outside reviewers, who found many of the key facts asserted in the cases to be “substantially in error.” They also complained that they found it impossible to replicate much of Dupuy's data.³⁰ My analysis of a different eight cases from the same

27. These figures are based on the summary data chart in *ibid.*, p. 3-20, which is reproduced as Table 2 in Epstein, “Dynamic Analysis and the Conventional Balance in Europe,” p. 156. That chart actually does not provide a total number for the cases where the attacker's force ratio advantage was less than 3:1. Instead, the chart gives a number (492) for all the cases where the attacker's force ratio advantage was exactly 3:1 or less than 3:1. Nevertheless, I have treated the 492 figure as if it represented only cases below 3:1. This makes no significant difference, however, as very few cases (I calculate three) fall exactly on the 3:1 mark.

28. Colonel Trevor N. Dupuy, *Understanding War: History and Theory of Combat* (New York: Paragon House, 1987), pp. 260–266. Especially important are the charts on pp. 156, 261. For the original study, see Colonel Trevor N. Dupuy, et al., *A Study of Breakthrough Operations*, Report No. DNA 4124F, Prepared for Defense Nuclear Agency (Dunn Loring, Va.: Historical Evaluation and Research Organization, October 1976). Dupuy's study actually examined 14 breakthrough battles. Dupuy does not explain why he selected these particular 14 battles for examination. Epstein does not reference five of these battles; in these five, Dupuy's data on personnel and firepower ratios—the data Epstein reports—support the 3:1 rule.

29. The four outside reviewers were the U.S. Army Military History Institute, Carlisle Barracks, Pa.; U.S. Army Center of Military History, Washington, D.C.; Department of History, U.S. Military Academy, West Point, N.Y.; and the U.S. Army Combat Studies Institute, Fort Leavenworth, Kansas. Each institution looked at three different battles. The results are reported in considerable detail in *Dupuy Data Base*, Vol. 1.

30. The *Dupuy Data Base* has no footnote references and a spotty bibliography, making it extremely difficult to determine where Dupuy's information came from. His study of fourteen

data base (see below) exposes the same kind of errors in those cases, thus casting further doubt on the reliability of the larger data base.³¹

Furthermore, the CAA did not perform a fair test of the 3:1 rule. Many of the 598 battles included in the CAA study are envelopments and meeting engagements, not attempted breakthroughs. The former are not the class of battle covered by the rule, and should be excluded from an evaluation of the rule. The CAA test of the 3:1 rule also focuses exclusively on the number of troops on each side. It does not account for differences in the quality of the opposing forces; it omits differences in the quality and quantity of weaponry available to the two forces; and it omits the effects of surprise. Relative personnel strength often does not accurately reflect combat strength, as discussed above. Hence simply comparing troop strength, as the CAA does, is not a proper test of the 3:1 rule.

The same problems arise with the nine purportedly successful breakthrough battles that Epstein cites. In fact *none* of the nine disconfirms the 3:1 rule—a far cry from the nine-of-nine that Epstein claims. Four varieties of problems attend these cases, and provide good grounds to exclude them from a test of the rule. First, Dupuy's force ratios for four of the battles are wrong: the attacker had at least a 3:1 advantage at Megiddo (1918), Flanders (1940), Ukraine (1941), and Korea (1950). Second, four other cases were not successful breakthrough battles. The Japanese did not break through the Indian lines in the Malaya (1941) case. Sinai–Abu Ageila, Sinai–Rafa, and Syria–Qala (all 1967) were Israeli victories resulting from envelopments, not breakthroughs. Third, in all nine cases the attacker's forces were of significantly higher quality than the defender's forces;³² hence simply comparing the size of forces does not provide a reliable measure of their relative combat power. The force ratio should have been adjusted to take this into account. Finally, in seven of the nine cases (all except Syria–Tel Fahar and Syria–Qala), surprise was a factor, requiring an adjustment in the force ratio to take this into account.

breakthrough battles, *A Study of Breakthrough Operations*, has only twenty-three endnotes and footnotes, and no bibliography. His *Understanding War* has more notes, but these reveal little about his data sources. The security affairs field badly needs a comprehensive historical data base of the sort that Dupuy tried to create. Assembling such a data base would require an enormous effort, involving years of labor by several people. Dupuy deserves much credit for attempting this important and difficult task, even if the results are not yet satisfactory.

31. One of Epstein's nine cases (Korea 1950) is not included in the larger 598-case data base.

32. Dupuy's analysis supports this point. See Dupuy, *Understanding War*, pp. 264–265.

Table 1 summarizes these cases, which are detailed in the Appendix to this article. It shows that for all nine cases there is at least one reason to reject Epstein's claim that they disconfirm the 3:1 rule. One case should be rejected for one reason, two cases should be rejected for two reasons, and the remaining six cases should be rejected for three separate reasons.

The manner in which Epstein draws inferences from these nine cases is puzzling for at least two reasons. First, conventional force analysts routinely take quality and surprise into account; Epstein's failure to do this is unorthodox. Second, Dupuy provides the data that Epstein would have needed to make the necessary adjustment; Epstein should have used these data in his analysis, but omitted them. Specifically, Dupuy includes three columns in the chart he employs to summarize these nine battles.³³ The first two columns express ratios for personnel and firepower; the third column aggregates these ratios and adjusts them for the quality of the forces on both sides, for surprise, and for other factors. (See Table 2.) Epstein drew his data from this summary chart, but neglected to report the contents of the third column. This omission is peculiar, since one of Dupuy's principal aims in *Understanding War* was to develop a measure that took account of quality, surprise, and other factors, and the data in his third column summarize this effort.

Table 1. Problems with Epstein's Nine Purportedly Successful Breakthrough Battles.

	Incorrect force ratio	Not successful breakthrough	Significant qualitative asymmetry in fighting forces not accounted for	Some degree of surprise not accounted for
Megiddo, 1918	✓		✓	✓
Flanders, 1940	✓		✓	✓
Ukraine, 1941	✓		✓	✓
Korea, 1950	✓		✓	✓
Sinai-Abu Ageila, 1967		✓	✓	✓
Sinai-Rafa, 1967		✓	✓	✓
Syria-Qala, 1967		✓	✓	
Malaya, 1941		?	✓	✓
Syria-Tel Fahar, 1967			✓	

33. The chart can be found on pp. 156, 261 of Dupuy, *Understanding War*.

Table 2. Data on Breakthrough Operations.

Operation	Attacking Force	Attacker to Defender Ratios		
		Personnel Strength Ratio	Force Strength Ratio	Combat Power Ratio
1. Megiddo, 1918	Allies	2.81	2.99	5.20
2. Flanders, 1940	Germans	1.07	2.42	2.70
3. Ukraine, 1941	Germans	0.88	1.17	3.36
4. North Korea, 1950	North Koreans	1.58	1.73	3.20
5. Sinai–Abu Ageila, 1967	Israelis	1.04	0.94	3.12
6. Sinai–Rafa, 1967	Israelis	1.00	1.45	4.19
7. Syria–Qala, 1967	Israelis	0.91	2.27	4.47
8. Malaya, 1941	Japanese	0.58	2.06	2.52
9. Syria–Tel Fahar, 1967	Israelis	0.90	1.79	4.47

SOURCE: Trevor Dupuy, *Understanding War*, p. 261.

In short, *Epstein failed to report Dupuy's principal summary data; had he reported them, his argument would have collapsed*, because the adjusted ratio was greater than 3:1 in seven of the nine cases and was close to 3:1 in the other two.

Thus the 3:1 rule seems empirically sound for two reasons: first, it has been supported by the long experience of great power militaries; and second, its critics have offered no persuasive evidence to disconfirm it.³⁴ A final

34. In addition to criticizing the 3:1 rule, Epstein offers further criticisms of my work on the European balance in a lengthy footnote. Epstein, "Dynamic Analysis and the Conventional Balance in Europe," pp. 157–158 n. 6. His first criticism grows from my assertion that if the Soviets had an overall advantage in armored division equivalents (ADEs) of 2:1, they could not launch a multi-pronged offensive and achieve overwhelming superiority on each of 5 or 6 or 8 axes of attack. Epstein accepts my logic, but points out that he can use my numbers to construct a scenario where the Pact achieves force ratios greater than 3:1 on two axes, thereby suggesting that I missed this important point. This is untrue. In fact, the main purpose of my discussion was to make the point that Epstein accuses me of missing. Thus, I wrote that "if the Soviets hope to defeat NATO with a *blitzkrieg*, they will have to concentrate massive amounts of armor on one, two or, at most, three major axes of advance." Mearsheimer, "Why the Soviets Can't Win Quickly in Central Europe," p. 19. Second, he notes that I do not take account of air power,

judgment on the 3:1 rule will have to await a comprehensive survey of relevant cases. Until then, however, enough evidence supports the rule to qualify it as a useful analytical tool. It thus remains a valuable yardstick for gauging NATO's conventional force requirements, since a war in Europe would turn on breakthrough battles of the sort covered by the 3:1 rule.

Analysis of Epstein's Adaptive Model

Epstein not only challenges the 3:1 rule, but also suggests that his Adaptive Model is superior to other approaches, including those that use the 3:1 rule. If so, my defense of the 3:1 rule may be beside the point, because Epstein's alternative could be superior to approaches using the 3:1 rule, even if the rule is valid. His claim therefore deserves scrutiny.

DESCRIPTION OF THE ADAPTIVE MODEL

Despite its appearance of mathematical complexity, Epstein's model is relatively simple.³⁵ It has two components: a ground-war model and an air-to-

implying that doing so will lessen NATO's prospects for success. I know of no student of the European balance who believes that air power will work to the Pact's advantage. Moreover, Epstein's own analysis (see below) shows air power redounding to NATO's benefit. Third, he challenges my assertion that NATO—acting in accordance with the dictates of its forward defense strategy—will be able to move forces about the theater to reinforce threatened positions. He correctly notes that in a different article, on the relative merits of mobile and forward defense, I raised doubts about whether NATO could maneuver forces about the battlefield in the ambitious manner called for by a mobile defense strategy. He incorrectly asserts that this argument, if accepted, would also cast doubt on NATO's ability to execute the maneuvers required by a strategy of forward defense. In fact mobile defense and forward defense are very different strategies; the former requires much more difficult maneuvers than the latter. Maneuvering large operational reserves in the depths of West Germany to strike decisive blows at the Pact's armored spearheads is far more difficult than moving reserves forward to plug an opening, or bumping forces laterally from one corps sector to another. As I noted in the original article, NATO needs only "a limited form of mobility" to implement forward defense. Mearsheimer, "Maneuver, Mobile Defense, and the NATO Central Front," *International Security*, Vol. 6, No. 3 (Winter 1981/82), p. 106. Thus Epstein appears to have missed the essential differences between the two strategies. This is further reflected in his claim that in my analysis of forward defense, I take "NATO's ability to shuffle forces among corps sectors [as] a certainty," while in my description of mobile defense, "NATO's inability to do so is its Achilles' heel." Mobile defense, however, is not organized around the defense of corps sectors; therefore the conduct of mobile defense has little to do with moving forces from one corps sector to another. Fourth, Epstein maintains that I have been guilty of inconsistency in arguing that a less ambitious Soviet limited aims strategy is satisfactory for defeating a mobile defense while a more ambitious blitzkrieg is needed to defeat a forward defense. In fact I made no such argument. I assessed both defensive strategies in terms of their ability to thwart a Soviet blitzkrieg. I did devote one short paragraph (*ibid.*, p. 114) to describing the problems that a limited aims strategy would present to a mobile defense, but that hardly constitutes "inconsistency." In sum, the criticisms in Epstein's footnote 6 are without merit.

35. The Adaptive Model (which Epstein sometimes refers to as the Adaptive Dynamic Model)

ground model. Let us first examine his model of the ground war, describing it as it would operate in the absence of air power. The ground-war model, as Epstein employs it, assumes that all forces on both sides are lined up across the front. One side then launches an assault along the entire front. The attacker, according to Epstein, does not attempt to achieve a breakthrough by massing forces at a particular point along the defender's front. Thus Epstein is not concerned with force ratios along specific main axes of attack, but with the aggregate theater-wide force ratio.³⁶

The winner of the war can be determined in every case by comparing two numbers: the aggregate force ratio and the expected casualty-exchange ratio. Specifically, to defend successfully the defender must hold the attacker's force ratio advantage to a level at or below the defender's expected casualty-exchange ratio advantage. For example, if the casualty-exchange ratio favors the defender by 3:1, then the defender wins if the attacker's force ratio advantage is 3:1 or less. With a force ratio advantage of above 3:1, the attacker wins.

Thus, if the air war is excluded from consideration, no calculations are required to determine which side is awarded victory by Epstein's model. One can identify the winner by simply comparing these two ratios to see which is larger.

Epstein estimates that the casualty-exchange ratio in a NATO-Warsaw Pact conflict will be 1.85:1 in the defender's favor. So if the Pact's aggregate force ratio advantage is greater than 1.85:1, it wins; if less, NATO wins. Since Epstein estimates that the Pact will have a force advantage of only 1.77:1 in ADEs, NATO wins.³⁷

was first outlined in Joshua M. Epstein, *The Calculus of Conventional War: Dynamic Analysis without Lanchester Theory* (Washington, D.C.: Brookings, 1985), pp. 14–31. It was presented again, with no apparent change, in Joshua M. Epstein, *Strategy and Force Planning: The Case of the Persian Gulf* (Washington, D.C.: Brookings, 1987), pp. 117–125. Epstein does not describe his model in much detail, although one can discern how it works from these writings. *Strategy and Force Planning* is where he uses the model to assess the American military's prospects for thwarting a Soviet offensive in the Persian Gulf. He uses the model to assess NATO's prospects of stopping a Soviet offensive in Joshua M. Epstein, *The 1987 Defense Budget* (Washington, D.C.: Brookings, 1986), pp. 28–41; and Epstein, *The 1988 Defense Budget* (Washington, D.C.: Brookings, 1987), pp. 36–45. There appear to be no differences between these two NATO assessments.

36. The Adaptive Model could be used to analyze a single breakthrough battle in isolation. After all, the model is designed to treat a conventional war between two adversaries as one giant breakthrough battle. Thus there is no reason the level of analysis could not be changed to focus directly on a smaller-scale breakthrough battle.

37. For these two key values, see Epstein, *The 1988 Defense Budget*, pp. 38, 44. See also Stephen D. Biddle, "The European Conventional Balance: A Reinterpretation of the Debate," *Survival*, Vol. 30, No. 2 (March/April 1988), p. 119 n. 22.

In essence, then, Epstein's ground-war model rests on the same logic that underpins the 3:1 rule. With both, the force ratio advantage required by the attacker reflects and is roughly equal to the casualty-exchange ratio advantage enjoyed by the defender.³⁸ Epstein's model differs only in that he employs a rather conservative 1.85:1 rule of thumb (more accurately, an author's estimate) instead of the more widely used 3:1 rule.³⁹

Epstein's ground-war model also accommodates retreat, allowing the defender to trade space for time. The purpose of the mathematical equations in his ground-war model is to describe this military operation. Both the attacker and the defender, Epstein maintains, are concerned about their rates of attrition, and both have thresholds at which they will seek to limit the pace of attrition. As combat intensifies in the initial battle, both sides will close in on these thresholds, which he estimates at 7.5 percent (attacker) and 6 percent (defender).⁴⁰ When the attacker reaches his threshold, he simply reduces the pace at which he prosecutes the combat. The defender, on the other hand, limits the pace of attrition by withdrawing to his rear. It is this capability to alter the pace of attrition that makes the model "adaptive."

However, this aspect of the model does not help to determine which side wins the war. Hypothetically, retreat could help the defender salvage success in two ways: by shifting the casualty-exchange ratio in the defender's favor, or by allowing the defender to improve the force ratio by bringing in reinforcements. In other words, to matter, retreat must influence at least one of the two key ratios that determine the battle's outcome. In Epstein's model, however, retreat does not change the casualty-exchange ratio; this is held constant throughout the entire engagement. His model also has no function that allows either side to bring reinforcements into the battle. Therefore, withdrawal does not alter who wins the war, since it leaves the two determining factors unchanged. The withdrawal function of the Adaptive Model determines the time and place of final defeat for the attacker or defender, but does not affect the identity of the winner.

38. Neither Epstein nor I adopt the Lanchesterian assumption that the casualty-exchange ratio changes as the force ratio changes. Instead, we both assume that the casualty-exchange ratio remains constant throughout the battle, even if the force ratio changes.

39. As discussed below, Epstein originally justified his 1.85:1 casualty-exchange ratio by portraying it as a conservative version of the 3:1 rule. Thus, one might refer to his 1.85:1 rule of thumb. However, now that he has rejected the 3:1 rule, his 1.85:1 ratio becomes an author's estimate, which is the term I will use to describe it in the subsequent discussion.

40. For these values, see Epstein, *The 1988 Defense Budget*, p. 44. For a general discussion of these thresholds and how they work in the model, see Epstein, *The Calculus of Conventional War*, pp. 15–18.

Epstein emphasizes that “the trading of space for time” is “the most fundamental tactic in military history,” and claims that his model improves on Lanchesterian and other models of conventional war by incorporating the effects of retreat.⁴¹ However, since his model does not connect the effects of retreat to the two factors that decide who wins the battle, it fails to relate retreat to the all-important question of which side prevails. Hence it is difficult to see the improvement that the retreat function in his model provides.⁴²

Epstein’s air-to-ground model is similarly straightforward.⁴³ Its function is to model the effects of air power on the balance of ground forces, and it affects the battle’s outcome by affecting this ground balance. Specifically, air power destroys enemy ground force units, and thereby helps determine the ratio of forces on the ground. Epstein counts the number of close air support aircraft on both sides and then assigns a sortie rate per day for each aircraft. Epstein assumes NATO has 1500 aircraft and generates three sorties per day per aircraft, so there will be 4500 NATO sorties per day of combat. The Pact figure is 3200 sorties per day (1600 aircraft, two sorties per day per aircraft). Epstein then assigns an attrition rate for aircraft lost over the battlefield, which he estimates at five percent for each side. These calculations provide a clear picture of how many aircraft each side can put above the battlefield from day to day. Finally, Epstein provides a value for the number of armored fighting vehicles killed per NATO sortie (.5) and per Pact sortie (.25). From there, the model calculates how much damage each side’s aircraft will inflict on the other’s ground forces. Air power’s effect on the ground war is not mitigated by withdrawal, and thus the air-to-ground model is not “adaptive” like the ground-war model. In Epstein’s analysis, NATO is strengthened when the air component is included, although NATO wins with or without the air component.⁴⁴

41. Epstein, “Dynamic Analysis and the Conventional Balance in Europe,” p. 160. He provides no basis for his assertion about the importance of withdrawal. Although trading space for time is an important aspect of war, it is difficult to see how Epstein could substantiate his claim that it is the single most significant tactic in military history.

42. A further problem with Epstein’s ground-war model lies in his failure to explain or justify his equations. Unlike Lanchester, who elaborates in detail the microfoundations for his equations, Epstein declares his principal equations without explaining why he believes that they represent combat accurately. Literally thousands of different equations could be employed to represent the relationship between attrition and retreat that he is attempting to capture. Each would almost surely produce different results. Epstein should provide a substantive story about how combat works from which his equations are a logical consequence.

43. For the values in the air-to-ground model, see Epstein, *The 1988 Defense Budget*, pp. 38, 44. For a general discussion of the air-to-ground model, see Epstein, *The Calculus of Conventional War*, p. 18.

44. I have run computer simulations of Epstein’s model that substantiate this point. Also see Biddle, “The European Conventional Balance,” p. 119 n. 22.

The values Epstein assigns to the variables in his model come from two sources. Some are his own author's estimates, for which he provides limited historical or empirical support. Many are author's estimates from other analysts, especially Barry Posen.

What is Epstein's source for his all-important estimate that the defender's casualty-exchange advantage will be 1.85:1? This is an author's estimate. It is not derived by calculation or borrowed from any study of likely casualties in a conventional war. It is merely Epstein's personal assessment. He does, however, buttress his estimate by referring, surprisingly, to the 3:1 rule of thumb that he later challenges in his 1988 *International Security* article. Specifically, he approvingly references the 3:1 rule and then explains that he will use a ratio that is even more conservative for the defender than called for by that rule.⁴⁵ Thus he seems to justify his ratio as a variant of the 3:1 rule. In fact he cites my work to support his use of the 3:1 rule.

SHORTCOMINGS OF THE ADAPTIVE MODEL

Epstein's analysis of conventional war suffers five weaknesses. Some of these derive from flaws in the Adaptive Model itself, while others reflect problems with the manner in which Epstein has used it.

First, Epstein pictures the battle as one in which the attacker's basic strategy resembles a front-wide steamroller. The attacker does not attempt to break through on one or a few narrow sectors, but rather tries to crush the defender along the entire front. For this reason, Epstein concerns himself with *overall* theater-wide force ratios. This image stands in marked contrast to a classical armored blitzkrieg, where the attacker concentrates his forces at particular points along the defender's front and attempts to rupture that front and then achieve a deep strategic penetration. Students of blitzkrieg, while paying attention to aggregate force ratios, are mainly concerned with *local* force ratios. There is an overwhelming consensus among defense experts that a Soviet attack against NATO would be a blitzkrieg. There is little reason, especially when one considers Soviet military writings, to think that the Pact would act in accordance with the strategy portrayed in Epstein's model. Therefore, his sole focus on aggregate force ratios is fundamentally misplaced. The important question is whether, on a particular breakthrough

45. See Epstein, *The 1988 Defense Budget*, p. 44. For other examples of Epstein approvingly referencing the 3:1 rule, see *ibid.*, pp. 41–42; and Epstein, *Strategy and Force Planning*, pp. 74–75.

sector, the Pact is likely to achieve more than a 1.85:1 or 3:1 ratio (depending on which value one chooses).

The implications of Epstein's failure to model blitzkrieg properly are illustrated by applying his model to the May 1940 German offensive in the West. The aggregate ratio of forces was close to parity, hence, according to Epstein's model, the Allies should have checked the Wehrmacht. Of course, the Germans succeeded because they secured a decisive advantage (more than 3:1, as I show in the Appendix) on a particular breakthrough sector.

Second, despite the importance that Epstein places on a defender trading space for time, his model fails to capture the reality of this phenomenon. Withdrawal, especially by a force still in contact with the attacker, is among the most difficult of military operations.⁴⁶ It can easily lead to collapse of the front, especially if the retreating forces are not first-rate fighting units.⁴⁷ A retreating defender can no longer fight principally from prepared positions but must expose himself to the attacker's fire for lengthy periods. Each retreating unit must also keep an eye on both its destination in its rear and its adversary to its front, while at the same time making sure not to lose contact with neighboring units on its flanks. If the defender is faced with a formidable attacker who maintains constant pressure along any portion of the front, catastrophic defeat is a real possibility. Defending armored units, on the run and under intense pressure, are likely soon to find that the attacker's forces have run past them and into their rear.

Epstein's model treats withdrawal as a function that axiomatically helps the defender by allowing him to limit his rate of attrition. One can certainly posit a scenario where retreat improves the defender's position, especially if he falls back to more obstacle-ridden terrain. However, one can just as easily imagine withdrawal *itself* causing a marked increase in the defender's attrition rate, and perhaps producing a rapid defeat. A model that fails to capture the downside risks of withdrawal is not very useful.

46. Consider, for example, what Jomini had to say about the subject: "Retreats are certainly the most difficult operations in war. This remark is so true that the celebrated Prince de Ligne said . . . that he could not conceive how an army ever succeeded in retreating. When we think of the physical and moral condition of an army in full retreat after a lost battle, of the difficulty of preserving order, and of the disasters to which disorder may lead, it is not hard to understand why the most experienced generals have hesitated to attempt such an operation." Baron De Jomini, *The Art of War*, trans. Captain G.H. Mendell and Lieutenant W.P. Craighill (Westport, Conn.: Greenwood Press, n.d.), p. 211.

47. Consider, for example, the plight of the 11th Indian Division at Jitra, which is discussed in the Appendix hereto. Disaster can also befall top-notch fighting forces attempting to retreat in the face of enemy pressure, as happened to General Walter von Seydlitz-Kurzbach's 51st Corps at Stalingrad. See Paul Carell, *Hitler's War on Russia*, trans. Ewald Osers (London: Harrap, 1964), pp. 595-597.

Third, Epstein surrounds his model with an illusion of precision. His writing—for instance, his critique in *International Security* of the backing for the 3:1 rule of thumb—implies that he has developed a precise model, when, in fact, it is composed of numerous variables that are assigned values simply based on author's estimates.⁴⁸ He provides little evidence—historical or otherwise—to support his estimates. Moreover, his estimates are plugged into a model that depicts an interactive combat process with many iterations. As a result, small errors in inputs, or in the model's mathematical equations, soon compound to large output errors.⁴⁹

Epstein also adopts a double standard when judging the works of his colleagues. He demands that proponents of the 3:1 rule demonstrate a scientific basis for it. He additionally criticizes Lanchester models because there is no historical evidence supporting them.⁵⁰ Yet he provides little evidence for his own estimates, nor does he attempt to verify with history the performance of his own model.

Fourth, the very same historical data from Trevor Dupuy that Epstein uses to challenge the 3:1 rule also undermine his own model. If we accept the validity of the Dupuy data for the moment, the empirical basis for Epstein's model collapses. As emphasized, the attacker succeeds in the Adaptive Model when he achieves a force advantage of more than 1.85:1 over the defender. This 1.85:1 author's estimate can easily be tested against Epstein's chosen data base, which he presumably considers reliable because he used

48. Epstein also relied heavily on author's estimates in his book on air power in Europe, prompting Benjamin Lambeth in a critical review to complain that nothing more than "intellectual Kentucky windage" underlay Epstein's analysis. Benjamin S. Lambeth, review of *Measuring Military Power: The Soviet Air Threat to Europe* by Joshua M. Epstein, *American Political Science Review*, Vol. 80, No. 3 (September 1986), pp. 1064–1066. Also see Lowell Bruce Anderson, *A Review of Epstein's Model for Measuring the Soviet Air Threat to Europe*, unpublished paper, Institute for Defense Analyses, Alexandria, Va., June 1987.

49. It further appears that small changes in inputs to Epstein's model sometimes produce large changes in output that do not intuitively seem correct. For example, as Epstein acknowledges, small changes in the attrition rate that the attacker is willing to suffer (a decrease from 7.5 to 6 percent per day) produce large changes in the movement of the battle front (a decrease from 119.5 to 9.1 km during the campaign) in Epstein's Persian Gulf "Case 3." *Strategy and Force Planning*, pp. 144–145. In this same case, increasing the defender's close air support aircraft attrition rate per sortie quite modestly, from 5 to 5.5 percent, produces a large increase in movement of the front during the campaign, from 119.5 to 370.1 km. Perhaps, in actual combat, such small changes in input values would produce output changes of this magnitude, but this seems unlikely, and Epstein should provide some explanation for these results. I am indebted to Barry Posen for this observation.

50. Epstein, "Dynamic Analysis and the Conventional Balance in Europe," pp. 161–162; and Epstein, *The Calculus of Conventional War*, pp. 8–11.

it to assess the 3:1 rule.⁵¹ Consider first the summary findings for the 598 battles examined in the CAA study. Although it is not possible to determine the exact number of battles where the attacker had less than 1.85:1, it is easy to determine the number of battles where the attacker had a 1.5:1 or smaller advantage.⁵² There are 296 such battles. According to Epstein's model, the defender should have won a large majority of them. Yet in more than half of those cases—166 to be exact, or 56 percent—the attacker won. Thus Epstein's author's estimate does almost as badly as the 3:1 rule of thumb, which "failed" in 59 percent of CAA's cases.

Consider next the select data Epstein presents for the nine major breakthrough battles. He gives a personnel strength ratio and a firepower ratio for each battle. Epstein's 1.85:1 estimate fails eight out of nine times when personnel strength ratios are used. In other words, the attacker succeeded in those eight cases with less than a 1.85:1 advantage. The 1.85:1 estimate also fails five out of nine times when firepower ratios are used, a total of 13 failures in 18 cases.⁵³ In short, it would appear that Epstein has discredited a key element of his own model. The same data he used to undermine the 3:1 rule undermine his model as well.

However, the analysis of the historical data presented in the Appendix and summarized above, which corrects Dupuy's errors and also takes into account such factors as surprise and qualitative differences between the two sides, rescues Epstein from this particular predicament. After all, Epstein explains his 1.85:1 estimate as a more conservative version of the 3:1 rule. Thus, if my argument for the 3:1 rule holds, the 1.85:1 estimate must also hold.

Fifth, Epstein chooses the value for the all-important casualty-exchange ratio in a manner that does not accord with scientific practice. Specifically, a puzzling change takes place over time in the value he assigns the casualty-exchange ratio. In *The Calculus of Conventional War* (1985), where he first

51. Epstein's model is being used here to analyze specific breakthrough battles, not a theater-wide clash. Not only is this a fair test of the model (see note 36), but doing so in these nine cases increases the model's prospects for correctly predicting the attacker's success: an attacker's force advantage along a breakthrough sector is usually greater than his overall advantage, thus increasing the prospect in these cases that the attacker will have a force advantage greater than 1.85:1. Also, the focus of this test is exclusively on Epstein's ground-war model since the data are not available to assess the air component of his model.

52. See Epstein, "Dynamic Analysis and the Conventional Balance in Europe," p. 156, Table 2. The measure used in the CAA test of the 3:1 rule is number of troops on each side.

53. See *ibid.*, Table 1.

describes the model, he uses a 1.5:1 value. He uses the same value in *Strategy and Force Planning* (1987), where he assesses the Rapid Deployment Force's prospects for thwarting an all-out Soviet offensive into Iran.⁵⁴ However, he uses the 1.85:1 figure when he analyzes the NATO–Warsaw Pact balance.⁵⁵ In both cases, he justifies his chosen ratio in terms of the 3:1 rule of thumb. One therefore might argue that the difference between his two values is not important, since both are well below 3:1. There are, however, two major problems with that argument. First, Epstein now maintains that the 3:1 rule is useless, which eliminates the anchorage for his chosen values as well as the argument that he can manipulate the casualty-exchange ratio as long as he keeps it well below 3:1. Second, and more troubling, if he had applied the 1.5:1 casualty-exchange ratio to the NATO–Pact case, NATO would have lost, as he assigns the Pact a force advantage in ADEs of 1.77:1, and NATO's advantage in air power could not have compensated for its disadvantage on the ground, according to my own simulations using Epstein's model. It was only by changing the casualty-exchange ratio from 1.5:1 to 1.85:1 that Epstein was able to produce a NATO success. Manipulating that value thus has very serious consequences for Epstein's assessments. Yet, he provides no explanation for why he altered it. Sound analysis requires some explanation for values assigned to the critical variables in a model, and further requires some explanation for changes that completely reverse the conclusion.

Conclusion

Epstein's Adaptive Model suffers from major problems that cast serious doubt on its utility. He could meet some of these criticisms if he makes basic changes in the model and in the way he employs it. Regardless, these criticisms cast doubt on the analyses he has published to date that are based on the existing model. These include his analyses of the conventional balance in Europe and the Persian Gulf.

Even if Epstein were to adapt his model to these criticisms, however, it would still suffer weaknesses that are inherent in mathematical models of combat when these are applied to phenomena like breakthrough battles. Epstein's approach assumes that it is possible to go beyond the 3:1 rule to

54. See Epstein, *The Calculus of Conventional War*, p. 26; and Epstein, *Strategy and Force Planning*, pp. 74–75, 127–128.

55. Epstein, *The 1987 Defense Budget*, p. 38; and *The 1988 Defense Budget*, p. 44.

develop a relatively sophisticated model that captures the details of the dynamics of combat in a breakthrough battle. In fact, however, mathematical models are not well suited to analyzing breakthrough battles; for these, an approach based on a single rule of thumb is better suited. Mathematical modeling is suitable for analyzing certain military phenomena—strategic nuclear exchanges, battles for the control of sea lanes, and some tactical air engagements. At the same time, many phenomena are not suitable for analysis by a single rule of thumb, but for breakthrough battles, a single rule of thumb is suitable and mathematical models are not.

The 3:1 rule is superior to mathematical models of breakthrough battles for two reasons. First, the accumulated evidence shows the 3:1 rule to be a powerful predictor of battlefield outcomes. Many phenomena do not obey rules of a gross nature, such as the 3:1 rule, but breakthrough battles apparently do. In short, the 3:1 rule is a sound analytical tool. Second, our understanding of the dynamics of combat is too rudimentary to allow us to design reliable breakthrough models. The dynamics of battle are very complex, but have received little study. As a result, we do not know much about the details of the combat process. Thus, it is not surprising that Epstein provides little support for the values he assigns the variables in his model or for the equations he employs, and instead relies largely on his own judgment. He was forced to this method by the absence of a sound literature on combat. But mathematical models like Epstein's work well only when the details of the phenomena being studied are well and precisely understood. Otherwise, errors in input values or in the accuracy with which equations represent real-world relationships quickly compound themselves to produce very inaccurate results.

If breakthrough battles in fact obeyed no rule of thumb, then we might be forced to use mathematical models, despite their weaknesses. Or, if we had precise understanding of the dynamics of combat and high confidence in our input data, mathematical models of breakthrough battles might be superior to the 3:1 rule, even though the rule works well. However, given our knowledge as it stands, only the 3:1 rule provides results in which we can have much confidence.

[Editors' Note: Appendix follows, pp. 80–89.]

Appendix

This appendix examines the nine cases that Joshua Epstein cites as evidence against the 3:1 rule. This examination highlights problems with the data base on which Epstein relied (which he drew from Trevor Dupuy's *Understanding War*) and with Epstein's use of Dupuy's data.

The first four cases are breakthrough battles in which the successful attacker had more than a 3:1 advantage.

MEGIDDO 1918

The World War I battle of Megiddo involved a September 1918 British offensive against Turkish forces in Palestine.¹ The Turkish front extended 97 km from east to west across the waist of what is today Israel. The British breakthrough was focused on the easternmost part of the Turkish front. The British concentrated 35,000 infantry, 9,000 cavalry, and 383 guns along the 24 km breakthrough sector, where the Turks had only 8000 infantry and 130 guns.² Thus, in terms of raw numbers, the British had a local force advantage of at least 4:1.³

The British also had clear-cut air superiority, which they used well, and furthermore they caught the Turks off guard and surprised them.⁴ Most importantly, however, there was a stark contrast in the quality of the two forces. The British were well-trained and morale was high. In contrast, "The Turkish rank and file were ill-clothed and ill-fed and very war-weary. Desertion was rife. The transport animals were in a wretched condition. . . . [and] the bad feeling between the Turks and the Germans

1. The best two sources on Megiddo are Captain Cyril Falls, *Military Operations Egypt and Palestine, from June 1917 to the End of the War*, Part 2, Official British History of World War I (London: His Majesty's Stationery Office, 1930), pp. 438–512, 628–647; and Colonel A. P. Wavell, *The Palestine Campaigns*, 2nd ed. (London: Constable, 1929), pp. 192–219.

2. Wavell, *The Palestine Campaigns*, p. 203. Dupuy actually uses these same numbers in his narrative description of Megiddo in *A Study of Breakthrough Operations* (p. 17). However, in his data base he gives manpower figures of 51,170 and 18,250 for the British and Turks respectively. The latter figures produce the 2.81:1 personnel strength ratio Epstein cites. See Dupuy, *A Study of Breakthrough Operations*, p. 10; and *Dupuy Data Base*, Vol. 4, p. 286. I cannot determine the origin of these data base numbers or explain the discrepancy between them and those used in the narrative.

3. Liddell Hart estimates that the British had "a five-to-one superiority on the vital sector." B.H. Liddell Hart, *The Real War, 1914–1918* (Boston: Little, Brown, 1930), p. 444.

4. The Official British History concludes: "The Royal Air Force had contributed vastly to the day's great victory . . . its most valuable service had been the spreading of destruction, death, and terror behind the enemy's lines. All the nerve-centres had been paralysed by constant bombing." Falls, *Military Operations Egypt and Palestine*, p. 487. Regarding surprise, Wavell writes, "The Turks [were] utterly surprised and aghast at the suddenness and pace of the onslaught." Wavell, *The Palestine Campaigns*, p. 207.

was acute.”⁵ It is no surprise that one student of the campaign concludes, “the battle was practically won before a shot was fired.”⁶

FLANDERS 1940

The Flanders 1940 case involves the crossing of the Meuse River around Sedan by Heinz Guderian’s 19th Panzer Corps.⁷ The battle took place between May 13 and 14, 1940, along a 10 km front, and was one of the key events leading to the fall of France.⁸ Nineteenth Panzer Corps comprised three Panzer divisions and one infantry regiment. One French division—the 55th Infantry Division—covered the section of the Meuse where 19th Panzer Corps struck. Thus, the Germans had about a 3.3:1 advantage in raw divisions at the point of attack. It is surprisingly difficult to determine the exact manpower levels for those fighting forces, but it appears that it was about 3:1.⁹ When other factors are considered, however, it becomes apparent that the real German advantage in combat power was much greater than 3:1.

First, the Germans had an overwhelming superiority in tanks—about 850 to none.¹⁰ Second, the French 55th Infantry Division comprised largely older, poorly trained

5. Wavell, *The Palestine Campaigns*, pp. 194–195.

6. *Ibid.*, p. 203. Liddell Hart concludes, “The morale of the Turks had so declined that it is often argued that Allenby had merely to stretch out his hand for the Turkish army, like an overripe plum, to fall into it.” *The Real War*, p. 439.

7. The best English language accounts of this operation are Guy Chapman, *Why France Fell: The Defeat of the French Army in 1940* (London: Cassell, 1968), ch. 4; Colonel A. Goutard, *The Battle of France, 1940*, trans. A.R.P. Burgess (New York: Ives Washburn, 1959), ch. 3; Jeffrey A. Gunsburg, *Divided and Conquered: The French High Command and the Defeat of the West, 1940* (Westport, Conn.: Greenwood, 1979), ch. 8; Alistair Horne, *To Lose A Battle: France 1940* (Boston: Little, Brown, 1969), chs. 11–14; and William L. Shirer, *The Collapse of the Third Republic: An Inquiry into the Fall of France in 1940* (New York: Simon and Schuster, 1969), pp. 623–658.

8. A powerful force the size of 19th Panzer Corps would not normally attack across a front as narrow as 10 km. The Germans were able to do so in this case because they had strung their attacking forces out to the rear, maintaining a relatively small portion of each division along the Meuse River. This deployment scheme naturally worked to diminish the combat power that 19th Panzer Corps could immediately bring to bear in the river crossing.

9. Trevor Dupuy maintains that 19th Panzer Corps comprised 48,000 troops, which is a reasonable number when one considers the typical size of the units assigned to that corps. *Dupuy Data Base*, Vol. 6, pp. 7–9. The French 55th Infantry Division probably comprised about 16,000 men. See Ulrich Liss, *Westfront, 1939–1940* (Neckargemund, FRG: Kurt Vowinkel Verlag, 1959), p. 258; and Barry R. Posen, *The Sources of Military Doctrine: France, Britain, and Germany between the World Wars* (Ithaca: Cornell University Press, 1984), p. 82.

10. Burkhart Müller-Hillebrand, *Das Heer, 1933–1945*, Band 2, *Die Blitzfeldzüge, 1939–1941* (Frankfurt: Verlag von E. S. Mittler & Sohn, 1956), pp. 107, 141; and Liss, *Westfront*, p. 270. The BDM Corporation has analyzed the May 1940 balance of forces in ADEs, which account for differences in the weaponry on both sides. See Phillip A. Karber, et al., *Assessing the Correlation of Forces: France 1940*, Report No. DNA-001-78-C-0114 (McLean, Va.: BDM Corporation, June 18, 1979). The study concludes that although the Allies had a slight advantage in terms of the overall balance (1.03:1), the Wehrmacht’s Army Group A, which was located in the Ardennes area, had a force advantage over the opposing French forces of 4.2:1. Unfortunately, the study does not consider individual engagements such as the breakthrough at Sedan. Nevertheless, when one considers the size and quality of the particular forces engaged at Sedan, the ADE ratio at that point was surely at least 4.2:1, and probably much greater.

reservists whose fighting skills were manifestly deficient, while the German Panzer units were in crack fighting condition. Third, the Germans had clear-cut air superiority on the opening day of the battle and they used it to their advantage. Finally, the French did not expect the 19th Panzer Corps to begin crossing the Meuse as early as May 13 and thus were caught off guard by the German onslaught.

The tremendous German advantage in combat power is reflected in the unfolding of the battle for Sedan. The Germans began crossing the Meuse at 3:00 pm on May 13, after earlier taking advantage of their initial air superiority to pound the 55th Infantry Division with Stuka attacks. These air attacks badly shook the French reservists. The start of the German ground assault further shook them and at 6:00 pm—a mere three hours after the attack began—the 55th began to disintegrate. This process continued throughout the night of the 13th and by the morning of the 14th the 55th Division was no longer an effective fighting unit. It had collapsed before offering serious resistance to the Germans.

There were a significant number of French units in the vicinity of Sedan that could have been used to reinforce the 55th Infantry Division, and to redress—at least somewhat—the imbalance of combat power in the immediate breakthrough sector. This did not happen, in part because the 55th Infantry Division collapsed so quickly that there was little time to move reinforcements forward. More importantly, however, French ineptitude during the course of the battle was so great that they were incapable of bringing the majority of their reinforcements to bear against 19th Panzer Corps. The French did manage to launch some scattered counterattacks against 19th Panzer Corps, but these took place after the 55th Infantry Division had collapsed and the French line had been pierced. Moreover, because the French were now in effect launching offensives of their own, they did not enjoy the defender's casualty-inflicting advantage that attends the 3:1 rule.¹¹

11. A word is in order regarding how Dupuy reaches the conclusion that the Germans had less than a 3:1 advantage at Sedan. Actually, he provides two sets of force ratios for this battle. In the data base he provided CAA, he credits the Germans with 48,000 men and the French with 60,000, which translates into a 0.8:1 personnel strength ratio. *Dupuy Data Base*, Vol. 6, p. 9. He reproduces those same figures in a chart in his recent book, *Understanding War* (p. 270). However, in two places in that same book he gives the personnel strength ratio for Sedan as 1.07:1 (pp. 156, 261). He also used this ratio in an earlier book, *Numbers, Predictions and War: Using History to Evaluate Combat Factors and Predict the Outcome of Battles* (Indianapolis: Bobbs-Merrill, 1979), where the 1.07 figure is apparently based on crediting the Germans with 48,000 men and the French with 45,000 (pp. 236–237). Dupuy uses the same figure for the Germans (48,000) in both sets of battle data. This is a reasonable estimate. It is his number of French soldiers, however, that changes (from 60,000 to 45,000) and in both cases is substantially higher than the actual number of French forces engaged (see note 9). The 45,000 figure apparently comes from counting unspecified elements of the French 7th and 9th Armies (*Numbers, Predictions and War*, p. 236). This calculation is puzzling because, in the engagement under discussion, the 19th Panzer Corps had only minor contact with forces from the 9th Army and did not do battle with forces from the 7th Army. In fact, the French 7th Army was far north of the Ardennes area. The German attack was directed at 2nd Army. The 60,000 figure seems to come from counting the entire French 2nd Army (*Dupuy Data Base*, Vol. 6, p. 7). There is no question that 19th Panzer Corps engaged units from that army. However, it makes no sense to count all the units in that army since Guderian's forces did not come into contact with the majority of them. It is not possible

UKRAINE 1941

The case of the Ukraine, June 1941, also involved the Wehrmacht; the defender in this case was the Soviet army. Dupuy focuses on Army Group South's initial breakthrough in an area due west of Rovno during the first days of Operation Barbarossa.¹² The breakthrough occurred on a 70 km front and was made by the German 6th Army, which had the First Panzer Group subordinated to it for this operation. The breakthrough was made by seven infantry divisions and two Panzer divisions.¹³ The Soviets maintained only a handful of divisions along their border in the Ukraine, emphasizing instead a defense-in-depth in that area.¹⁴ In fact, many Soviet units were deployed a hundred or more kilometers behind the front. Along the 70 km front in question, the Soviets maintained two rifle divisions, neither of which was at war-time strength when the nine Wehrmacht divisions attacked on June 22, 1941.¹⁵ Thus, in terms of raw numbers, the Germans had approximately a 4.5:1 advantage in divisions and probably about a 6.5:1 advantage in manpower.¹⁶ Moreover, the Germans had about 330 tanks with their first echelon force, while the Soviets had few if any tanks in their two infantry divisions.¹⁷ On top of this, the Germans had air superiority, achieved almost complete surprise, and were surely qualitatively superior fighting forces at

to ascertain from the various data bases and studies consulted why Dupuy chose these numbers for the French.

12. See Dupuy, *A Study of Breakthrough Operations*, pp. 32–42, which is a good narrative of the campaign.

13. The seven infantry divisions were the 298th, 44th, 299th, 111th, 75th, 57th, and 297th, while the Panzer divisions were the 11th and the 14th. The two Panzer divisions were located right behind the infantry divisions and were immediately moved forward into the breakthrough battle. The composition of the German force is determined from Horst Boog et al., *Das Deutsche Reich und der Zweite Weltkrieg*, Band 4, *Der Angriff auf die Sowjetunion* (Stuttgart: Deutsche Verlags-Anstalt, 1983), pp. 470–486; and its *Beiheft* (supplement), especially maps 1, 2, and 7.

14. See John Erickson, *Stalin's War With Germany*, Vol. 1, *The Road To Stalingrad* (New York: Harper and Row, 1975), pp. 71–72, 86–87; and John Erickson, *The Soviet High Command: A Military-Political History, 1918–1941* (London: Macmillan, 1962), pp. 580–581, 591.

15. The two Soviet rifle divisions along the border were the 87th and the 124th. See Erickson, *The Soviet High Command*, p. 592; B.N. Buisikh et al., *Kievskii Krasnoznamennyi: Istoriia Krasnoznamennogo Kievskogo voennogo okruga 1919–1972* (Moscow: Voenizdat, 1974), maps 1 and 2; and map 2 of the *Beiheft* for *Der Angriff auf die Sowjetunion*. The projected wartime strength of Soviet rifle divisions on the Eastern Front was to be 14,500 men. However, those divisions were maintained at different *shtats* or readiness levels during peacetime. The highest peacetime readiness level was 12,000, while the lowest was 6,000. See Bryan I. Fugate, *Operation Barbarossa: Strategy and Tactics on the Eastern Front, 1941* (Novato, Calif.: Presidio Press, 1984), p. 319; and Erickson, *The Soviet High Command*, pp. 567–571.

16. There were in 1941 about 15,600 men in a typical Panzer division and 17,700 men in a typical German infantry division. Fugate, *Operation Barbarossa*, pp. 344–346. Thus, the key first echelon of 6th Army probably comprised about 155,100 men. Assuming that the two Russian divisions were at the highest state of peacetime readiness (a very generous assumption), they would have included 24,000 men (see note 15). Erickson credits the Germans with employing six infantry divisions against two Soviet divisions, which nevertheless provides the Germans with slightly more than a 3:1 advantage. See Erickson, *The Soviet High Command*, p. 592.

17. Burkhart Müller-Hillebrand, *Das Heer, 1933–1945*, Band 3, *Der Zweifrontenkrieg* (Frankfurt: Verlag von E. S. Mittler & Sohn, 1969), p. 205. I have found no evidence that tanks were attached to the two Soviet infantry divisions that absorbed the Wehrmacht's initial blow.

that point in the war. Thus the Germans had an overwhelming advantage in combat power at the point of attack.¹⁸

With this decisive force advantage, the Wehrmacht quickly broke through Soviet forward defenses and, as John Erickson notes, "By the morning of 23 June, German penetration at the junction of the Soviet 5th and 6th Armies was an accomplished and menacing fact."¹⁹ Because the Soviets maintained large numbers of forces well behind those forward positions in the Ukraine, the Germans had considerable trouble exploiting their breakthrough and getting to Kiev quickly. This difficulty, however, involved the exploitation phase, not the initial breakthrough, which was accomplished with relative ease because the Germans had more than a 3:1 advantage at the point of attack.²⁰

KOREA 1950

The fourth case where Dupuy incorrectly described the force ratio at the point of breakthrough as less than 3:1 concerns the initial North Korean invasion of South Korea in late June 1950. The offensive called for a number of breakthroughs along the 38th Parallel; Dupuy's focus is apparently on the key breakthrough, which took place in the 47 km-wide Uijongbu Corridor north of Seoul.²¹

18. Soviet literature on the war concurs with this assessment. See, for example, P.N. Pospelov, et al., *Great Patriotic War of the Soviet Union, 1941–1945: A General Outline*, trans. David Skvirsky and Vic Schneerson (Moscow: Progress Publishers, 1974), pp. 50–52. The Germans, of course, achieved breakthroughs all along the front by concentrating forces at specific points so as to achieve greater than 3:1 advantages in combat power. See Erickson, *The Soviet High Command*, p. 592. The only place along the Soviet front where the Germans failed to achieve a breakthrough was northern Finland, where the Germans struck with a superiority of only 3:2. A.F. Upton, "The Finnish Front," in B.H. Liddell Hart, ed., *History of the Second World War*, Part 23 (London: BPC Publishing, 1966), p. 629.

19. Erickson, *The Road To Stalingrad*, p. 163. Dupuy himself writes, "By the end of the first day of the invasion [west of Rovno], the Germans had penetrated deeply into Soviet territory." *Dupuy Data Base*, Vol. 6, p. 33.

20. Dupuy arrives at his 0.88:1 force ratio for this battle by defining the breakthrough battle as lasting 5 days, June 22–26, with the exploitation phase beginning after June 26. See *Dupuy Data Base*, Vol. 6, pp. 15–33; and Dupuy, *A Study of Breakthrough Operations*, pp. 10, 32–42. This allows him to count many Soviet forces that were initially deployed well to the rear of the border, but were moved forward after the initial breakthrough. A close examination of the war in the Ukraine, however, shows clearly that there was no breakthrough on June 26 and, in fact, the resistance the Germans met immediately after June 26 was hardly different from the resistance they encountered immediately before June 26. This point is actually reflected in Dupuy, *A Study of Breakthrough Operations*, pp. 41–42. Also see Erickson, *The Road To Stalingrad*, pp. 163–171; and Carell, *Hitler's War on Russia*, pp. 37–40, 116–128. Regardless, these problems concerned the exploitation phase of the campaign, where the 3:1 rule has limited utility. The breakthrough into the Ukraine took place on the first day of the conflict.

21. Dupuy never stipulates which breakthrough battle along the 38th Parallel he is focusing on, although it appears from the characteristics of the battle described in his data base, as well as the narrative description he provides of the June 1950 invasion, that he is examining the attack down the Uijongbu Corridor. See Dupuy, *A Study of Breakthrough Operations*, pp. 10, 83–90.

The Uijongbu Corridor runs in a north-south direction from the 38th Parallel in the north to the city of Uijongbu at its southern end.²² The key breakthrough battles took place in the northern half of the Corridor on the first day of the war. The North Koreans attacked in this area with two infantry divisions and two tank regiments. These forces comprised approximately 28,000 men and 80 tanks.²³ The North Koreans also had substantial amounts of artillery in these divisions. The South Koreans had an understrength division comprising two regiments defending the Uijongbu Corridor. It totaled about 7000 men and had no tanks.²⁴ It was also short on ammunition and lacked effective anti-tank weapons and artillery. Immediately after the North Korean offensive began on June 25, the South Koreans moved part of a regiment from Seoul to the Uijongbu Corridor so that the South Korean division near the 38th Parallel would have its normal complement of three regiments.²⁵ That understrength regiment comprised 650 men and no tanks, thus bringing the South Korean total number of forces in the northern half of the Uijongbu Corridor to 7650 men and no tanks.

Thus, for the crucial breakthrough battle, the North Koreans had more than a 3.5:1 advantage in manpower and an overwhelming advantage in tanks, which were a key ingredient in the North Korean success and for which the South Koreans had no effective antidote.²⁶ The North Korean advantage in artillery also played an important

22. The best English language sources on the campaign in the Uijongbu Corridor are Roy E. Appleman, *South to the Naktong, North to the Yalu (June–November 1950)*, U.S. Army Official History of the Korean War (Washington, D.C.: Department of the Army, Office of the Chief of Military History, 1961), pp. 7–35; and Kim Chum-kon, *The Korean War, 1950–1953* (Seoul: Kwang-myong Publishing Co., 1980), pp. 175–247. The most comprehensive studies of the campaign, which are not available in English, are Kukpangbu Chonsa Pyonchan Wiwonhoe (The War History Compilation Committee, Ministry of National Defense, Republic of Korea), *Hankuk Chonjaengsa* (The History of the Korean War), Vol. 1 (Seoul, 1967), Vol. 2 (Seoul, 1968), and Vol. 1, revised (Seoul, 1977), with Map Appendix (Seoul, 1977); Yukkon Ponbu Chonsa Kamsil (The Office of War History, Army Headquarters, Republic of Korea), *Yuk'io Sapyon Yukkun Chonsa* (The Battle History of the Army during the Korean War), Vol. 1 (Seoul, 1952). The following discussion draws heavily on these latter studies. I am indebted to Moon Young Park for guiding me through these Korean language sources.

23. The North Korean figures are from Appleman, *South to the Naktong*, pp. 11, 24–25; Kim, *The Korean War*, pp. 180–183, 221–228; and *Hankuk Chonjaengsa*, Vol. 1, rev'd (1977), p. 318. There is evidence that the size of the North Korean force—in terms of both manpower and tanks—might have been larger than the numbers cited here. See *ibid.*, pp. 96, 318; and *Hankuk Chonjaengsa*, Vol. 1 (1967), p. 770.

24. *Hankuk Chonjaengsa*, Vol. 1, rev'd (1977), p. 318.

25. Appleman incorrectly credits this South Korean division (the 7th) with having three regiments stationed in the Uijongbu Corridor on June 25, 1950. He places one of those regiments along the 38th Parallel and the other two directly below the Parallel, near Pochon and Tongduchonni. *South to the Naktong*, p. 25. In fact, that division only had two regiments, the third having been transferred to Seoul as of June 15, 1950, where it was incorporated into the Capitol Division. Upon the outbreak of war, that regiment was transferred back to the 7th Division, although only two battalions reached the battlefields of the Uijongbu Corridor. See Kim, *The Korean War*, p. 222; and *Hankuk Chonjaengsa*, Vol. 1 (1967), pp. 318, 765; Vol. 2 (1968), pp. 123, 127; Vol. 1, rev'd (1977), pp. 318, 338–339.

26. The North Korean breakthrough actually took place on two axes of attack within the

role in the campaign. In addition to their raw numerical advantage, the North Koreans achieved almost complete surprise and were superior to the South Koreans in training and leadership.²⁷

The North Koreans, after breaking through the South Koreans' forward defenses in the northern portion of the Uijongbu Corridor, fought two more breakthrough battles as they exploited their opening victory and moved towards Seoul. These battles occurred at Ch'uksongryong Passage and Uijongbu in the southern half of the Corridor on the second day of the war. The North Korean force advantages in troops alone for those battles were 3.3:1, and 6:1 respectively.²⁸ In short, the North Koreans enjoyed more than a 3:1 advantage in combat power in each of their winning breakthrough battles in the Uijongbu Corridor.

Information describing the force levels of the two sides in the remaining five battles is very difficult to find. I have been unable to find numbers other than those provided by Dupuy for any of the four Israeli cases. There are some data available on the size of the forces involved in the Malaya (1941) case, but it is difficult to reconstruct what the force ratios were at the point of main attack. I will for the sake of argument, therefore, accept Dupuy's claim that the attacker did not have a 3:1 advantage in any of these five cases.²⁹ These cases share another common characteristic: each was a small-scale battle between forces with undefended or very lightly defended flanks.

Uijongbu Corridor. The offensives were located on the two principal north-south roads in the Corridor. However, both the North Koreans and the South Koreans divided their forces evenly between the two axes, so the overall ratio presented here for the Corridor applies to each axis of attack.

27. For a comparison of the capabilities of the two armies, see Appleman, *South to the Nakdong*, pp. 7–18. Regarding the North Koreans' achievement of surprise, see *ibid.*, pp. 19–21.

28. At Ch'uksongryong Passage, there were four South Korean battalions from the 5th and 16th Regiments of the 2nd Division numbering about 3000 men. The North Koreans had two regiments from the 4th Division and a separate tank regiment available for this battle. Assuming that this force, which would normally total about 11,000 men, had absorbed 1000 casualties on the first day of the offensive (if anything, this number is too high), there were then 10,000 North Korean troops available at Ch'uksongryong Passage.

Just below Uijongbu, the South Koreans deployed three battalions comprising about 3000 men. The North Korean forces actually converged at Uijongbu, bringing much of their original fighting strength (28,000) to bear against the South Koreans. Two regiments (6000) were diverted around Uijongbu and there were casualties in the battles north of that city (at most 3000). Thus, there were about 19,000 North Korean troops available to fight 3000 South Koreans. In all of these battles, the North Koreans also had a significant advantage over the South Koreans in terms of weaponry. See *Hankuk Chonjaengsa*, Vol. 1, rev'd (1977), pp. 368–385; *Yukkun Chonsa*, pp. 63–65, 79–81; and Appleman, *South to the Nakdong*, pp. 10, 11, 15.

29. Dupuy's *Elusive Victory: The Arab-Israeli Wars, 1947–1974* (New York: Harper and Row, 1978), appears to be the only English language source that gives information on force levels for Middle East battles. It is not possible, however, to determine the source of Dupuy's data. Although I have no reason to think Dupuy's numbers are unreliable, one cannot have much confidence in these undocumented numbers. Regarding Jitra (Malaya, 1941), it is possible to determine roughly how many forces were present for the battle, although I was unable to determine the force ratio at the critical point of attack with any degree of precision. See note 38.

Not surprisingly, therefore, three of the five were not breakthrough battles, but envelopments, to which the 3:1 rule does not apply.

SINAI-ABU AGEILA 1967

Consider how the Israelis defeated an Egyptian force of similar size at Abu Ageila, a key Sinai battle of the Six-day War.³⁰ The Egyptians occupied well-fortified trench lines that faced due east. The Israelis produced a stunning victory by landing a paratroop battalion in the Egyptian rear and, more importantly, by moving an infantry brigade around to the northern end of the Egyptian trench lines and then striking down those lines in a southerly direction. The Egyptians, who did not think the Israelis could outflank them by moving forces through the sand dunes to their north, were caught completely by surprise and quickly routed.

SINAI-RAFA 1967

At Rafa in the Sinai, the Israelis won another key victory against the Egyptians during the Six-day War.³¹ Again, the opposing forces were relatively evenly matched in numbers of weapons and personnel. The Egyptian forces were in strong positions along the Mediterranean coast in the northern Sinai. Israeli strategy called for a double envelopment of the Egyptian forces, which were spread out in a line running in a northeast to southwest direction. The attempted envelopment of the southwest end of the line was not very successful, but the Israeli 7th Brigade easily got behind the Egyptian forces at the northeast end of their line and rolled up the entire Egyptian force in short order.³²

SYRIA-QALA 1967

Qala was a battle fought in June 1967 between the Israelis and the Syrians on the Golan Heights. Here too the Israelis won an important victory with an envelopment.³³ The Israelis had two battalions available to take Qala, both of which they planned to use for an envelopment from the north. One of the battalions accidentally went down the wrong road and ended up driving directly into the teeth of the Syrian defenses. That battalion did reasonably well for itself, although it absorbed significant casualties.

30. See Randolph S. Churchill and Winston S. Churchill, *The Six Day War* (London: Heinemann, 1967), pp. 115–123; Yael Dayan, *Israel Journal: June, 1967* (New York: McGraw Hill, 1967), pp. 37–62; Dupuy, *Elusive Victory*, pp. 257–263; and Edward N. Luttwak and Daniel Horowitz, *The Israeli Army, 1948–1973* (Cambridge, Mass.: Abt Books, 1983), pp. 244–248.

31. See Churchill and Churchill, *The Six Day War*, pp. 105–115; Dupuy, *Elusive Victory*, pp. 248–252; Luttwak and Horowitz, *The Israeli Army*, pp. 233–244; and Shabtai Teveth, *The Tanks of Tammuz* (New York: Viking Press, 1968), pp. 128–180.

32. The 7th Brigade did have to break through some very weak Palestinian units in the Khan Yunis area to get behind the Egyptian positions.

33. See Dupuy, *Elusive Victory*, pp. 318–324; Luttwak and Horowitz, *The Israeli Army*, pp. 277–279; and Teveth, *The Tanks of Tammuz*, chs. 26–27.

However, victory only came when the second battalion, which took the correct route, enveloped the Syrian position.

The remaining two battles were not envelopments, but attempted breakthroughs.

MALAYA 1941

At the Battle of Jitra in Malaya, December 1941, powerful elements of the Japanese 5th Division struck frontally against the 11th Indian Division.³⁴ The Japanese forces did penetrate the Indian positions, but they did not break through them. The Indians had checked the Japanese advances and the basic integrity of the 11th Division remained intact, when British military leaders decided to withdraw the Indian unit. That decision was predicated on the belief that the 11th Division, which was a poorly trained fighting force, was not likely to hold out for the long term as well as on the fact that another Japanese force was threatening to envelop it from the rear.³⁵ The withdrawal in the face of Japanese pressure was the first of a series of disasters for this inexperienced unit. Jitra was a great victory for the Japanese, but it was not the result of a successful breakthrough.

Jitra was also a case of qualitatively mismatched foes. By all accounts, the 11th Indian Division was a woefully inadequate fighting force.³⁶ It had no tanks; in fact, many of the unit's soldiers had never seen a tank. The Indian government was constantly "milking" this unit of trained manpower to provide forces for new divisions being raised in India. The 11th Division was thus in a constant state of unpreparedness. Moreover, it devoted much of its limited training time to preparing for an offensive into Thailand, which detracted from preparing defenses at Jitra. The Japanese 5th Infantry Division, on the other hand, was highly trained, partly mechanized and generally considered one of the finest divisions in the Japanese army.³⁷ Even if the Japanese had broken through the Indian defenses at Jitra, it would not have

34. The best source in English on Jitra is Major General S. Woodburn Kirby, *The War Against Japan*, Volume 1, *The Loss of Singapore*, Official British History of World War II (London: Her Majesty's Stationery Office, 1957), pp. 163–171, 201–219, 501–504, 513–515, 521–523. Also useful are K.D. Bhargava and K.N.V. Sastri, *Campaigns in South-East Asia, 1941–1942*, Official History of the Indian Armed Forces in the Second World War (India and Pakistan: Combined Inter-services Historical Section, 1960), ch. 7; Lt. Gen. Arthur E. Percival, *The War in Malaya* (London: Eyre and Spottiswoode, 1949), pp. 121–135; Arthur Swinson, "Japanese Victory: The Conquest of Malaya," in B.H. Liddell Hart, ed., *History of the Second World War*, Part 26 (London: BPC Publishing, 1966), pp. 710–721; and Colonel Masanobu Tsuji, *Singapore, The Japanese Version*, trans. Margaret E. Lake (New York: St. Martin's, 1960), pp. 119–128.

35. This discussion points up that although technically the Japanese did not effect a breakthrough at Jitra, the battle might still be classified as a successful breakthrough since the Japanese would have probably broken through if the 11th Division had not retreated. One might also argue that the attacker's success at Jitra was due in good part to the threat of envelopment and therefore it cannot be considered a fair test of the 3:1 rule. These are both legitimate points which highlight the difficulty of categorizing Jitra—especially in the space allotted here. Also see note 38.

36. See Kirby, *The War Against Japan*, pp. 163–169.

37. See Swinson, "Japanese Victory," p. 711; and Tsuji, *Singapore, The Japanese Version*, passim.

represented a meaningful refutation of the 3:1 rule.³⁸ If one controls for the quality of the two forces, it is apparent that the Japanese superiority was above 3:1.

SYRIA–TEL FAHAR 1967

Tel Fahar is another case from the Six-day War of an Israeli victory against the Syrians on the Golan Heights.³⁹ This battle is the only one among the nine that appears to be a case of an attacker with less than a 3:1 advantage winning the kind of breakthrough battle that is relevant for testing the 3:1 rule. However, here the Israelis had a very large qualitative advantage over the Syrians—an advantage so great that their effective advantage in combat power was well above 3:1. There is an abundance of evidence from the 1967 war, and other Arab-Israeli conflicts, which demonstrate that point: for example, probably twenty Syrian soldiers died for every one Israeli death on the Golan Heights,⁴⁰ where the Israelis were on the offensive and the Syrians were fighting from prepared positions. The situation was not much different in the Sinai. In the trench fighting at Abu Ageila, for example, the Israelis lost ten infantrymen, the Egyptians, more than 300.⁴¹ The history of Arab-Israeli aerial engagements also supports the idea that the Israelis enjoy a great qualitative advantage over their Arab foes. Epstein notes that in the 1967, 1973, and 1982 air battles, the Israelis had “extraordinarily high exchange rates” of 20:1, 40:1 and more than 80:1 respectively.⁴² Quality of the pilots, he explains, account for these lopsided ratios. The same basic explanation—differences in troop quality—accounts for the great asymmetries in the performance of the two sides’ armies in the ground war.

38. As emphasized, I could not determine with any degree of precision what the overall force levels were at Jitra. For the best information, see Kirby, *The War Against Japan*, pp. 504, 522–523. Nor could I ascertain what kind of force advantage the Japanese had when they struck the right flank of the 11th Division and penetrated the front of its 15th Brigade. It is especially difficult to determine which Japanese units were involved in the various assaults against the Indian front. Nevertheless, a detailed analysis *might* show that the Japanese had as much as a 3:1 advantage in combat units along the part of the front where the penetration was made. The Japanese, as Dupuy notes, committed more forces at Jitra than is commonly recognized. Dupuy, *A Study of Breakthrough Operations*, p. 49. Furthermore, the Indian forces were spread across a broad front and the Japanese concentrated their sizeable force at a particular point along that elongated front. See Kirby, *The War Against Japan*, map 9. It is also clear from narratives of the battle that the Japanese were more adept than the Indians at bringing reinforcements to the main battle area.

39. See Moshe Dayan, *Story of My Life* (London: Weidenfeld and Nicolson, 1976), pp. 302–303; Dupuy, *Elusive Victory*, pp. 318–324; and Nadav Safran, *From War to War: The Arab-Israeli Confrontation, 1948–1967* (New York: Pegasus, 1969), p. 378.

40. Luttwak and Horowitz, *The Israeli Army*, p. 282.

41. Yael Dayan, *Israel Journal*, p. 54. It is generally agreed that 275 Israelis and 12,000 Egyptians died in the Sinai, which translates into an overall casualty-exchange ratio of 44:1. See Luttwak and Horowitz, *The Israeli Army*, p. 282; and Kessing’s Research Report, *The Arab-Israeli Conflict: The 1967 Campaign* (New York: Charles Scribner’s, 1968), p. 41. For a good general discussion of qualitative differences between the Egyptian and Israeli forces, see David Kimche and Dan Bawly, *The Six-Day War: Prologue and Aftermath* (New York: Stein and Day, 1971), pp. 162–175.

42. Epstein, *Strategy and Force Planning*, p. 90.