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NET-CENTRIC BEFORE ITS TIME

The Jeune École and Its Lessons for Today

Erik J. Dahl

The story is a familiar one to students of military technology and transformation: a visionary military officer—a vice admiral—offers a new concept of how his navy, and his nation, will fight wars of the future. He suggests that smaller, faster forces, networked by new technology and following the latest ideas of business and economics, could replace in part the large, expensive military forces currently in use. His ideas resonate with many but generate opposition from others, and they are debated in military journals and even in the press. Finally the country's political leaders decide to support his ideas, and he is appointed to a more senior post and given the opportunity to put his vision into practice.

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This story applies to the U.S. military today, in connection with the concept of network-centric warfare (NCW). Originally developed by Vice Admiral Arthur K. Cebrowski, U.S. Navy (President of the Naval War College from 1998 to 2001), it remains one of the leading visions for the transformation of warfare. After retirement, and until recently, Admiral Cebrowski served as Director, Office of Force Transformation for the Department of Defense. But our story also applies to the French Navy in the late 1800s, when the revolutionary ideas of Vice Admiral Hyacinthe-Laurent-Theophile Aube produced a school of thought known as the *Jeune École*, or “young school.” Aube was appointed Minister of Marine in 1886, and although his time in office was relatively short he left behind a

legacy of innovation and controversy that changed the French Navy for decades to come.

Network-centric warfare and the Jeune École represent innovative approaches toward the transformation of warfare, and both have been cited as examples of the type of thinking that can lead to revolutions in military affairs (RMAs). Both have also been charged with many of the same failings, such as an overemphasis on technology and excessive focus on tactical applications. Few historians or analysts have drawn a comparison between the two schools of thought, and although NCW advocates often cite historical parallels, they have not attempted to compare their innovations today with those of the French Navy more than a century ago. In fact they are unlikely to do so, because the Jeune École is often described as an example of how *not* to conduct a military transformation—too much technology, some critics charge, and not enough Clausewitz.

But this disparaging conventional view is overly simplified, and the Jeune École deserves more attention than it has been given. This article argues that the Jeune École can best be understood as a revolutionary concept of warfare that was well ahead of its time. Its leaders were wrong about many things, yet when we look closely at their ideas we see a remarkable resemblance to some of today's innovative visions of information-age warfare, and to network-centric warfare in particular. It is not too much to say that the Jeune École was the network-centric warfare of its time.¹

The story of the Jeune École's rise and fall holds important lessons for military transformation today, and its swift decline in particular represents a cautionary tale for NCW advocates. Yet just as the reasons for the Jeune École's failure have been misunderstood, so have its implications. The Jeune École failed for many reasons, but primarily because it attempted to do too much, was unwilling to accept criticism or allow dialogue, and misjudged the pace of change in warfare. Today's advocates of military transformation and revolution sometimes exhibit similar failings.

This article first reviews present-day thinking about the Jeune École among military writers and strategists. It then examines the school's origins, how it attempted to change the French Navy, and why it fell abruptly from power. Next it describes how the reasons for the school's fall have been misunderstood and why those reasons are relevant today. We will then compare the Jeune École with the concept of network-centric warfare and conclude by considering what lessons this comparison holds for the concept of NCW and, more broadly, for American defense transformation.

TWO SCHOOLS OF THOUGHT

History has not been kind to the Jeune École; historians of the French Navy have generally neglected it, while scholars of technology and military affairs typically give it little credit for innovative thinking or positive influence. One historian, for example, writes dismissively of Vice Admiral Aube that his mind “was running along a very old track.”² Another scholar, assessing the impact of technology on naval operations in the latter half of the nineteenth century, has only this to say: “The Jeune École in France deployed the most radical logic, but it was not matched by performance.”³

If commentators today agree that the Jeune École was a failed attempt at a revolution in military affairs, they disagree over what caused that failure and what lessons, if any, it holds for contemporary military planners. Two schools of thought can be seen in the literature. The first, and predominant, view holds that Aube and his followers were misguided in their overemphasis on technology; it



Vice Admiral Arthur K. Cebrowski, USN (Ret.)

sees the movement as an anomaly, with nothing positive to teach today’s military. The second school of thought is that the Jeune École offered truly valuable and innovative ideas but that for technical, tactical, and strategic reasons they could not be implemented—that it was, in effect, an RMA before its time.

Milan Vego, one of the few scholars to make an explicit comparison between the Jeune École and NCW, has expressed the first view. For Dr. Vego, who is critical of network-centric warfare for placing too much emphasis on tactics and technology, “NCW bears a striking resemblance to various discarded theories of war fashionable over the last two centuries.”⁴ Like NCW, he writes, the Jeune École emerged as a response to rapid technological changes in warfare and espoused the netting of naval forces (in its case,

through the telegraph and signal stations). Aube mistakenly felt that technology made moral factors irrelevant; many of his ideas, such as about torpedo boats, did not work; and he and his followers tried fruitlessly to make up for their mistakes with complex mathematical models. The result, in this view, was decades of disarray for the French Navy.

James J. Tritten is also critical of the significance of the Jeune École: “The Jeune École did not represent mainstream naval thought and should be interpreted as a temporary sidetrack resulting from the introduction of, and opportunities afforded by, new technologies in an austere fiscal environment.”⁵ Michael Vlahos sees the Jeune École advocates as technocrats, unable to see the

big picture while they pushed for their favorite project, the torpedo boat: “Aube’s and Charmes’ promotion of the wrong weapons resulted in the utter stagnation of the French navy.”⁶

Stephen Biddle is the primary theorist to make the considerably less popular case that the *Jeune École* was revolutionary but premature. Biddle has described the *Jeune École* as an example of a military that attempted too much radical change, too fast, and so failed to achieve a revolutionary effect.⁷ For him, the *Jeune École*, European air-warfare visionaries before World War I, and the U.S. Army pentomic division experimenters of the 1950s “all represent visionary, forward-looking thinkers who decided a revolution was at hand when it was not.”⁸

Biddle’s view is most definitely in the minority, however, and the consensus among historians and strategists is clear—that the *Jeune École* placed its bets on the wrong technology and tactics, primarily on the torpedo boat over the battleship, and neglected the moral, strategic, and human dimensions of warfare. Its effect was to reduce French naval readiness dramatically, and its only legacies for today are warnings against making the same mistakes again. But as the history of the *Jeune École* will show, this consensus view is based on an insufficient understanding of Aube and the school he founded.

TECHNOLOGICAL CHANGE AND STRATEGIC UNCERTAINTY

The middle of the nineteenth century was a time of great change in naval warfare, driven largely by technological innovation.⁹ Not all of the military changes of the period, of course, were specific to navies, and not all were driven by technology; new ideas in economics and politics, such as social Darwinism and imperialism, were making their marks in land warfare as well as naval theory. The greatest driver of change was technology unleashed by the industrial revolution, and those advances tended to affect navies more rapidly than armies. Every generation, it seemed, new technologies threatened to make obsolete all previous ship designs.¹⁰

Sir Nathaniel Barnaby, Britain’s leading naval shipbuilder, wrote in 1876 about the technological uncertainty of the age: “The introduction of the screw propeller into the Navy in 1844 made a magnificent Navy obsolete; the realization of the terrible effects of shell fire in 1854 again rendered our grand screw line-of-battle ships and frigates things of the past.”¹¹ The greatest technological development was steam propulsion, which made ships independent of the wind and gave them much greater speed—especially with the later addition of the steam turbine. Other changes affected naval armor and ordnance. These developments led to confusion in naval tactics, with some strategists predicting that future naval warfare would be chaotic, characterized by melees, but others

believing that new tactical formations and weapons would actually make war at sea more orderly than it had been.¹²

But despite these dramatic changes, seapower played little part in the European wars of the mid-nineteenth century, and the general opinion was that the next war would follow the same pattern. Many—not just in France, but throughout Europe—supported the traditional army view that “sea power was a matter concerning trade and colonies and that, at best, it had only a secondary role to play in the relations of the great European states.”¹³

By the 1870s the French Navy, in particular, faced a problem. During the Franco-Prussian War of 1870, which had ended in the downfall of the French empire, the Navy had found itself unable to bring its power to bear. Although the French Navy was much larger than the German fleet, a combination of poor planning, lack of amphibious capability, and operational mistakes meant that the French had been unable to achieve their wartime objectives of destroying the



Vice Admiral Theophile Aube

German ironclads, blockading the German coast, and landing an army corps. Instead the German fleet remained in port, and the French were only able to mount an ineffective attempt at a blockade. Despite its failures at sea, the Navy did contribute to the war: naval officers and men served on land to help defend Paris. Thus the Navy emerged from the war in the strange position of having failed in its primary duty but having won the admiration of the French population.¹⁴ But popularity did not translate into large budgets, as much of the public regarded the Navy as an expensive luxury compared to the Army, leaving the service in a precarious financial situation.

Some French naval officers began to look toward new concepts of warfare and technology. They were inspired by the success during the American Civil War of the Confederate raider *Alabama*. As a leading scholar in the field recounts, “in a twenty-one-month cruise covering much of the globe, this comparatively weak steamer with auxiliary sail power took more than sixty prizes.”¹⁵ The *Alabama* and other raiders did not succeed in breaking the Union blockade of the South or in significantly interrupting the sea communications of the North, but they did have enormous influence on naval thinkers of the time. Britain in particular appeared to be a prime target for such a strategy of commercial warfare, having become, since the elimination of its Corn Laws (protectionist measures restricting the import and export of grain), highly dependent on maritime commerce for food and raw materials.¹⁶

Another key factor in naval thought at the time was the development of the independently running, or “automobile,” torpedo. Torpedoes until that time

had been mostly fixed weapons, essentially what are today called naval mines. Early automobile torpedoes began as small, petroleum-burning steamboats guided by ropes from the shore. Robert Whitehead, an Englishman working in Austria, greatly improved on the idea: he eliminated the ropes, replaced steam with compressed air, and made the torpedo an underwater weapon by creating a “balance chamber” that enabled it to stay at a constant depth.¹⁷ By 1871 most of the European powers had begun to adopt his invention.

These developments attracted the attention of Captain Baron Louis-Antoine-Richild Grivel, the ideological forefather of the *Jeune École*. Grivel wrote a book in 1869 describing how new technology and inventions could help make commerce raiding (*guerre de course*) an effective anti-British strategy. The orthodox view among French naval officers at that time was essentially Mahanian, holding that only the clash of arms at sea could be decisive; this, Grivel argued, was not the right approach for France to take against England.¹⁸ These ideas were taken up by Vice Admiral Aube, who would become the leader of a new school of naval thought.

Aube had spent most of his career on overseas stations and as a result had developed an outlook focusing on the defense of overseas interests and commerce. In a series of articles written in the 1870s, he began developing a naval strategy based on a new concept of warfare—that the object of war was to do the greatest possible harm to the enemy. This, wrote Aube, was to be accomplished by destroying the enemy’s national wealth; the destruction of the enemy’s battle fleet was by itself unimportant. The real wealth of Britain, specifically, was in its commerce, much of which was carried by merchant ships, so the prime aim of naval warfare against it was to destroy its merchant ships with commerce-raiding cruisers and torpedo boats. As Aube later wrote, “To destroy England’s fleet would be to humble her pride, but the way to make war on England is to sink the ships that bring the English their bread, meat and cotton and enable their workers to earn their living.”¹⁹

Aube was strongly influenced by the many new scientific ideas that were being discussed throughout Europe in this period. His call for unrestricted torpedo-boat warfare, for example, reflected a Darwinian contempt for the rule of law at sea.²⁰ Another new idea that appealed to Aube was the division of labor, which suggested it was a bad idea to put too much of the fleet’s power into a relatively small number of large battleships. He encouraged experimentation and the development of new ideas that ran counter to prevailing military doctrines. One such promising idea, he believed, was that the key to success in a future war would be a sudden, coordinated attack by a large number of small, torpedo-equipped ships and larger cruisers against the enemy’s commercial shipping—a blow that, along with bombardment of coastal cities, would create panic and

social collapse. In a widely quoted passage, Aube described the actions of his torpedo boats:

Tomorrow war breaks out; an autonomous torpedo boat—two officers, a dozen men—meets one of these liners carrying a cargo richer than that of the richest galleons of Spain and a crew and passengers of many hundreds. . . . The torpedo boat will follow from afar, invisible, the liner it has met; and, once night has fallen, perfectly silently and tranquilly it will send into the abyss liner, cargo, crew, passengers; and, his soul not only at rest but fully satisfied, the captain of the torpedo boat will continue his cruise.²¹

The Navy split in two over these radical ideas; Aube's followers became known as the new, or young, school, while old-school traditionalists—the *Vielle École*, or to one German scholar, the *Alte Schule*—advocated continuing emphasis on sea battle and blockade.²² The traditionalists were not necessarily unreasoning reactionaries; the old school wanted to connect the new with the old; “Continuity, evolution was its program, not revolution.”²³ The admirals who opposed the Jeune École did not like publicity, which put them at a disadvantage, because the struggle between the young and old schools was fought primarily in the press and parliament. Politicians were attracted to Aube's ideas because they offered significant economies. A liberal deputy, Etienne Lamy, produced a far-reaching report on the naval budget of 1879 in which he praised Aube's ideas and argued that battleships were too expensive:

The construction of battleships is so costly, their effectiveness so uncertain and of such short duration, that the enterprise of creating an armored fleet seems to leave fruitless the perseverance of a people. In renouncing warfare between battle fleets, a nation does not abdicate if it can produce, after having ensured the defense of its coasts, ships with powerful engines and strong artillery, able to remain at sea for an extended time, and destined for commercial war.²⁴

The Jeune École attracted support from politically minded journalists, as well as from younger officers who had been embittered against their seniors by the slow rates of advancement as the French Navy transitioned from a large fleet of sailing ships to a smaller one dominated by ironclads. Most notable among the journalists was Gabriel Charmes, a brilliant young writer and student of foreign affairs. Charmes knew little of naval matters, but he and Aube became close friends and colleagues—so close that “it is impossible to distinguish between the ideas of the two men.”²⁵ Charmes would eventually—before his early death—develop tactical ideas of his own, most notably that of the *bateau-canon*, a gunboat built like a torpedo boat but armed with a single gun. He supported the idea that the battleship violated the principle of division of labor: “The principal vice of ironclads is the attempt to combine in them at one time all of the means of

naval warfare: the ram, the gun, and the torpedo. The result is that they are not really suited to use any of them.”²⁶ Charmes was the primary advocate of the *Jeune École* in the press, frequently stressing the political nature of its reforms: “It will be the reign of justice succeeding that of favoritism, it will be equality replacing privilege.”²⁷

The debate between the reformers and traditionalists became heated and extreme, with no compromise possible. Advocates for the *Jeune École*, for example, did not speak simply of torpedo boats but of “democratic torpedo boats”; anyone opposing them was opposing democracy itself.²⁸ Aube was given his chance on 7 January 1886, when he became Minister of Marine—an appointment made more for political reasons than on the perceived merits of Aube’s naval ideas.²⁹ Whatever the reasons, “for a short space of a year and a half, the dream came true; the philosopher was king; ideas could really be put into practice.”³⁰

THE JEUNE ÉCOLE IN POWER

Aube soon found that not all of his theories translated well into practice. The first idea to be put to the test was that of the autonomous torpedo boat. In February 1886 he sent two torpedo boats from Cherbourg to Toulon, in order to test their independent cruising endurance at sea. The crews were so shaken up by the trip that they would have been unable to fight. One sailor later recalled that the weather forced them to subsist largely on sardines:

As a rule, we lived on ham, sardines, and tinned soups; for most of the time the weather was so rough that it was as much as we could do to get a little water boiled. We had a table about eighteen inches wide, but there was no point in laying it, for nothing would stay on it. The usual plan was for one man to hold the sardine tin while the other picked out sardines by their tails and transferred them to his mouth.³¹

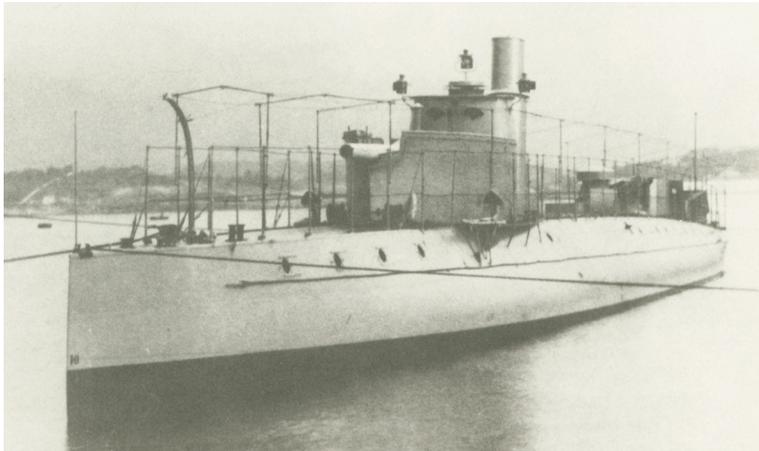
From then on it was agreed that torpedo boats would have to be used for coastal defense. As has been pointed out, this should not have been a surprise to the *Jeune École*: “Charmes should have been able to make for himself the astounding discovery that a 33-meter boat was not yet an Atlantic liner.”³²

Other experiments, however, showed that the torpedo boat could fire a torpedo at a moving battleship, and in May and June 1886 Aube tested this concept in the first French naval maneuvers of modern times. A *Jeune École*-style fleet of some twenty torpedo boats, supported by three cruisers and a coastal-defense battleship acting as mother ship, faced an “attacking” fleet that included eight battleships. It was to be a battle of microbes against giants, wherein many small, specialized boats would take on ironclads according to the division-of-labor principle. The torpedo boats failed to prevent the battleships from

“bombarding” the port of Toulon, but when the attackers established a blockade, the boats were judged to have “sunk” most of them—an important result, as a fundamental part of Aube’s theory held that close blockade by a large fleet could be made impossible.³³ Overall, however, these exercises did not show torpedo boats to be as successful as the Jeune École had hoped. In December 1886 Aube settled on a revised, three-pronged strategy: offense in the Mediterranean, with the entire battle fleet concentrated at Toulon against Italy; defense in the Channel; and commercial warfare in the Atlantic.³⁴

Another idea that proved unsatisfactory was Charmes’s project of fast gunboats, the *bateaux-canon*s. The first of these was launched in April 1886; it was named for him after his death at thirty-six of tuberculosis, soon after Aube came into power. It was equipped with a 5.5-inch gun, intended to support attacks by torpedo boats. But its sea trials in 1887 presented the Jeune École with another setback. The boat proved to be a very unstable platform; the *Gabriel Charmes* could not hit anything. The planned construction of fifty additional *bateaux-canon*s was scrapped, and the *Charmes* lost its gun, after which it was ignominiously redesignated simply *Torpedo Boat 151*.³⁵

Aube’s work with torpedoes and torpedo boats is his best-known innovation, but he also initiated a number of other projects, such as experiments with oil fuel



The Fast Gunboat *Gabriel Charmes*
Source: Naval Historical Center

and the initial Navy trials of the high-explosive melinite shell, which had been adopted in the French Army for bombardments and which Aube proposed to use against battleships and Italian cities. One far-sighted innovation that Aube supported came to fruition, but not in his lifetime—the submarine.

Two months after becoming minister, he opened an official competition for designs for a submarine, a process that ultimately led to the construction of France’s first viable underwater craft, the *Gymnote*.³⁶

Many of his projects could not be completed, because Aube fell from office in May 1887 in a political reshuffle. In poor health, he retired to the country and ceased to be active in the movement he had founded. By this time most of the other Jeune École creators had also disappeared from the scene: Charmes

was dead, and Grivel had died as well, in 1882. With Aube gone, “there disappeared the last with the ability to keep it from degenerating into a mere naval faction.”³⁷ The debate between reformists and conservatives became instead one between radicals and reactionaries; to the end of the century the French Navy was torn by bitter debates among officers, in the press, and in parliament.

The result was a lack of strategy and vision for the Navy, the poor condition of which was finally revealed in the Fashoda crisis of 1898, which arose after a colonial expedition raised the French flag at the town of Fashoda, on the Nile, despite warnings from the British against such an act. Soon a British army under Lord Kitchener arrived. France and Britain came close to war, but the French were forced to back down when they realized that their navy—which was derisively described as a “fleet of samples”—was no match for the British.³⁸

Even after the crisis, supporters of the *Jeune École* program continued to argue in favor of it; one journalist declared in 1900, for example, that if Aube’s “ideas had been followed, if his plan had been executed, France would be at this moment the greatest naval power in the world.”³⁹ But after Fashoda a movement for moderation began to gain strength among the *Jeune École* and the traditionalists. A coherent naval strategy emerged in 1900, under the ministry of Jean-Louis de Lanessan, who was part of a cabinet intended to heal the wounds of a much larger struggle, the Dreyfus Affair. This strategy represented “the beginning of an official realization that public (and parliamentary) opinion was generally right in matters of administration and generally wrong in matters of naval strategy and building programs.”⁴⁰ A middle ground developed in terms of both naval construction and strategy, as Vice Admiral François-Ernest Fournier supported a fleet containing both battleships and cruisers, prepared to conduct either a traditional war on the high seas or a campaign against commerce.⁴¹

Naval stability would have to wait, because the *Jeune École* was destined to come back to power one last time. In 1902, the radical politician Camille Pelletan became Minister of Marine. Pelletan—who, attempting to stamp out all vestiges of aristocracy in the Navy, suppressed dress uniforms for officers and gave ships good “republican” names like *Justice* and *Liberty*—favored pet projects that frequently ran counter to common sense as well as the wishes of the naval establishment. “Pelletan faithfully based his administration on the worst of the *Jeune École* ideas of the 1890s: that the welfare of the arsenal workers, the common sailors, and the republican officers was more important than the welfare of the navy as a whole.”⁴² The Pelletan ministry came under widespread criticism and eventually was succeeded by a wider consensus and spirit of compromise in naval affairs, but while it lasted his tenure solidified the negative image of the *Jeune École* for posterity.

In its wake, the Jeune École appears to have left behind little but discord and a series of failed, if well intended, experiments. Many of its tactical and technological innovations were quickly overtaken by other developments in naval warfare. The development of torpedo nets and electric searchlights made battleships less vulnerable to torpedo attack, and improved propulsion and rapid-fire guns gave larger ships the speed and firepower needed to counter the torpedo-boat threat. Smokeless gunpowder eliminated the artificial “fog of war” upon which torpedo boats depended to close in on larger warships.⁴³ By 1890 most navies were building battleships again, and the ideas of Alfred Thayer Mahan became popular in France as well as in much of the rest of the world. The enthusiasm for the latest technology had been largely overtaken by a return to the older military principles of Clausewitz and Jomini.⁴⁴ Just as important, the strategic environment had changed. Britain was beginning to look more like an ally than an enemy, whereas against any enemy but England, France would need a traditional navy, able to engage enemy fleets at sea.⁴⁵

RETHINKING THE JEUNE ÉCOLE

There is no doubt that the school of thought begun by Aube failed in its attempt to reform the French Navy and that the debate over the Jeune École sparked several decades of bitter debate that left the service far weaker than it been. But many of the criticisms that have been directed against the school are misguided. The Jeune École deserves another look from history and from military thinkers today; advocates of network-centric warfare have as much to learn from its strengths as from its weaknesses.

Historical Anomaly or Culmination of Innovative Tradition?

First, although it is frequently treated as if it were a historical anomaly—a simple mistake sparked by misguided enthusiasts—the Jeune École actually represented the continuation and culmination of decades of French naval technological innovation in the early and middle 1800s. As early as the 1820s, French naval officers had embraced the notion that technology would be the key to any successful challenge to Britain’s naval position. Andrew Krepinevich, a prominent scholar in the field of military innovation, has described how the French Navy led the way early in what he calls the “Naval Revolution,” pioneering the adoption of steam propulsion and screw propellers in 1846, launching the first high-speed, steam-powered ship of the line in 1851 and the first seagoing iron-clad fleet in the late 1850s.⁴⁶ The government, rather than the private sector, funded much of this early experimentation, and this pattern continued into the Jeune École era with the torpedo boat in the 1880s and the submarine in the 1890s.⁴⁷ The Jeune École, then, might be considered the ultimate expression of

naval technological innovation, in the most innovative navy, in what was until that point the most innovative period in naval warfare ever seen.

Who Was Responsible?

Second, the creators of the Jeune École should not bear full responsibility for the poor state to which the French Navy fell by the turn of the century. The decline was largely brought about by politicians and polemicists in the press who hijacked the naval reform movement, and it was also the result of problems in French naval administration that preceded the Jeune École.

It does appear, however, that the collaboration between Aube and Charmes was ultimately detrimental to the Jeune École's reputation, for Charmes went beyond what Aube had recommended. The historian Paul Halpern, citing contemporary sources, writes that it was Charmes who introduced the concept of "division of labor" into the Jeune École argument and distorted the school's doctrine in favor of an extreme advocacy of the torpedo boat and, especially, the *bateau-canon*.⁴⁸ Theodore Ropp, a leading scholar in the field, agrees with this negative assessment of Charmes's influence: "The incredibly doctrinaire—and incredibly French—character of the debate was at least partly due to Charmes. Like most French journalists, he believed that all things could be solved by argument, if only the polemic was violent enough."⁴⁹

Nonetheless, and while Charmes can be considered more radical than Aube, neither of the school's founders took the debate to the extremes to which it degenerated later. One historian, Stephen Roberts, suggests that there existed in effect two Young Schools: the teachers who developed the theories, especially Aube and Charmes, and the disciples who adopted and used them because they found them useful in the political and social struggles of the day. After Aube fell from office and Charmes died, Roberts wrote, "the Naval Young School of Aube and Charmes soon died out, but the political Young School remained to plague the Navy through the 1890s."⁵⁰ In the 1890s the political Young School took the Jeune École to an illogical extreme, focusing entirely on the building of a fleet of hundreds of torpedo boats for coastal defense and denying completely the need for any high seas fleet—which Aube had never intended.⁵¹

This distortion of Aube's original ideas reached its peak (or nadir) under the ministry of Camille Pelletan, whom Roberts describes as "the most violent member of the political Young School."⁵² If the commentators of the time are to be believed, the Jeune École certainly did deserve the blame for the chaotic and unready state of the French Navy at the beginning of the twentieth century. For example, Theophile Delcasse, the French minister of foreign affairs from 1898 to 1905, proclaimed, "Thanks to Camille Pelletan, we no longer have a fleet."⁵³ But the policies of Pelletan were not the same as those of Aube, and it is important to

separate the ideas of the true Jeune École from those of the individuals who later took on its mantle.

Moreover, the poor condition of the French Navy cannot be blamed completely on either the original Jeune École or its later followers, for the service at that time suffered from long-standing problems of poor administration and meddling by government. It was chronically disorganized, often in the throes of reorganization at the behest of politicians who may not have known much about what they were doing. As one observer wrote in 1913, “The navy is a department of generally organized disorder.”⁵⁴ Tritten puts it this way: “The history of the French navy is one of mismanagement by governments who *could* have known better.”⁵⁵

Halpern argues that although the French Navy had a good technological base, it suffered from an administrative organization notorious for complexity and red tape: “These organizational difficulties would by the turn of the century inflict great harm on the navy, offsetting the potential advantages that might have been derived from the imaginative or technically daring constructors. The French, in summary, did not manage technology well and the French Navy would pay the price.”⁵⁶ It may be that the failure of the Jeune École was at least in part a result, and not a cause, of poor administration in the French Navy of that period.⁵⁷

Foolish, Inflexible, and Fixated on Technology?

The Jeune École has often been charged with many of the same faults that critics see in network-centric warfare, but the view we have today of the Jeune École largely reflects the later interpretations of radical politicians and others. While its leaders have been caricatured as extremist, inflexible, and even perhaps a bit foolish, this was certainly not the perception among other navies at the time. Aube, in particular, was a much more flexible and innovative thinker and leader, often willing to compromise and experiment, than he is now often made out to be.

Despite its focus on technology, the Jeune École was actually as concerned with the moral and social effects of military actions as on their immediate tactical outcome. Against Italy, for example, the reliance of which on foreign trade was small, the Jeune École realized it could not succeed through commerce warfare. Accordingly it envisioned, in case of war with that nation, shore bombardment, not to do indiscriminate damage but to affect the morale of the population. Writes Ropp: “The moral effects of bombardment were more important than the actual destruction, for the real economic strength of Italy, the heavy industry in the northern plain, could not be touched by such means.”⁵⁸

The other major naval powers of the time took the Jeune École very seriously. At the height of the influence of the Jeune École’s popularity, Austria, Russia,

and Germany all abandoned their battleship construction plans. The British Admiralty may not have responded appropriately. At least one scholar, Angus Ross, has argued that British naval planners failed to address this challenge sufficiently: “There is little doubt that British trade would have been vulnerable to a properly organized and systematic attack of the type envisaged by the French in the 1880s.”⁵⁹

Many Britons despaired, convinced that the country would be cut off from food by commerce raiding; journalists and scaremongers encouraged this fear, writing of what they called the “starvation” theory. The distinguished mid-twentieth-century historian Arthur J. Marder referred to “the ‘guerre de course’ nightmare.” The fear did not subside until a royal commission studied the problem in 1903; it accepted the Admiralty’s claim that it could and must maintain command of the seas, and that as long as it could do so, it would be able to prevent commerce from being seriously interrupted.⁶⁰ By 1905, the chance of war with France had become remote, and the problem faded in Britain. But Marder, writing his famous study of the Royal Navy during the early days of World War II, would note that “for two decades the possible consequences of the *guerre de course* on the outcome of a maritime war and upon England’s prosperity had been the same nightmare to the experts and those in authority as London’s vulnerability to air-bombing in recent years.”⁶¹

The ideas of the Jeune École strongly affected the Austro-Hungarian Navy, through the close ties that existed between its navy’s staff and that of the French, and in particular through the influence of Admiral Max von Sterneck, its commander. Sterneck was a close follower of Aube, and he had his navy test many of Aube’s tactics while they were still being debated in France.⁶² Sterneck wrote of his relationship with Aube: “It appears as if we have had the same ideas simultaneously, with the difference that I can put them into action immediately.”⁶³

The Jeune École may have had its greatest effect, however, through its influence on a naval strategist who disagreed strongly with most of its program, Alfred Thayer Mahan. Mahan wrote his major works at least in part to counter its influence, seeking specifically to disprove the view of the Jeune École (and many others at the time) that the days of great naval battles were past. The Jeune École looked to the wars from 1854 to 1870 and saw in them lessons pointing to *guerre de course* and coastal warfare; Mahan reached back farther in history to prove the importance of command at sea and traditional naval battles.⁶⁴

Aube himself not only instituted naval maneuvers and exercises but took account of their results—such as in early 1886, when torpedo boats proved not seaworthy enough for long independent voyages. From then on, Aube no longer advocated the use of autonomous torpedo boats, focusing instead on their role in short-range operations along the coast.⁶⁵ After the failure of the *Gabriel*

Charmes in early 1887, fast gunboats disappeared from the building program.⁶⁶ As minister, Aube was even willing to compromise with the traditionalist admirals on the subject of battleships; the 1887 budget acknowledged that ironclads would still form the nucleus of the French Navy.⁶⁷

Many of the Jeune École's ideas—such as small boats operating independently—were clearly misguided, and even appear foolish today. Indeed, Ropp writes that it was “neglect of the most elementary military principles” that proved the undoing of the reformers. But he also points out that “in the ridicule which now greeted their tactical proposals, many people had already forgotten that Aube and his followers had been the first people to analyze many of the salient features of modern naval war.”⁶⁸ The positive influences of the Jeune École, often forgotten, included the early development of a modern cruiser fleet, the idea of a worldwide system of bases and coal stations, emphasis on coastal protection, and administrative reforms, including the founding of the French naval academy.⁶⁹

Perhaps the most forward-looking concept promoted by Aube was the submarine. There is some question as to how much credit he deserves for helping to advance this idea; Brodie sees Aube as an important factor in putting France ahead of other navies in developing the submarine, while Ropp argues that this advance was not the result of the Jeune École but of “patient experimentation by a long series of naval officers,” especially Dupuy de Lome, who developed the *Gymnote*, which Aube accepted for trials in 1886.⁷⁰ However, even Ropp acknowledges that it was partly because the school had been so thoroughly discredited that its ideas concerning the submarine received so little attention, and that “the competition which eventually produced the first successful French submarine had been started by Aube himself.”⁷¹ Although more research might prove useful here, it seems that the concept of submarine warfare is but one of several areas in which Aube deserves more credit for flexibility and thoughtful innovation than he often receives.⁷²

Ahead of Its Time?

To assert that many of the Jeune École's innovations were well ahead of their time is not at all the same as arguing that the Jeune École was “right”—clearly it was wrong, in terms of many of its tactical concepts, its administrative methods, and its political impact. It is one thing to be wrong because one's ideas are fundamentally ill considered; it is another to be wrong because they appear too early. In the first case, the lessons for posterity can only be negative, and this is the view represented by Professor Vego's interpretation of the Jeune École—that we must take care not to do what it did. But perhaps the Jeune École was wrong largely because it was premature. If so, the lesson is quite different—we must take care not to do things *how and when* the Jeune École did.

Students of the Jeune École often make the point that Aube and his followers were prophetic in their tactical understanding of future naval warfare. Theodore Ropp has described the Jeune École as foreseeing that in a future war:

- The weaker fleet would stay at its bases and refuse combat.
- The stronger would be forced to do the same, for fear of the torpedo.
- The only significant naval activity would be commercial warfare.
- Warfare would be absolutely merciless, disregarding the laws of war.

As Ropp writes, “It is possible to view the events of the war of 1914–18 under exactly those four points.”⁷³ The historian Lawrence Sondhaus has argued that “from the perspective of the First World War, Aube’s predictions seemed prophetic, especially his conviction that battleships ultimately would stay in port while smaller vessels ventured out to fight. Indeed, Germany’s deadly campaign of submarine warfare in the First World War seemed to vindicate the Jeune École.”⁷⁴

Sondhaus makes an even stronger argument, that “if the evolution of the submarine somehow had been advanced by a quarter-century, the Jeune École would have survived to establish a new paradigm of naval warfare, making cruisers the capital ships of the world’s navies. In such a scenario, the battleship renaissance of the years 1890–1914 would never have occurred.”⁷⁵ This may be taking the point too far; we should not need to resort to counterfactual history to see the significance of the Jeune École for today’s naval planners. The Jeune École was not ahead of its time simply because it predicted many of the important features of future war—as significant as that accomplishment might have been. It was also farsighted in that it analyzed its environment and used concepts remarkably similar to those used by many of today’s forward-looking military strategists. It saw changes taking place not only in military technology but also in communications, business, and society, and it looked for a way to combine those changes into a new way of warfare.

Yet despite its best efforts, the Jeune École could not enable the French to gain and maintain the initiative against the British navy. If the British Admiralty was slow to take up the challenge of naval reform, once it felt threatened it used the nation’s economic strength to engage France in applying new technologies to ship design. It turned the tables fairly quickly, developing the *Dreadnought* and taking the lead in the naval revolution.⁷⁶ What, from the French viewpoint, had gone wrong?

The primary point is not the Jeune École’s emphasis on technology, for it was never as obsessively focused on technical matters as its critics have argued. Nor did it fail because of the extremes to which some of its adherents took its policies, although its cause was certainly harmed by the radicalism of Aube’s

successors. Rather, Aube and his followers failed because they did not understand well enough the temper of their times—and the times were not yet ready for the Jeune École. Its members foresaw many significant developments in naval technology and tactics, and they produced a strategy that might have worked. But they misjudged the pace of change in warfare; the state of the art was not advancing as quickly as they seem to have felt. Many of their ideas would return years later as key elements of naval warfare (such as the submarine) or as potentially transformational concepts more than a century later (networking many small units), but in the 1880s the time was not yet at hand. The dominance of capital ships and conventional war at sea would not have run its course until the end of the Second World War, at least; other, potentially more effective technologies or strategies would have to wait.⁷⁷

THE PARALLEL WITH NETWORK-CENTRIC WARFARE

Network-centric warfare suggests that just as a network of computers is much more capable than a number of stand-alone units, a network of military platforms will be more efficient, faster, and more capable than the same number of unconnected platforms. But NCW advocates are quick to point out that the concept involves much more than just communications networks. As Vice Admiral Cebrowski describes it, “NCW is not narrowly about technology, but broadly about an emerging military response to the information age.”⁷⁸ According to him, this type of change “enables a shift from attrition-style warfare to a much faster and more effective warfighting style characterized by the new concepts of speed of command and the ability of a well-informed force to organize and coordinate complex warfare activities from the ground up.”⁷⁹

More recently, its boosters have credited NCW with helping to produce military success in Operations ENDURING FREEDOM and IRAQI FREEDOM, supporting peacekeeping and peace-enforcement operations around the globe, and “even aid[ing] in combating the outbreak of SARS [severe acute respiratory syndrome] in South East Asia.”⁸⁰ Critics like Frederick W. Kagan have charged that the underlying tenets of NCW are overdrawn and rely too much on technology, but defenders reply that these critics do not understand the nature of military transformation. Transformation, in their view, is much broader than just the use of technology, such as airpower and precision guided munitions: “Instead, transformation is an effort to provoke the military and civilian leaders of the nation to ask themselves tough questions and then to find the right, though challenging, answers.”⁸¹

At least one of those challenging answers does involve a great deal of technology. Notably, NCW has inspired a major Department of Defense (DoD) effort to create a secure global information network called the Global Information Grid,

or GIG—also referred to as the “war net.” Press reports indicate it may cost hundreds of billions of dollars and take two decades to build, and even Vint Cerf, one of the fathers of the Internet and a consultant on the war net, worries that it may not be realistic: “This is sort of like Star Wars, where the policy was, ‘Let’s go out and build this system,’ and technology lagged far behind.”⁸² The Defense Department’s supporters argue the GIG will play a central role in transforming the U.S. military into a net-centric force, but the Government Accountability Office argues that “while DoD’s vision of the GIG is compelling, the breadth and depth of the GIG and DoD’s objectives for netcentric warfare, present enormous challenges and risks—many of which have not been successfully overcome in smaller-scale efforts and many of which require significant changes in DoD’s culture.”⁸³

A full evaluation of NCW or of specific programs, such as the GIG, would be beyond the scope of this article, but we can already recognize several aspects of the Jeune École experience. Of course, the strategic circumstances facing France in the 1880s were quite different from those facing the United States and its navy today, but the theories of the Jeune École and NCW appear to be inspired by some of the same dynamics. At the broadest level, both ideas represent an effort to develop new strategic concepts that depart from the traditional emphasis on command of the sea. Command of the sea is no longer as contentious today as it was during the Cold War, whereas new threats require the application of naval power ashore; in their time the Jeune École enthusiasts realized that they simply could not afford to contest command of the sea with the British and sought an alternative approach. The approach they chose resembles network-centric warfare in a number of specific ways.

Emphasis on Technological Innovation. This may be the most obvious parallel. Even if, as NCW advocates argue, their concept involves much more than new technology and connectivity, modern weaponry and innovative technology are still fundamental parts of their proposed transformation. Technology was also a key factor for the Jeune École, with the torpedo only the most prominent of the new inventions incorporated into their strategies and tactics; under Vice Admiral Aube the French Navy experimented also with the use of oil fuel instead of coal, new types of high-explosive shells, and the submarine.

But even more significant is that in both schools of thought we see a strong faith not just in the latest technical fads but in technological progress writ large. Innovation, experimentation, and change were watchwords for the Jeune École, much as they are today for advocates of network-centric warfare. One supporter of the Jeune École wrote, “Let us be better, if that be possible, but in any case *we must be different*, in the adaptation to rejuvenated methods of war, of new engines,

judiciously conceived and rapidly executed.”⁸⁴ The enthusiasm for change is no less evident among NCW advocates: “The objective,” declares Vice Admiral Cebrowski, “is to create an ethos for experimentation, innovation, and a willingness to risk across the entire force.”⁸⁵

A Scientific Approach to War. NCW supporters often draw upon physics, biology, and computer science, and they avidly apply concepts like chaos and complexity theory to military operations. The Jeune École took a similarly sweeping and yet eclectic approach toward a scientific approach to war; while military theorists had long attempted to apply mathematical formulas to warfare, the French naval reformers looked to many other fields of science for ideas and principles they could apply. For example, they advocated the concept of many small craft attacking a larger ship not just because they believed it effective but because it was scientific in itself—the Jeune École saw the battleship as a complex organism that could be destroyed by the “microbes” of torpedo boats.⁸⁶

Speed and Precision. NCW relies on speed both in the relatively simple, tactical sense of weapons and forces operating quickly, but also at higher levels, at which speed of command and decision making become vital. The Jeune École did not address speed of command as such, but it proposed to use the technology and tactics of its time to gain speed and precision. It emphasized speed over mass, made full use of steam propulsion, and employed many small, fast, swarming platforms rather than a few big, slower ones.⁸⁷ Its stress on the torpedo can be seen as a parallel to today’s focus on cruise missiles and other precision weapons.

Networked Forces. The most fundamental concept underlying NCW may be that networked forces are intrinsically more capable than so many individual platforms. The modern concept of a network did not exist in Aube’s time, but he clearly saw the importance of using the latest communications systems to coordinate attacks by geographically dispersed units. The telegraph, in particular, was to be used to synchronize the attacks of torpedo boats, a capability Aube saw as crucial in defending a coast against an enemy landing: “With the extreme mobility that steam gives to all warships . . . with the speed and sureness of information permitted by the electric telegraph, with the ability to concentrate forces provided by the railroad, though no point on the coast is safe from attack, there is none that cannot be strongly and rapidly defended.”⁸⁸

Focus on Effects. Network-centric warfare embraces the concept of “effects-based operations”; Vice Admiral Cebrowski has described NCW as incorporating a “new mental model of warfare that emphasizes outcomes, or effects.”⁸⁹ The Jeune École’s similar emphasis on the ultimate effects of military actions rather than on immediate destruction achieved is implied clearly in its contingency

plans to strike Italy “from the sea,” using shore bombardment against forts and cities to destroy the morale of the populace.

Shock and Awe. Here we see another modern term that has been adopted by NCW theorists but has a clear parallel in the thinking of the Jeune École. A network-centric force will, advocates argue, “for the first time . . . provide us with the possibility of moving beyond a strategy based on attrition, to one based upon shock and awe.”⁹⁰ Terminology aside, this is what the Jeune École was thinking of when it argued that sudden massed attacks would create panic among the populations of enemy states. This effect was to be the purpose of shore bombardment against Italy, and also of a commercial war against England, which was intended “to produce an economic panic that would bring about social collapse.”⁹¹

Modern Business and Economic Concepts. NCW draws heavily from the business world: “The organizing principle of network-centric warfare has its antecedent in the dynamics of growth and competition that have emerged in the modern economy.”⁹² Economic ideas were just as important for the Jeune École. Gabriel Charmes explicitly argued that the concept of division of labor could be extended from political economy to warfare.⁹³ Aube was concerned about the social problems of capitalism, arguing that France had to expand its colonial empire to open new markets, encourage production, and eliminate poverty.⁹⁴

What have we proved? To point out these comparisons between network-centric warfare and the Jeune École tells us little about whether the concepts they share are valid or not. Both schools are criticized—often rightly—but the association between them is strengthened by the fact that they are often criticized for the same things. For example, although neither school focuses as exclusively on technology as their detractors believe, both seem to trust too much in overly complex and esoteric mathematical calculations and scientific theorizing.⁹⁵

On the other hand, we should be careful not to draw too much from this parallel. Not only was France’s strategic situation in the late 1800s very different from America’s today but, and more significantly, several areas of critical importance to the Jeune École have no direct analogue today—such as emphasis on commercial warfare, and colonial naval presence.⁹⁶ Nonetheless the similarities are striking enough that the experience of the Jeune École surely offers lessons for military and naval strategists today. The question is, then, what are they?

THE TEMPER OF THE AGE

Might network-centric warfare suffer the same fate as the Jeune École? Naval theorists today need not worry about some of the defects of the earlier school. For instance, Aube’s “three greatest faults were his technical incompetence, his

optimism, and his taste for resorting to the public press.”⁹⁷ While one can certainly disagree with the tactical and technological prescriptions of NCW enthusiasts, these advocates are hardly unqualified. They might be overoptimistic, but that is unlikely to be a fatal flaw unless—and this is a real risk—it turns to arrogance. Also, although the debate over NCW has occasionally become heated within the Navy and in the press, it shows little inclination to spill over into politics.

But our review has shown that the principal lessons of the Jeune École arise from *how* and *when* it attempted its naval revolution. Network-centric warfare proponents have much to learn from the Jeune École’s methods; they lack a key virtue of, and share a major failing with, Aube and his supporters of more than a century ago. The most important point of all may be the timing of military transformation; it is not at all clear that NCW has measured the temper of its age any better than the Jeune École did that of the late nineteenth century.

The key virtue that NCW lacks is flexibility, the willingness to admit a mistake. Admiral Aube—although not always his followers—demonstrated that virtue on several occasions. “Clearly,” observes one historian, “the very [torpedo boat] experiments designed to justify its theories had gone far to discredit the Jeune École.”⁹⁸ But as we have seen above, Aube admitted the mistake and abandoned his plans for small, long-range, independently operating combatants.

It is not clear that advocates of NCW and force transformation today are so flexible. Their inability to admit error can be seen in relatively small things, such as in the bland official responses to such complaints as that by retired Marine lieutenant general Paul Van Riper that the results of a large war game, MILLENNIUM CHALLENGE ’02, were rigged to support the Pentagon’s goals for force transformation. Senior officers at U.S. Joint Forces Command, which sponsored the war game, insist it was fair and that it validated future war-fighting concepts such as effects-based operations.⁹⁹ Frederick Kagan charges, however, that NCW boosters are inflexible concerning such fundamental issues as the transformation of warfare itself: “The U.S. is now attempting to transform its military in ways that hinder the conduct of current operations, even as those operations literally rip it apart.”¹⁰⁰

If so, the key failing that network-centric warfare shares with the Jeune École is the opposite of Aube’s personal flexibility—that supporters of both schools have frequently claimed too much for their ideas and dismissed criticism with an assurance bordering on arrogance. In the case of the Jeune École, its advocates tried to do too much and were unwilling to accept criticism or allow dialogue: “Whoever attacked them, attacked progress, logic, and science.”¹⁰¹ This single-mindedness can be seen in Charmes’s statement that “a war of pursuit will, therefore, necessarily, fatally, definitely, replace squadron warfare in future

conflicts between maritime nations.”¹⁰² It seems only a short step from Charmes’s confident pronouncement to declarations that network-centric warfare “will prove to be the most important RMA in the past 200 years.”¹⁰³ Today’s reformers may feel that sure of themselves, but history shows they can hurt their cause by trumpeting the fact too loudly.

The main caution that the story of the *Jeune École* offers for advocates of NCW and American defense transformation, then, is not that they may be wrong in their assessments of the trends influencing military force in the twenty-first century but that they may be right, too early. They may be ahead of their time *technologically*; critics have often charged that network-centric warfare relies on untested technical and engineering concepts.¹⁰⁴ But the comparison with the *Jeune École* shows that it may be even more dangerous to be ahead of one’s time *strategically*. In France in the 1880s not even the combination of a brilliant innovator and the latest technical advances was able to challenge successfully the traditional school of naval warfare. Critics today charge that NCW has also misjudged the changing nature of war. Loren B. Thompson, for example, believes that it is “time to set aside the network-centric ideology and recognize the many ways in which war has not changed.”¹⁰⁵

Advocates of network-centric warfare explicitly tie their revolution to the information age; the Department of Defense report to Congress on NCW, for example, states, “Warfare takes on the characteristic of its age. NCW continues this trend—it is the military response to both the challenges and the opportunities created by the Information Age.”¹⁰⁶ But just as the *Jeune École* misjudged the speed at which naval warfare was changing in the late 1800s, today’s transformation advocates may find they have invested too much in expensive and complex systems like the Global Information Grid, to the detriment of traditional military systems and capabilities. The *Jeune École* found that its confidence in the revolutionary nature of submarines and torpedoes was premature, and in the same way today’s military transformation supporters may find that information networks and precision guided munitions will not change warfare as quickly as they would hope. The history of the *Jeune École* reminds us that no new idea or innovative technology, no matter how prophetic, can change the nature of warfare on its own. It also suggests that if network-centric warfare fails, it is not likely to do so because it mimicked the *Jeune École* too closely but because it too could not judge the temper of its times.

NOTES

1. This is not to argue that the Jeune École was the only naval revolution to adopt network-centric principles. Admiral Sir John Fisher's transformation of the Royal Navy before World War I emphasized many of the same things as today's transformation advocates, including aggressive exploitation of new technologies and innovation, an emphasis on speed, and the development of a global information network based on the wireless telegraph. But the Fisher Revolution has been well documented, and while the lessons of the Jeune École are less well known, they may in fact apply more directly to today. On Fisher, see for example Nicholas A. Lambert, *Sir John Fisher's Naval Revolution* (Columbia: Univ. of South Carolina Press, 1999), and by the same author, "Transformation and Technology in the Fisher Era: The Impact of the Communications Revolution," *Journal of Strategic Studies* 27, no. 2 (June 2004), pp. 272–97.
2. E. H. Jenkins, *A History of the French Navy* (London: Macdonald and Jane's, 1973), p. 307.
3. J. R. Hill, "Accelerator and Brake: The Impact of Technology on Naval Operations, 1855–1905," *Journal for Maritime Research* (December 1999), available at www.jmr.nmm.ac.uk.
4. Milan Vego, "Net-Centric Is Not Decisive," U.S. Naval Institute *Proceedings* (January 2003), p. 53.
5. James J. Tritten and Luigi Donolo, *A Doctrine Reader: The Navies of United States, Great Britain, France, Italy, and Spain*, Newport Paper 9 (Newport, R.I.: Naval War College Press, 1995), p. 56.
6. Michael Vlahos, "Military Reform in Historical Perspective," *Orbis* 27, no. 2 (Summer 1983), p. 252. Martin van Creveld also appears to believe the Jeune École's failure was largely due to an overreliance on technology; Martin van Creveld, *Technology and War: From 2000 B.C. to the Present* (New York: Free Press, 1989), p. 204.
7. Stephen Biddle, "The Past as Prologue: Assessing Theories of Future Warfare," *Security Studies* 8, no. 1 (Autumn 1998), p. 9.
8. *Ibid.*, p. 67. The "pentomic division" organization, an attempt to deal with the prospect of tactical nuclear warfare, comprised five "battle groups," large battalions. See "Evolution of Large Divisional Structures," *Federation of American Scientists*, www.fas.org/man/dod-101/army/unit/docs/divhist.htm.
9. The key work on the Jeune École in English remains Theodore Ropp's *The Development of a Modern Navy: French Naval Policy 1871–1904*, ed. Stephen S. Roberts (Annapolis, Md.: Naval Institute Press, 1987), originally written as his Harvard PhD dissertation in 1937. Several other works, however, also deserve special mention. The only book-length study of the Jeune École to be published is in German: Volkmar Bueb's *Die "Junge Schule" Der Französischen Marine: Strategie Und Politik 1875–1900* (Boppard am Rhein, Ger.: Harald Boldt Verlag, 1971). It provides valuable insight, especially into the battle between the Jeune École and what Bueb describes as the "Alte Schule" of traditionalists. To my knowledge only one work of the Jeune École has been translated into English: Gabriel Charmes's *Naval Reform: From the French of the Late M. Gabriel Charmes*, trans. J. E. Gordon-Cumming (London: W. H. Allen, 1887), which aids in understanding the views of the Jeune École's primary advocate in the press. I also found very useful the exceptional 1965 Harvard senior honors thesis by Stephen Roberts (later the editor of Ropp's dissertation), "Warships and Politicians: The Effect of Politics on French Naval Preparedness, 1886–1900." In it Roberts makes impressive use of French archival sources—some of which had not been available to Ropp when he did his earlier work. Other particularly useful secondary works are Geoffrey Till, "The Jeune École," in his *Maritime Strategy and the Nuclear Age* (New York: St. Martin's, 1982), pp. 34–38; and Paul Halpern, "The French Navy, 1880–1914," in *Technology and Naval Combat: In the Twentieth Century and Beyond*, ed. Phillips Payson O'Brien (London: Frank Cass, 2001), pp. 36–52, both relying on French sources as well as on Ropp.
10. Bernard Brodie, *Sea Power in the Machine Age* (Princeton, N.J.: Princeton Univ. Press, 1941), p. 252; Theodore Ropp, *War in the Modern World* (Durham, N.C.: Duke Univ. Press, 1959), p. 190.
11. Ropp, *The Development of a Modern Navy*, p. 27.

12. Lawrence Sondhaus, *Navies of Europe 1815–2002* (London: Longman, 2002), pp. 68–69.
13. Theodore Ropp, “Continental Doctrines of Sea Power,” in *Makers of Modern Strategy*, ed. Edward Mead Earle (Princeton, N.J.: Princeton Univ. Press, 1944), p. 446.
14. Ropp, *The Development of a Modern Navy*, pp. 22–25.
15. *Ibid.*, 38.
16. See, for example: William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society since A.D. 1000* (Chicago: Univ. of Chicago Press, 1982), pp. 263–65.
17. Ropp, *The Development of a Modern Navy*, p. 112.
18. *Ibid.*, p. 19; Till, *Maritime Strategy and the Nuclear Age*, pp. 35–36.
19. Aube, writing in 1882, as quoted in James Cable, *The Political Influence of Naval Force in History* (New York: St. Martin’s, 1998), p. 77. See also Roberts, “Warships and Politicians,” p. 15.
20. Lawrence Sondhaus, *Naval Warfare, 1815–1914* (London: Routledge, 2001), p. 142.
21. Aube in 1885, cited in Ropp, *The Development of a Modern Navy*, p. 165, also in Roberts, “Warships and Politicians,” p. 17.
22. Bueb, *Die “Junge Schule,”* pp. 5–6.
23. *Ibid.*, p. 24.
24. Ropp, *The Development of a Modern Navy*, p. 120. See also Roberts, “Warships and Politicians,” p. 18.
25. Ropp, *The Development of a Modern Navy*, p. 159.
26. *Ibid.*, p. 160.
27. Roberts, “Warships and Politicians,” p. 19.
28. Bueb, *Die “Junge Schule,”* p. 159.
29. Roberts, “Warships and Politicians,” p. 21.
30. Till, *Maritime Strategy and the Nuclear Age*, p. 36.
31. Ropp, *The Development of a Modern Navy*, p. 176.
32. *Ibid.*
33. Roberts, “Warships and Politicians,” pp. 21–23; Ropp, *The Development of a Modern Navy*, pp. 176–77.
34. Ropp, *The Development of a Modern Navy*, p. 171.
35. Roberts, “Warships and Politicians,” p. 27; Ropp, *The Development of a Modern Navy*, p. 174.
36. Brodie, *Sea Power in the Machine Age*, p. 284; Ropp, *The Development of a Modern Navy*, p. 175.
37. Ropp, *The Development of a Modern Navy*, p. 178.
38. Halpern, “The French Navy, 1880–1914,” p. 41; Ropp, *The Development of a Modern Navy*, pp. 306–307.
39. M. Saissy, cited in Brodie, *Sea Power in the Machine Age*, p. 284.
40. Ropp, *The Development of a Modern Navy*, p. 326.
41. Halpern, “The French Navy, 1880–1914,” p. 45; Ropp, *The Development of a Modern Navy*, pp. 328–34.
42. Ropp, *The Development of a Modern Navy*, p. 325.
43. Sondhaus, *Naval Warfare, 1815–1914*, pp. 156–57.
44. See generally Ropp, “Continental Doctrines of Sea Power.”
45. Till, *Maritime Strategy and the Nuclear Age*, p. 38.
46. Andrew F. Krepinevich, “Cavalry to Computer: The Pattern of Military Revolutions,” *National Interest*, no. 37 (Fall 1994), p. 35.
47. Ropp, *The Development of a Modern Navy*, p. 8; Sondhaus, *Navies of Europe 1815–2002*, pp. 11–20.
48. Halpern, “The French Navy, 1880–1914,” p. 39.
49. Ropp, *The Development of a Modern Navy*, p. 167.
50. Roberts, “Warships and Politicians,” pp. 14–15.
51. *Ibid.*, p. 36.
52. *Ibid.*, p. 52.
53. Bueb, *Die “Junge Schule,”* p. 166.
54. Ropp, *The Development of a Modern Navy*, p. 10.

55. Tritten and Donolo, *A Doctrine Reader*, p. 69 [emphasis in the original].
56. Halpern, "The French Navy, 1880–1914," p. 37.
57. Bueb has made a similar argument, writing that it would be a simplification to blame the poor condition of the French Navy on either the Jeune École or the traditionalists who opposed them (*Die "Junge Schule,"* p. 165).
58. Ropp, *The Development of a Modern Navy*, p. 162.
59. Angus Ross, *Responding to the "Jeune École": The Royal Navy's Lack of Foresight in Addressing the Nature of the Mercantile Warfare Problem in the 1880s and 1890s*, paper prepared for presentation at the Victorians Institute Conference, The Citadel, October 2002, p. 10. See also Angus Ross, "Losing the Initiative in Mercantile Warfare: Great Britain's Surprising Failure to Anticipate Maritime Challenges to Her Global Trading Network in the First World War," *International Journal of Naval History* 1, no. 1 (April 2002).
60. Arthur J. Marder, *The Anatomy of British Sea Power* (New York: Knopf, 1940), pp. 93–94.
61. *Ibid.*, p. 104.
62. Sondhaus, *Navies of Europe 1815–2002*, pp. 95–96.
63. Lawrence Sondhaus, "Strategy, Tactics, and the Politics of Penury: The Austro-Hungarian Navy and the Jeune École," *Journal of Military History* 56, no. 4 (October 1992), p. 593.
64. Ropp, "Continental Doctrines of Sea Power," p. 452.
65. Roberts, "Warships and Politicians," pp. 21–23.
66. *Ibid.*, p. 27.
67. *Ibid.*, pp. 24–25.
68. Ropp, "Continental Doctrines of Sea Power," p. 452.
69. This list is from Bueb, *Die "Junge Schule,"* pp. 166–67.
70. Brodie, *Sea Power in the Machine Age*, p. 284; Ropp, *The Development of a Modern Navy*, p. 349.
71. Ropp, "Continental Doctrines of Sea Power," p. 453.
72. Of note, Alex Roland also gives the Jeune École credit for promoting submarine warfare. Alex Roland, *The Technological Fix: Weapons and the Cost of War*, paper presented at U.S. Army War College Sixth Annual Strategy Conference, 1995, p. 14.
73. Ropp, *The Development of a Modern Navy*, pp. 166–67.
74. Sondhaus, "Strategy, Tactics, and the Politics of Penury," p. 602.
75. Sondhaus, *Naval Warfare, 1815–1914*, p. 155.
76. Krepinevich, "Cavalry to Computer," p. 37.
77. On the continued relevance of the large-ship battle fleet following the introduction of the torpedo boat, see, for example, Karl Lautenschlager, "Technology and the Evolution of Naval Warfare," *International Security* 8, no. 2 (Fall 1983), pp. 18–20.
78. Arthur K. Cebrowski, "Network-centric Warfare: An Emerging Response to the Information Age," presentation at the 1999 Command and Control Research and Technology Symposium, 29 June 1999. For background on NCW, see Arthur K. Cebrowski and John J. Garstka, "Network-centric Warfare: Its Origin and Future," U.S. Naval Institute *Proceedings* (January 1998), pp. 28–35; U.S. Defense Dept., *Network Centric Warfare: Department of Defense Report to Congress* (Washington, D.C.: 2001); and Clay Wilson, *Network Centric Warfare: Background and Oversight Issues for Congress* (Washington, D.C.: Congressional Research Service, June 2004). Useful critiques of the concept include Richard J. Harknett, "The Risks of a Networked Military," *Orbis* 45, no. 4 (Winter 2000), pp. 127–43, and Bill Toti, "Stop the Revolution: I Want to Get Off," U.S. Naval Institute *Proceedings* (July 2000), pp. 30–33.
79. Arthur K. Cebrowski, "Sea, Space, and Cyberspace: Borderless Domains," address given at International Military Operations and Law Conference, Honolulu, Hawaii, 26 February 1999.
80. John Garstka, "Implementation of Network Centric Warfare," *Transformation Trends* (U.S. Defense Dept. Office of Force Transformation), 28 January 2004.
81. Tom Hone, "Understanding Transformation," *Transformation Trends*, 16 January 2004. For the view of NCW's critics, see, for example, Frederick W. Kagan, "A Dangerous Transformation," *Wall Street Journal Opinion Journal*, 12 November 2003, available at

- www.opinionjournal.com, and by the same author, "War and Aftermath," *Policy Review Online*, August/September 2003; Edmund C. Blash, "Network-centric Warfare Requires a Closer Look," *Signal* (May 2003), available at www.iwar.org.uk/rma/resources/ncw/ncw-forum.html. A more balanced but still critical view is Peter J. Dombrowski and Andrew L. Ross, "Transforming the Navy: Punching a Feather Bed?" *Naval War College Review* 56, no. 3 (Summer 2003), p. 107–31.
82. Tim Weiner, "Pentagon Envisioning a Costly Internet for War," *New York Times*, 13 November 2004, p. A1.
 83. U.S. Government Accountability Office, *The Global Information Grid and Challenges Facing Its Implementation*, GAO-04-858 (Washington, D.C.: July 2004), p. 29.
 84. Ropp, *The Development of a Modern Navy*, pp. 165–66 [emphasis original]. See also Ropp, "Continental Doctrines of Sea Power," p. 450.
 85. Cebrowski and Garstka, "Network-centric Warfare," p. 35.
 86. Ray Walser, *France's Search for a Battle Fleet: Naval Policy and Naval Power, 1898–1914* (New York: Garland, 1992), p. 17.
 87. This stress on numerous small ships resembles NCW thinking beyond simply its use of speed. Angus Ross has suggested that another NCW concept may have an analogy in the French Navy under Admiral Fournier, whom Ropp called "the best thinker of the Jeune École," and who at the turn of the century advocated a large, blue-water fleet supported by a fleet of smaller ships the U.S. Navy planning community might call "streetfighters." Personal correspondence, 2001.
 88. Aube, 1882, cited in Ropp, *The Development of a Modern Navy*, p. 157.
 89. Arthur K. Cebrowski, "Network-centric Warfare: An Emerging Military Response to the Information Age," presentation at the 1999 Command and Control Research and Technology Symposium, 29 June 1999.
 90. David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2d ed. (Washington, D.C.: Office of the Assistant Secretary of Defense for Networks and Information Integration, 1999), p. 184.
 91. Ropp, *The Development of a Modern Navy*, p. 162.
 92. Cebrowski and Garstka, "Network-centric Warfare," p. 29.
 93. Charmes, *Naval Reform*, p. 74. See also Ropp, *The Development of a Modern Navy*, pp. 160–61, and Walser, *France's Search for a Battle Fleet*, p. 11.
 94. Ropp, *The Development of a Modern Navy*, p. 163.
 95. Bueb, *Die "Junge Schule"*, p. 31; Vego, "Net-Centric Is Not Decisive," p. 53.
 96. Unless one tries to compare the Jeune École's colonial policy with NCW's emphasis on "forward sea-basing," but I think that is too much of a stretch. I also do not mean to make too much of the comparison between the positions held by Vice Admirals Aube (Minister of the Navy) and Cebrowski (Director of Force Transformation). A direct comparison of the influence wielded by these two positions is beyond the scope of this article; the point here is simply that both schools of thought were popular enough to generate broader interest beyond their originators and their immediate supporters, and that their originators were put into more senior positions where they had a chance to initiate the changes they had advocated.
 97. Ropp, *The Development of a Modern Navy*, p. 167.
 98. Alan Cowpe, "The Royal Navy and the Whitehead Torpedo," in *Technical Change and British Naval Policy 1860–1939*, ed. Bryan Ranft (London: Hodder and Stoughton, 1977), p. 30.
 99. Sean D. Naylor, "War Games Rigged? General Says Millennium Challenge 02 'Was Almost Entirely Scripted,'" *Army Times*, 16 August 2002. See also the PBS *Nova* interview with Van Riper, "The Immutable Nature of War," at www.pbs.org/wgbh/nova/wartech/nature.html. PBS also interviewed Cebrowski for the same program; he took a more flexible approach toward the controversy than Joint Forces Command did, arguing that the debate over how MILLENNIUM CHALLENGE '02 was run was "really a very American sausage-making process."
 100. Kagan, "A Dangerous Transformation."

101. Bueb, *Die "Junge Schule,"* p. 168.
102. Charmes, *Naval Reform,* p. 58.
103. Cebrowski and Garstka, "Network-centric Warfare," p. 29. For a less critical commentary on overconfidence on the part of NCW supporters, see Thomas P. M. Barnett, "The Seven Deadly Sins of Network-centric Warfare," U.S. Naval Institute *Proceedings* (January 1999), pp. 36–39.
104. For example, Blash, "Network-centric Warfare Requires a Closer Look," and Stephen D. Wolthusen, "Self-Inflicted Vulnerabilities," *Naval War College Review* 57, no. 3/4 (Summer/Autumn 2004), pp. 103–13.
105. Loren B. Thompson, "Military Transformation Falts in Mesopotamia," Lexington Institute Issue Brief (Arlington, Va.: 16 April 2004), available at www.lexingtoninstitute.org/defense/040416.asp.
106. *Department of Defense Report to Congress,* p. iii.