A Global Forum for Naval Historical Scholarship

International Journal of Naval History

Volume 2 Number 3 December 2003

John Ericsson and the Transformation of Swedish Naval Doctrine

by

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John Ericsson and the Revolution in Naval Warfare 1850-1880

Swedish National Defense College, Stockholm

Symposium, 14 November 2003

During the nineteenth century the Swedish navy faced both the challenge of a fundamentally new strategic situation and that of the technological revolution in naval warfare. The end result was in fact a rather happy one as new technology offered interesting opportunities for a minor navy, which had to concentrate on defence against sea borne invasion. The transformation process was however long and difficult as the formulation of a new doctrine was hampered both by strong traditions and a profound uncertainty about the potential and direction of technological development.[1]

This article discusses the role of the Swedish-American inventor and consulting engineer John Ericsson (1803-1889) in the transformation of the strategic and tactical doctrines of the Swedish navy. He was an important person in that process. Ericsson did not offer any lasting solution to the problems that the navy faced but, during a period when Swedish naval policy-makers were at a loss about what to do with the technological revolution, he offered solutions which proved essential as stopgap measures. Furthermore, Ericsson prestige and popularity in Sweden also made him influential even when his monitor system had lost most of its value for Swedish defence.[2]

Why was it possible for a consulting engineer who lived on the other side of the Atlantic to play an important and for a time crucial role in the transformation of the Swedish navy? Why was not the naval administration with its naval architects and officers or industrial companies in Sweden able to offer more interesting ideas to the navy and the policy-makers? One answer is that Ericsson's role for the Swedish navy was

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not at all unique in this period. Many of the innovations, which led to a revolutionary transformation of naval warfare from around 1850 to 1880, were not initiated by navies or entrepreneurs used to supply the naval organisations with weapons and equipment. It was not radical changes within the navies or in their strategic and tactical doctrines that were the cause of the revolution in naval technology. It was the great nineteenth century industrial upsurge which gave dynamics to the naval revolution, both by changing technology and at the same providing governments with the financial means to invest in advanced warships and weapons.

The navies were not generally conservative or reactionary but it was not their active search for new technology that led the development in the mid-nineteenth century. The steam engine, the screw and the iron hull were all used by civilian ship-owners before the navies adopted them. Even modern guns and later the new torpedoes were mainly developed by new mechanical engineering firms and steelworks which saw the navies and the armies as interesting markets for their new high-technology. The Swedish navy is a good illustration of this. It was generally open-minded about new technology but frequently at a loss of how to transform it into strategically and tactically efficient combinations of ships and weapons.

Industrialisation and the growth of know-how about modern naval technology outside the navies radically changed the international market conditions for naval armament. Earlier, most navies had designed and built their own warships and it was rare that sailing warships were imported. Now, many navies had to import technology but, on the other hand, advanced technology was readily available on the private market. Major navies did retain the capability to design warships, that is, to combine the best available technologies into ships useful for the type of war they intended to fight. But private inventors and shipbuilders became competitive in that branch of engineering too. Several smaller navies ceased to design their own warships. Instead they imported ships from private shipbuilders in major industrial countries or built ships to designs supplied by private firms or consulting naval architects. Several warship designs of private origin existed on the international market from the 1860s. Of these, John Ericsson's monitor system was that which was the most deviant from traditional naval architecture. Sweden was one of the few countries that imported warship designs from the United States rather than from Great Britain or France but, somewhat ironically, Sweden had first exported the designer to that country.[3]

In the mid-nineteenth century the Swedish navy had two main components: the sailing battle fleet with ships-of-the-line and frigates and the archipelago flotilla with gunboats powered by oars. These two forces originally had clearly defined and strictly complementary tasks. The battle fleet should control the open sea or at least limit the enemy's ability to control it. The archipelago fleet had primarily been intended for two key operational areas: the archipelago in the Gulf of Finland during wars with Russia and

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the archipelago between Gothenburg and Oslo during wars with Denmark-Norway. These archipelagos were limited in extent but the eighteenth century wars had proved that control of them for logistics was decisive for major army operations. This had made the Swedish archipelago fleet an important and prestigious force.[4]

The results of the Napoleonic Wars fundamentally changed these pre-conditions for Swedish strategic planning. Finland was lost to Russia in 1809 and Norway was unified with Sweden in 1814, although only in a loose union. The old threat of a two-front war against both Russia and Denmark-Norway, which had been a reality as late as in the War of 1808-09, was eliminated but considerable parts of the population and important strategic positions in the eastern Baltic were lost with Finland. The land frontiers to potential enemies had been radically reduced in length and strategic importance. The northern parts of Scandinavia were not suited for major military operations and consequently of limited strategic importance in the nineteenth century and Sweden-Norway had got an almost insular strategic situation. The most important threat to Sweden was from now on a large-scale sea borne invasion from Russia, a European great power that possessed both a superior navy and a much superior army.[5] Internationally, this was a unique threat and Swedish defence-planners had a special problem of striking a balance. Other states could assume that an invasion would primarily come by land and coast defence meant mainly defence against naval bombardments and limited attacks on strategic positions along the coast. Those few countries threatened by invasion of a superior army across the sea had naval superiority or parity compared to potential invaders. Sweden must assume that its armed forces would be markedly inferior on both land and sea and it had to seek safety by exploiting her unusual geographical position.[6]

In strategic terms, Sweden’s geographical position was composed of the Baltic Sea, the archipelagic coast and the relatively extensive and sparsely populated land surface. As a heritage from earlier periods, the country had three different forces for these tasks: the sea-going sailing fleet, the archipelago fleet and the army. Much of the public debate about defence policy was shaped by those who spoke for one of these separate parts of the defence establishment. They usually claimed that one of these forces should be made strong enough to resist a major invasion and that one or both of the other two might be more or radically reduced to avoid duplications.[7]

Traditionally, military and naval historians have described Swedish defence policy in the nineteenth century as orientated towards a "central defence strategy" which is supposed to have caused a neglect and decay of the navy. This is not correct, at least not in the sense that the navy was more "neglected" than the army. Both declined in relative importance in the European balance of power but this was a result of the generally peaceful conditions in northern Europe and a temporary Swedish economic stagnation compared to some other states in the early phase of European industrialisation.

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The "central defence" concept was actually the basic defensive strategic doctrine for the army. It should during its mobilisation phase be concentrated to the interior of the country in order to force an invading enemy to extend his lines of operation and weaken his main forces before a decisive battle was fought somewhere in central Sweden. This strategy was also supposed to give the Swedish army time to train both its part-time soldiers and the only briefly trained conscripts, and form them into combat units with some coherence. It would also make it easier to bring in reinforcements from Norway. Rather than giving the Swedish army top priority this strategic concept is part of the explanation of why major army reforms actually were delayed until the late nineteenth century.

Actually little changed in the resource allocation within the armed forces and all three components were retained with only minimal changes up to the 1860s. The sailing fleet was kept at a nominal strength of ten ships-of-the-line, the archipelago fleet had about 200 gunboats and the army remained largely unchanged in size and regimental structure. Investments were made in a new central depot fortress, Karlsborg, which was an important part of the army's strategic doctrine, but the fortifications protecting Stockholm and Karlskrona from a naval attack also underwent major modernisations.[8] There is nothing in this which indicates any reorientation of Swedish defence policy in order to reduce the role of the navy in the basic task of a defensive strategy: to at limit the operational freedom of the enemy as much as possible. How the existing naval forces should fulfil that task in the new strategic situation was, however, not stated officially by the government. Its ability to do so was a main object in the public debate.

This defence policy met the challenges and opportunities of a fundamentally new strategic situation with surprisingly little structural change. The conservative approach was partly the result of political and economic circumstances, which restrained reforms. The Swedish political system made it much easier for the government to get funds for existing structures than for changes. It may, however, also be argued that the existing Swedish system until the 1860s provided a working and fairly rational solution to the problem of delaying a superior invader sufficiently long for help to arrive. Sweden-Norway could not defeat Russia alone but the union states could avoid being decisively defeated until the European balance of power could provide help from other great powers. The sailing fleet could act as a fleet-in-being and tie the bulk of the Russian battle fleet in a blockade of Karlskrona. This would substantially reduce Russia’s transport capacity for the invading army as the sailing warships were important as troop transports for Russia which only had a small mercantile marine. The sailing fleet was in a sense a part of the army's central defence strategy. Most of the archipelago fleet was based at Stockholm and had its main role in the regional defence of the capital and the strategically important Lake Mälaren valley. It might also be used on the other large Swedish lakes, Vänern and Vättern, which from 1832 were connected with the Baltic Sea and with Skagerack by the new Göta Canal.[9] Naval control of the great Swedish lakes

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was important for operations on land as the army that was free to use the lakes had considerably greater operational freedom in interior Sweden.

Finally, the sailing fleet and the Karlskrona naval base had a political role. If a British or French fleet arrived in the Baltic Sea to cut the sea lines of communication for an invading Russian army it required a base and Karlskrona was suitably placed. The investments in fortifications and the addition of new docks up to 1860 was partly a result of Karlskrona's intended role for an allied fleet.[10] For the Bernadotte kings and for members of the Swedish political elite who had an interest in European power politics it was also important that the Swedish battle fleet formed a substantial and visible part of an allied fleet that made an end on a Russian invasion or threat of invasion. To many in Sweden and Norway, a sailing fleet was however closely associated with fears of an activist foreign policy directed by the king. It was suspected that such a fleet might be used in offensive alliances with great powers, most probably in attempts to re-conquer Finland. In Sweden, this made the sailing fleet, or the “great fleet” (*Stora flottan*), politically suspect and the Parliament (*Riksdagen*) tried to limit it in order to reduce royal power over foreign policy. In Norway, the Parliament (*Stortinget*) said emphatically no to the King’s plans to build Norwegian ships-of the line, which would have strengthened Sweden’s battle fleet in the Baltic Sea.[11]

John Ericsson entered naval technology in the mid-1830s with his new screw system for steamships. He was not alone in developing such a system but, compared to other inventors of the screw, he had an unusual combination of know-how. Ericsson was already a successful and innovative designer of steam engines, he increasingly became a theoretically skilled naval architect and he had a military background as engineer and infantry officer. He was able to design not only propulsion systems but also ships and their machinery and he was interested in radical changes in naval warfare. The first warship built to his design was the screw sloop *Princeton*, launched in 1843 for the U S Navy.[12] In 1843-44 a young Swedish naval engineering officer, Bror Johan Jonzon, was sent to Great Britain and the United States to study iron shipbuilding and screw propulsion. He studied both *Rattler*, the first British warship with screw (also launched in 1843) and *Princeton* and he reported that John Ericsson had been very helpful towards him during his visit in the United States. In August 1844 Jonzon recommended Ericsson's screw system as it had no gear drive, made it possible to place the machinery low in the hull and developed less vibrations compared to the British system.[13]

Jonzon had been sent out because the Swedish naval leadership already was interested in the screw for major warships and his report had important effects. Already in 1844-45 rear admiral Johan Henrik Kreüger, president of the Navy Board (*Förvaltningen av Sjöärendena*) and the minister of the navy, rear admiral Carl August Gyllengranat, were convinced about the future potential of the screw for warships.[14] They wished to build a Swedish copy of *Princeton*. This resulted in the 1,200 tons

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corvette *Gefle*, which was designed in 1845 and launched at Karlskrona in 1847. It was somewhat longer than *Princeton* and used Ericsson's screw system.[15] *Gefle* was one of the early screw warships in the world and as Swedish naval expenditures for new construction in the 1840s were strictly limited it is interesting that a substantial part of them were spent on a radically new type of ship. The navy was evidently interested in new technology. It is probable that the fact that a Swedish engineer had a key position in the development of the screw and that a full-scale screw warship had already been built to his design made it easier to introduce the screw in the Swedish navy than in some other navies. The contacts between Ericsson and the Swedish navy was not as intense in these years as they were in the 1860s but leading Swedish naval officers and technical specialists in the navy trusted his competence and believed that the screw was a relatively mature technology. The screw technology rapidly became familiar to Swedish marine engineers and introduced in the Swedish mercantile marine. Assistance from Ericsson was not required after the initial transfer of the technology.

There was a marked difference between the screw and the monitor system in its appeal to the broad public however. John Ericsson was evidently not a Swedish national hero in the 1840s. This became obvious in the 1847-48 Parliamentary session when C. A. Gyllengranat as minister of the navy introduced a naval program where he declared that screw ships-of-the-line should be the backbone of the future navy. In its day it was a radical program – no other leading policy-maker in any country had openly declared that all future capital ships were to be powered by steam engines and the screw. The Parliament did not approve the program, partly because the screw was regarded as untried, partly because the majority did not like the idea of major investments in the seagoing fleet.[16]

Dramatic events close to Sweden soon made the Parliament change its mind. The war between Denmark and German forces in Schleswig-Holstein in 1848-50 and the large British and French operations in the Baltic against Russia in 1854-55 made it clear that the Baltic quickly and unexpectedly might become a war zone. Considerable funds were voted for reconditioning of the existing fleet. Parts of these funds were used for converting two sailing ships-of-the- line of around 2,800 tons to screw steamers from 1852 to 1856 and the conversion of two more were planned in these years. Two smaller screw warships of 800 and 400 tons were launched in 1852-53. Up to 1858 the minister of the navy informally followed a long-term plan which was generally similar to that presented to the Parliament in 1848. After that, no long-term plan existed but the Parliament voted money for new construction of two steam frigates (2 100 tons) of which one was launched in 1862. The second was cancelled by the government in late 1861 due to rising doubts about the combat value of wooden warships.

It was an advantage that Ericsson's screw system had been tested in the navy for several years before these conversions of capital ships were started. Teething troubles had

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been solved and no foreign assistance was necessary. No change is visible in the naval doctrines but it is obvious that the seagoing battle fleet had become more politically acceptable. The screw had also made it look more modern and versatile while the future of the oared forces had become uncertain. Steamers could use the Swedish archipelago more freely than sailing warships and the oared flotilla looked increasingly obsolescent as a fighting force, except for amphibious warfare. Its ability to defend the archipelago against modern steam warships was in doubt. One partial answer was the screw gunboat armed with shell guns. A prototype of 170 tons and one shell gun was launched in 1850, followed by a series of 10 slightly larger boats with two shell guns launched from 1856 to 1862. They were built to domestic designs made by Swedish officers and engineers, but the prototype, a very early example of the screw on a small warship, must have been easier to design with knowledge of Ericsson's screw system. They were similar in general capabilities to the "Crimean gunboats" built in large numbers for the British navy from 1854 on but they were smaller and the guns were lighter as they were not intended for bombardments of fortresses.[17]

Although small, the Swedish steam navy of the 1850s was composed of the same type of ships as the major navies: ships-of-the-line, large and small cruisers and gunboats. Of these, only the gunboats had been produced in series but the long-term plan of the government was to create a balanced steam fleet with ships-of-the-line, frigates, corvettes and gunboats. The screw had by the late 1850s clearly made a major contribution, indeed the only major contribution to the modernisation of the Swedish navy. It had however probably also delayed the development of new naval doctrines. Naval officers adopted new technology in the belief that it made the traditional naval organisation, its ships and its doctrine more credible in the eyes of the policymakers and the public. For a time they were right and the navy was given substantial funds for ships, guns and training at sea. Although Ericsson, his screw system and the *Princeton* design had been influential in a few years in the 1840s his connections with the Swedish navy had practically ceased after that. There were no discussions or dialogue between him and the Swedish naval establishment about new technology and its possible influence on Swedish naval doctrine. As John Ericsson himself has claimed that he had developed the monitor system and other new devices for naval warfare in order to provide his native country with efficient defence against Russia this lack of contacts before 1862 is surprising.[18]

The introduction of armoured warship in Europe in the late 1850s and the rapid increase in size for capital warships which had started in that decade made it clear that the small Swedish ships-of-the-line were becoming obsolete as capital warships, even when fitted with screw propulsion. Reforms were inevitable and a parliamentary committee working in 1861-62 proposed a future navy with six broadside-armed armoured ships as the main force. These ideas were almost immediately overtaken by events. The events were the surprising news in spring 1862 that the U S Navy had introduced a radically new type of warship, designed by John Ericsson. Most sensationally, the prototype had fought

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an enemy armoured ship of four times its own size with considerable success. This news had a great impact on the Swedish public, which not unnaturally became enthusiastic of the important role which Ericsson and his monitors rapidly gained in the great drama in North America.

Among the least impressed were the Swedish sea officers. The totally unconventional monitor was obviously not what most of them had expected of the future. It was not a ship that a seaman used to high hulls and a complicated rig took to the open sea with great confidence in its ability to defeat an enemy or escape from a superior enemy force. Neither was it a small vessel suitable for mass production and amphibious warfare, which the archipelago fleet was used to. To the public it looked as an ideal defensive weapon system, a not too expensive warship suited to a nation which had no offensive ambitions but ambitions to fight off an invading great power. Public opinion and the rising bourgeois and farmer groups had also, at this very moment, become very important and even decisive for Swedish defence policy. Up to the late 1850s, the kings, Karl XIV Johan (Marshal Bernadotte) and his son Oscar I, held the political initiative in defence policy and in policy in general. Their ability to extract increased funds for military purposes from the Parliament was limited but they had wide discretionary power to administrate the existing armed forces. No group was able to seriously challenge the technological and professional competencies, which existed in the military and naval administration.

Political development in the late 1850s and the 1860s rapidly diminished this sphere of action for the Swedish monarch. Especially the navy and its transformation became dominated by decisions in the Parliament, rather than by the king and the naval administration. At the same time, the naval administration rapidly and decisively lost the initiative in technical questions related to the navy. Some naval officers and former officers, especially those with a liberal ideology, were influential in the Parliament but they were not always representative for the opinion among the naval officer corps. Officers and policymakers who actively searched for new technology took personal contacts with engineers and private companies who had solutions which looked more interesting than those, which the naval administration could provide.

Baltzar von Platen, the minister of the navy in 1862-68 when the monitor system was introduced, was not a career naval officer but a rich liberal aristocrat with financial interests in modern industry. Von Platen had served as a naval officer in his youth but he had for a long time argued against the sailing battle fleet. He held the opinion that too many Swedish naval officers were uninterested in coastal defence problems and that they had joined the navy because they dreamed of blue-water expeditions with sailing ships. He saw the low and totally unrigged monitor as a useful antidote to that. Von Platen was closely assisted by Axel Adlersparre, a reform-minded naval officer who earlier had been a leading spokesman for a group of young officers who held the idea that Sweden should

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have a small but well-trained battle fleet. Adlersparre had been in American waters in 1861-62, commanding a frigate and he had met John Ericsson when the original *Monitor* was under construction. Adlersparre immediately became an enthusiastic admirer of the monitor system and John Ericsson's most important contact in Sweden. In the decisive years in the 1860s, Adlersparre was the practical leader of a large-scale reorganisation of the Swedish navy.[19]

Support from public opinion and an active minority among the sea officers did provide funds for four Swedish monitors, which were completed from 1865 to 1871. They were designed by the Swedish naval architect J. C. A. d'Ailly but Ericsson provided him with the necessary information about his monitor design. The first three monitors of 1,500 tons had almost exactly the same main dimensions as the Ericsson-designed *Passaic* class monitors in the U S Navy, while the fourth was slightly larger to provide for additional armour and speed.[20] In the same period Norway also built four monitors. The two union states had for a time a homogeneous and substantial fleet of medium-sized armoured warships. For both navies it was important that the prestige of the monitor system and John Ericsson's international reputation could be transformed into political support from majorities in the two parliaments for new construction. Like other navies, they urgently required modern armoured warships with heavy armour-piercing guns and the monitor was a quickly available solution, which had the advantage of being tested in actual warfare. Whatever its shortcomings, it was evidently not only an inventor's eccentric idea. It was used in actual warfare more than any other type of armoured warship in this period and the U S Navy appeared to be satisfied with it.

In Sweden, the monitors were in the 1860s and early 1870s intended to form the new seagoing fleet together with un-armoured corvettes with heavy armour-piercing guns. The original four were only the first batch of a series of projected monitors. Around 1870 an enlarged monitor of 2,500 tons was designed and in 1871 the navy minister declared that the government intended to build six such ships.[21] The strategic role of this monitor/corvette fleet in Swedish defence strategy was however unclear. It was never stated why the monitor, rather than any other type of major or medium-sized warship, was optimal for Sweden's defence and how its special combination of mobility, firepower and protection should give the Swedish navy tactical advantages. Its value was usually expressed in negative forms. The large size and high costs of modern armoured battleships made it impossible for Sweden to build such ships in substantial numbers. The monitor could mount a few guns, as heavy as the heaviest on a full-size battleship. Its armour was as thick as that on the largest battleships of the time and it covered the whole ship, which gave an impression of invulnerability. In an age when technology and strength expressed in calibres of guns and thickness of armour had a broad appeal to the public, the monitor had impressive figures to show for a limited amount of money.

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The monitor system did not convince the majority of the Swedish sea officers however. Few of them dreamt of a battleship fleet but the tactical and strategic usefulness of the monitor was increasingly questioned. The original *Monitor* had fought a successful "David and Goliath" style battle against the much larger *Virginia* (ex *Merrimack*) at Hampton Roads in 1862 and it was this epic event which had shaped the mental picture of the monitor for the Swedish public. In the American Civil War the monitors had however mainly been used for bombardments of coastal fortifications and for blockades of ports in more or less sheltered waters. This was offensive warfare against an inferior and largely stationary enemy but this type of warfare was irrelevant for Sweden.

If Sweden should have a seagoing fleet of medium-sized warships the ambition must be that the ships were able to defend the long Swedish coast and substantially limit the operational freedom of an invading enemy who had superior naval forces. It must be able to be rapidly redeployed from one part of the coast to another facing the risk of meeting superior enemy forces and it must be able to avoid being defeated either by escaping or by ability to survive enemy attacks. The monitor was slow and, although it was safe to take to the open sea in heavy weather, it could only open its gun ports in calm and moderate seas. Its main asset had originally been its invulnerability to all existing guns but the increased penetrative power of guns soon made its armour protection insufficient. The only solution was to increase the size of the monitor but, as the Swedish navy found with the enlarged monitor design around 1870, that meant an expensive warship with much armour but limited striking power in proportion to its size and cost.

The ram and the new underwater explosive weapons (mines and torpedoes) were also serious threats to the monitor as the extremely low hull had little reserve buoyancy. If it was damaged below waterline it would rapidly sink. The low speed made it also difficult for the monitor to escape from a superior enemy. The loss of invulnerability meant that the monitor rapidly declined from a seagoing warship, able to move from one part of the coast to another and survive attacks from enemy battleships, to an oversized and expensive armoured gunboat, which could be expected to fight with success only in narrow passages or in shallow water where large ships were at a disadvantage.

The monitor had been introduced in the Swedish navy without prior discussion about the doctrine for a future seagoing Swedish fleet. It proved impossible to define a realistic doctrine to which its special combination of mobility, protection and striking power was the optimal solution. However, for about a decade the Swedish naval officers were not able to formulate their criticism in positive terms, as they had no realistic doctrine for the role of a modern seagoing fleet in the defence of Sweden against major invasions. John Ericsson had provided them with a system that at least generated parliamentary support for medium-sized warships. The principle, but hardly the reality of a seagoing fleet survived with the monitor.

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Sweden had however also a strong tradition of pure archipelagic defence. There were important narrow passages to major ports, especially Stockholm, which had to be protected against an enemy who intended to bombard or take control of cities and ports. What could modern technology offer for this clearly defined naval doctrine instead of the traditional oared gunboats or the new screw gunboats? The latter could not carry heavy armour-piercing guns and they were un-armoured, a severe drawback in a period which was fascinated by the new armour protection technology. Several types of small armoured gunboats were designed in Sweden in the 1860s but not built. In 1867-68, two prototypes were launched, one designed by the director of Motala Verkstad, Otto Edward Carlsund and the other by John Ericsson. Motala Verkstad was Sweden's leading company in mechanical engineering and it had supplied the navy with all its steam engines and also built the four monitors.

Carlsund and Ericsson were without doubt the two leading Swedish-borne marine architects of their age and they were also the two most successful Swedish designers of internationally competitive steam engines. Their ingenuity made it possible to build armoured vessels of only about 250 tons with one very heavy gun. Ericsson's vessel, a miniature monitor with a fixed turret, had turret armour as thick as on contemporary battleships. The speed and seaworthiness of both vessels were very limited but they were useful as mobile artillery platforms in the inner archipelago. After comparative tests[22], Ericsson's design was selected and eight more vessels were built up to 1875, seven of them of an enlarged design of 450 tons. It is of interest that Ericsson's design had prevailed in competition with Carlsund, the leading mechanical engineer in Sweden at this time. In spite of that he had been absent from Sweden since forty years he was still the best designer of cost-efficient modern warships tailor-made to special Swedish naval demands.

This meant that both the seagoing fleet and the archipelago fleet had been renewed with warships designed on the other side of the Atlantic. From 1862 to 1875 John Ericsson's ideas about warship design dominated the Swedish navy. The Swedish navy of 1875 primarily consisted of warships built to Ericsson's ideas but while the monitor was a technological solution to a non-existing doctrine the small armoured gunboat was designed to suit a well-defined and almost uniquely Swedish doctrine.[23] As the navy, rather than the army, was the part of the Swedish defence that was modernised and reorganised in these years, it might be said that Ericsson's technological influence on Swedish defence policy was larger than any other individual. The reorganisation was more comprehensive than technological as it also involved a radical reduction of the personnel who on the other hand got much more professional training at sea than in the old navy. The change had however been stimulated, indeed made possible and necessary by the technological revolution, which reduced manpower but required intense training.

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Systematic training with new types of ships and yearly naval manoeuvres along the Swedish coast may have stimulated intellectual development among officers who began to think more about how new technology could be strategically and tactically used for defence. From the mid-1870s Swedish naval policy began to be shaped by a new doctrine, which was logically based on the potential of the new technology for new defence strategies. Earlier, the sailing and the oared fleets had for both technological and emotional reasons been two separate parts of the navy. Sailing warships could not fight without winds and their ability to operate in confined waters was limited. Oared warships were defenceless in fresh winds at sea and could only fight in sheltered waters. In Sweden this separation had been increased by different traditions in two largely separate officer corps and the long distance between the main bases for the two fleets, Karlskrona and Stockholm. Steam technology made much of the separation irrelevant and after a few decades of experience with steam warships the old antagonism between the two groups in the navy had largely disappeared.[24]

From 1873 to 1875, Swedish naval policy-makers, primarily the naval officer Fredrik Wilhelm von Otter, formulated a strategic and tactical anti-invasion doctrine.[25] In that, the fleet had one main task; to attack the enemy transport fleet, either when it came close to the Swedish coast or when it had anchored and begun to disembark the troops. A fleet transporting two or three army corps, 30,000 to 50,000 men with horses, artillery and equipment for an offensive campaign, was a huge and vulnerable target. An attack on it required several fast and seaworthy vessels, which rapidly could be sent to any threatened part of the coast and make a concentrated strike against enemy transport vessels. The ships should be small enough to navigate and fight in the Swedish archipelago, which also was useful as a sheltered zone for movements along the coast. The possibility to base the operational fleet in the archipelago made it difficult to blockade, as an enemy could not know where a mobile and fast fleet intended to emerge from the archipelago.

This Swedish fleet should be strong enough to break through an enemy fleet, which protected the transports but it should not try to fight a decisive battle with the enemy main fleet. The efforts should as far as possible be concentrated on the transport ships. After such an attack the surviving Swedish ships should retire as quickly as possible and take protection in the archipelago or a port. Serious losses were expected but this was regarded as acceptable if the fleet was able to inflict severe losses on the enemy transports and the army forces they carried. If these losses were large enough the enemy's offensive strength on land might be reduced to a level where the Swedish army might contain and finally defeat the invader. It was expected, even in the Swedish army's general staff, that a sizeable fleet of this type might make the extensive archipelago north and south of Stockholm more or less impregnable for invasion and limit the enemy to landings on open coasts.[26] It was a doctrine where the navy's strategically defensive role

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of limiting the enemy's operational freedom could be combined with tactical offensive actions.

The monitors and the armoured gunboats were of little use in this new naval doctrine, except as a "position defence" force in the archipelago, protecting important cities and ports. Nevertheless, the strictly defensive profile in the new doctrine had a considerable political appeal and it was soon accepted by the Parliament. Debates about naval policy were successively reduced to the question of how large the navy should be but its main tasks were defined. During the 1870s, the Parliament limited its support to the construction of small but seagoing warships. This resulted mainly in a series of nine fast (13-13.5 knots), un-armoured gunboats of 500 to 600 tons, armed with one 27,4 cm gun and one medium calibre gun. They were launched from 1874 to 1882 and designed by Göte Wilhelm Swensson, a naval architect who had made his career in the private Swedish shipbuilding and mechanical industry. These gunboats, an original Swedish design without any foreign model, were partly a stopgap measure but they provided the navy a small force with the speed and rapid striking power at sea that the monitors and armoured gunboats totally lacked. The minister of the navy was also looking for a suitable design for a medium-sized armoured warship and for a fast but seagoing torpedo vessel.

By the early 1880s a new Swedish fleet had begun to take shape. It was centred on two types of warships, moderately sized but seaworthy armoured ships and small and fast torpedo boats. The latter were built to British designs and were similar to torpedo craft in most other navies. The armoured ship was a genuinely Swedish type of warship, designed by G. W. Svensson, who from 1881 was head of the Swedish Corps of naval engineers. The original design, which was ready by 1880, was of 2,622 tons with a speed of 13 knots. The hull was much higher than the monitor's hull and the ship could fight in any type of weather when enemy battleships and cruisers could fire their guns. It had two 25,4 cm armour-piercing guns of the latest British W. G. Armstrong model, intended to inflict damage on major enemy warships protecting the transport fleet. It had a medium-calibre battery of three 15,2 cm Armstrong guns, which was intended to sink as many transport ships as possible on a short time. The armour was limited in extent as it was on most modern armoured ships of the time but it was thick and it protected the main armament, the machinery and the hull's floatability. The ship had a good chance to absorb at least a few hits from heavy artillery without losing its fighting ability. With the slow-firing guns of this period it was believed that a fleet of such ships together with many torpedo boats could break through an enemy line of warships and destroy a large number of troop transports with guns and torpedoes.

John Ericsson had no role in the development of this new doctrine and its gun-armed ships. But he still had a role to play in relation to the public and the Parliament. He was famous and he had a strong public reputation for favouring purely defensive

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warships of moderate size rather than large and politically controversial capital ships. Personally he was no longer committed to the monitor concept. During the 1870s and 1880s Ericsson was mainly interested in the development of underwater weapons and he made large efforts to develop a torpedo and a torpedo-carrying warship. Already in 1876 Ericsson became an enthusiastic supporter of the new Swedish naval doctrine which he believed would require a large number of fast, seagoing warships of moderate size armed with torpedoes and a medium-calibre gun.[27] He made several efforts to make the Swedish navy interested in his own torpedo design and in the new unconventional warship, which he designed to carry this weapons.

Around 1880, Ericsson even built a prototype torpedo vessel for his own money, the *Destroyer*. It had a lightly armoured deck and it could partly be submerged when it attacked but it was a far larger vessel than the fragile, small torpedo boats, which became common at this time in several navies. Ericsson argued that vessels of his type were ideal for Swedish anti-invasion defence and, undoubtedly, the vessel (if given higher speed than the prototype, which must have been limited by Ericsson personal resources) answered well to the new Swedish naval doctrine. The Swedish minister of the navy declared that he was interested in it but it appears that he expected that the U S Navy or another major navy should show its interest in the project before Swedish naval funds were committed to it.[28] That never happened but it was politically important that the famous John Ericsson was positive to the new Swedish ideas of fast seagoing warships, primarily intended as a striking force against an invader. It would have been a problem for the navy if he had continued to argue for the monitor.

John Ericsson's continued importance is obvious in the debate in June 1883 when the Swedish Parliament finally approved the construction of the first of the new armoured coast defence ships. The 80-year-old engineer, who had been absent from Sweden for 57 years, was very much present in this debate.[29] Naval officers navy had for years been anxious to describe the new coast defence ship as a logical modernisation of the monitor concept, a small armoured ship with two heavy guns in a turret. It was even called "armoured boat" (*pansarbåt*) to underline its small size. Actually it was a very different type of ship than the monitor, built for a different strategy and a widely different tactic. In the parliamentary debate several supporters of the new ship and the minister of the navy could quote very positive comments from John Ericsson, which he had sent to Swedish newspaper. The minister even read a telegram from Ericsson to underline that the national hero was behind Swedish naval policy. Ericsson called the new ship "excellent" and the best type of armoured ship of the smaller type that any nation had. He suggested that it should be made a little longer, a suggestion that in fact underlined that he did not saw it as a large ship.[30] Ericsson claimed that a number of these armoured ships together with 20 vessels of his own *Destroyer* type would make Sweden impregnable from the sea.

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It is probable that Ericsson's positive attitude partly was motivated by his interest in selling the *Destroyer* concept and that he hoped that support for the armoured ship would make the minister more positive to his own project. The effect of John Ericsson public approval of the new type was however that the sea officers' and the minister's rather populist invocation of the monitor as the natural predecessor of the new armoured ship became credible and difficult to argue against. The argument that torpedo vessels were an alternative to large ships was also difficult to use when Ericsson, an inventor of a new torpedo system, declared that it was a complement rather than alternative to armoured ships with heavy guns. The new Swedish coast defence fleet with moderately sized armoured ships and flotillas of torpedo-carrying vessels, which remained the backbone of Swedish naval doctrine until the 1940s, was founded with the full public approval of the man who had made more than anyone else to make the old Swedish naval doctrines obsolete.

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[1] This article is based on the author's study of the development of the Swedish naval doctrine during the nineteenth century: Jan Glete, *Kustförsvar och teknisk omvandling: Teknik, doktriner och organisation inom svenskt kustförsvar, 1850-1880* (Stockholm: Militärhistoriska Förlaget, 1985). It was mainly based on parliamentary records (Riksdagstrycket), contemporary journals and pamphlets, published and unpublished papers from committees on naval defence, a limited selection of papers in the large archives from the Swedish naval administration and several private collections of papers left by naval officers. I have also published studies of Swedish nineteenth century defence in Jan Glete, "Beredskap och vidmakthållande. Varvet och linjeflottan 1772-1866," in *Karlskronavarvets historia, 1, 1680-1866*, ed. Erik Norberg (Karlskrona: Karlskronavarvet AB, 1993), 145-252 and Jan Glete, "Krigsvetenskapsakademien, försvaret och den industriella samhällsomvandlingen, 1870-1920," in *Fäderneslandets försvar: Kungl. Krigsvetenskapsakademien, 1796-1996*, ed. Erik Norberg (Stockholm: Atlantis, 1996), 141-260. They include extensive references to literature about Swedish nineteenth century military and naval history.

[2] The only major biography on John Ericsson is still William C. Church, *The Life of John Ericsson*, 2 vols (London: Scribner, 1890).

[3] More important studies of nineteenth century naval architecture and engineering are listed in *Glete 1985*. A major later is *Conway's History of the ship. Steam, steel and shellfire: The Steam Warship 1815-1905*, eds Robert Gardiner & Andrew Lambert (London: Conway, 1992). *Conway's All the world's fighting ships, 1860-1905* (London: Conway, 1979) is the standard reference work, which gives comprehensive information about builders of warships for all navies.

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[4] Jan Glete, "Navies and power struggle in northern and eastern Europe 1721-1814" in *Navies in Northern Waters 1721-2000*, eds Rolf Hobson & Tom Kristiansen (London: Frank Cass, 2004), 66-93.
[5] There are no studies about Russian nineteenth century war planning against Sweden. It is unlikely that it had a high priority in Russian planning and preparations. The Russian military presence in Finland was limited to a defensive force, primarily covering St Petersburg, Pertti Luntinen, *The Imperial Russian army and navy in Finland, 1808–1918* (Helsinki: SHS, 1997).
[6] Naval strength in the Baltic up to 1860, Jan Glete, *Navies and nations: Warships, navies and state building in Europe and America, 1500–1860*, vol. 2 (Stockholm: AWI, 1993), 433-5 and the appendices.
[7] Allan Jansson, *Försvarsfrågan i svensk politik från 1809 till Krimkiget* (Uppsala: Appelbergs, 1935) remains the standard work on Swedish defence policy in the first half of the nineteenth century. It has however its focus on the debate rather than on how the military and naval funds actually were administrated and used.
[8] In the period 1819-66, 4.2 million riksdaler were spent on Karlsborg, 2.8 million on the Vaxholm sea fortress outside Stockholm and 2.65 million on the sea fortifications at Karlskrona, *Underdånigt betänkande angående planerna för fästningsbyggnaderna vid Carlsborg, Waxholm och i Carlskrona skärgård* (Stockholm, 1868).
[9] The Göta Canal was the largest Swedish civil engineering project in its day where the young John Ericsson and his brother Nils (1802-1870) received their training as engineers in the 1810s. Nils Ericson became the leading Swedish civil engineer of his generation and he led the first large-scale Swedish state railway projects in the 1850s and 1860s.
[10] Sjöförsvarsdepartementet, Konseljakter 14/10 1862: Betänkande av 1861 års sjöförsvarskommitte, Appendix 16, written by Major-General Johan af Kleen, outlines the strategic motives behind investments in Karlskrona since 1814. British Baltic policy, Andrew Lambert, "Great Britain and the Baltic, 1809-1890", in *In quest of trade and security: The Baltic in power politics, 1500-1990, I: 1500-1890*, eds Göran Rystad *et al* (Stockholm: Probus, 1994), 297-334.
[11] Norwegian naval policy: Roald Berg, *Profesjon-Union-Nasjon: Norsk forsvarshistorie, vol. 2, 1814-1905* (Bergen: Eide), esp. 56-62.
[12] Donald L. Canney, *The old steam navy, vol. I: Frigates, sloops and gunboats, 1815-1885* (Annapolis: Naval Institute Press, 1990), 21-7
[13] Joh. Jonzon's report 17/8 1844, Marinförvaltningen, Skeppsbyggnadsavdelningen, Inkomna handlingar, inkomna rapporter, bunt 2, Krigsarkivet, Stockholm. In Britain, Jonzon also visited *Great Britain*, the new iron-hulled screw passenger ship designed by Isambard K. Brunel.
[14] Minutes of the naval committee 13/10 1842, ÄK 383; Riksarkivet, Stockholm; J. H. Kreüger to the minister of the navy 26/4 1843 with a proposal that an officer should be sent abroad to study Ericsson's and Francis P. Smith's screw systems, J. H. Kreüger to the minister of the navy 14/7 1844 with a proposal that an iron-hulled steamer with Ericsson's screw system should be built, Kreügerska arkivet, vol. 4, Krigsarkivet,

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Stockholm; Memorandum to the King by C A Gyllengranat 27/12 & 29/12 1845 about a new steam navy, Axel Adlersparres samling, vol. 13, Krigsarkivet, Stockholm.

[15] The hull of *Gefle* was designed by the Swedish naval architect Jacob Henry d'Ailly while the machinery was designed by O. E. Carlsund, managing director of Motala verkstad, Marinens Ritningar, AIIb, Krigsarkivet, Stockholm. B. J. Jonzon prepared preliminary drawings for the machinery section based on *Princeton*, see letter from Jonzon 30/6 1845 in Kreügerska arkivet, vol. 4, Krigsarkivet, Stockholm. The design displacement was around 1,170 metric tons. No detailed comparison with *Princeton* (displacement 1,046 long tons or 1,063 metric tons) has been made but the only major difference in main dimensions was that *Gefle* had greater length. The Swedish ship had eight guns (30-pounders and 20 cm shell guns), a more conventional type of armament than *Princeton's* two 12-inch super-guns and ten carronades. It had also a lower rig with less canvas than *Princeton*.

[16] Swedish naval policy and new construction for the navy is based on *Glete 1985*, 45-87 and *Glete, Beredskap 1993*, 238-46. A detailed historical list of machine-powered Swedish warships: Gustaf von Hofsten & Jan Waernberg, *Örlogsfartyg: Svenska maskindrivna fartyg under tretungad flagg* (Stockholm: Svenskt Militärhistoriskt bibliotek, 2003).

[17] Antony Preston & John Major, *Send a gunboat: A study of the British gunboat and its role in British policy, 1854-1904* (London: Longmans, 1967), 9-31.

[18] *Church, 1*, 240-1.

[19] Axel Adlersparre was in practice deputy minister of the navy (*Chef för Sjöförsvarets Kommandoexpedition*) in 1863-68 and president of the Navy Board in 1868-71. He was also a liberal member of the Parliament from 1865. Important private collections of letters and papers regarding Swedish naval policy and technology, including many letters from John Ericsson: Brev och skrivelser från Otto E. Carlsund... ...rörande nybyggnader vid flottan (X 803), Handlingar rörande ombildningen av Sveriges sjöförsvar 1865 (X 809), Brev från John Ericsson till Axel och Sophie Adlersparre, 1862-79 and Brev från John Ericsson till Baltzar von Platen 1863-67, all in Kungliga Biblioteket, manuscript department, Stockholm; many important letters also in Axel Adlersparre's private collections in Kungliga Biblioteket, Riksarkivet and Krigsarkivet, all in Stockholm.

[20] Monitor development in the United States: Donald L. Canney, *The old steam navy, vol. II: The ironclads, 1842-1885* (Annapolis: Naval institute Press, 1993).

[21] Design specification for "Monitor No. 5" in Marinens Ritningar B31, Krigsarkivet, Stockholm.

[22] Comparative trial report 16/9 1869 in Marinens Ritningar B33, Krigsarkivet, Stockholm.

[23] In the end of 1875, the navy had four monitors, nine small monitor gunboats, one armoured gunboat of Carlsund's design, three wooden-hulled screw cruisers (including the old *Gefle*), one brand-new fast gunboat (G. W Swensson's design, see below), ten small screw gunboats and a Thornycroft-built torpedo launch.

[24] This is a summary of the main conclusions in *Glete 1985*.

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[25] Fredrik Wilhelm von Otter was minister of the navy in 1874-80. He was succeeded by his brother admiral Carl Gustav von Otter, who remained minister until 1892.
[26] Jan Glete, "Hugo Raab och den samtida krigföringens utveckling (1848-1871)", in *Hugo Raab: Förkämpe för ett modernt försvar*, ed. Gunnar Artéus (Stockholm: Försvarshögskolan), 115-60, esp. 154-8.
[27] Ericsson's views on Swedish defence problems and the use of his own torpedoes for anti-invasion defence can be followed in his letters to Axel Adlersparre, Brev från John Ericsson till Axel och Sophie Adlersparre, 1862-79, Kungliga Biblioteket, Stockholm.
[28] In the parliamentary debate on 5/6 1883, the minister of the navy C. G. von Otter described the contacts he and the naval administration had had with Ericsson since 1879 about the torpedo and the *Destroyer*, Första Kammarens protokoll 1883, no. 51.
[29] Första Kammarens protokoll, no. 51, 5/6 1883; Andra Kammarens protokoll, no. 60, 5/6 1883.
[30] The first ship of the new type, *Svea*, launched in 1885, was in fact longer than the original design. The displacement became 2,900 tons, the speed 14,7 knots, longer 25,4 cm guns were fitted than in the original design and the number of 15,2 cm guns was increased from three to four. This was the result of that the times for the shipbuilding industry were hard in the 1880s and the Swedish shipbuilders offered low prices. This made it possible to build a larger ship with the funds voted by the Parliament. It is not known if Ericsson's advice had any influence on this but evidently the Swedish naval administration had the same opinion as the old engineer about how the design could be developed if funds were available.