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Ships, Forests, Knowledge, and Empire: Shipbuilding as a Maritime Knowledge System in Malabar and Swedish Finland, 1500-1700

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Abstract

This article compares the shipbuilding industry of the Malabar Coast and the Swedish realm's territories of Finland from 1500 to 1700. Instead of seeing shipbuilding as a narrowly technological craft, or ships as tools of commerce and warfare, it sees the construction of ships as a maritime knowledge system: a historically constituted assemblage of environmental intelligence, material selection, artisanal skill, labour organisation, navigational experience, commercial capital, administrative regulation, and coercive power. Malabar and Swedish Finland were in different maritime regions, both with very different environmental and political characteristics. The latter was a part of a monsoon-dominated Indian Ocean trade network supported by Asian merchant communities, hardwood forests, port cities, and long maritime histories. The latter constituted the eastern part of the Swedish composite state and was involved in a Baltic economy that was organized around forests, tar production, archipelagic navigation, seasonal ice, coastal transport, and growing naval administration. But both areas show that maritime power was built up on land, as well as at sea. Ships originated in forests, river systems, labouring communities, workshops, credit networks, and political institutions. These dispersed systems of knowledge and resources were sought after by Portuguese and Dutch interventions in Malabar and by Swedish naval expansion in the Baltic. The article suggests that early modern maritime expansion was not as much about individual innovations as it was about the ability to coordinate the diverse modes of practical knowledge within institutions, using a common analytical lens of timber, tar, shipyards, labour, technological encounter, capital, warfare, and forced mobility. The comparison challenges Eurocentric narratives on technological progress and places shipbuilding at the nexus of environmental history, history of science, labour history, maritime archaeology and global history.

Keywords: *Malabar, Swedish Finland, shipbuilding, maritime knowledge, Indian Ocean, Baltic Sea, timber, tar, maritime labour, Portuguese Empire, Dutch East India Company, Swedish naval power.*

Introduction: The movement has been a common theme in the narration of early modern maritime history. Its main figures have been voyages, trade routes, naval campaigns, merchant diasporas, imperial rivalries and circulating commodities. This ship typically appears in these histories as one of the vehicles by which people, goods, soldiers, religious beliefs and political power moved. The social and environmental processes that led to the creation of the vessel are less visible. No history of oceanic commerce or maritime empire is complete without an attempt to reconstruct the shipbuilding, ship maintenance, financing, repair, provisioning, and manning of ships. A ship was not just a wooden box to trade in or fire artillery. It was a concentrated materialization of environmental knowledge, accumulated craftsmanship, organized labour, investment and political capacity. The article analyzes the shipbuilding process in Malabar Coast and Swedish Finland from 1500 to 1700 by using the concept of maritime knowledge system. It is a term for the historically variable interactions between forests, timber workers, shipwrights, merchants, navigators, rulers, companies, dockyards, ports and maritime environments. It defines shipbuilding as an area where ecological intelligence, technical practice, social organisation and political power came together. Maritime knowledge was not limited to navigational astronomy, cartography or written treatises. It contained the knowledge of identifying appropriate trees, predicting the

properties of various wood, moving heavy timbers, bending structural components, making iron fastenings, making ropes and sails, making waterproof hulls, estimating carrying capacities, navigating rough coasts and repairing vessels over and over again. The Malabar Coast and the Baltic Sea experienced dramatic commercial and geopolitical changes from 1500 to 1700. Portuguese presence in the Indian Ocean from 1498 sought to change the existing Asian trade networks by using armed shipping, fortified ports, monopolistic contracts, and the cartaz licensing system. The VOC (Dutch East India Company) then expanded forms of commerce warfare to Malabar and attempted to control its pepper trade through its broader Asian network. The interventions did not generate Malabar trade. They came to a highly networked oceanic environment that was maintained by the presence of longstanding merchant communities, port polities, monsoon sailing, regional credit, and indigenous shipping. Malabar was a vital space where European military-commercial institutions met, relied on, and sought to monopolize Asian maritime knowledge. In the same time the kingdom of Sweden grew from a small Scandinavian kingdom to a great military power in the Baltic. The eastern part of the Swedish realm was occupied by present-day Finland. Finnish forests, tar-producing areas, coastal cities, rivers, sailors and rural populations were gradually linked to a state-controlled maritime economy. For the expansion of the Swedish navy, the country needed iron, hemp, sails, timber, pitch, tar, seamen, food, and finance, as well as administrative coordination. The Baltic system was also linked to other systems internationally. Dutch shipping and capital were at the heart of Baltic trade, and forest products from the Swedish realm were used for building and upkeep of European merchant and naval fleets. The comparison is not intended to establish a false equivalence between Malabar and Finland. Their environment, political systems, ship culture, work practices and business geography were very different. Malabar shipbuilding was in a tropical hardwood environment and a maritime calendar dictated by the monsoon winds. Coniferous and mixed forests, rocky archipelagos, shallow coastal channels, harsh winters and seasonal ice were all challenges to maritime activity in Finland. Portuguese and Dutch involvement in Malabar was overseas colonial and corporate expansion, while Swedish extraction in Finland was in a composite monarchy, Finnish territories were politically incorporated, but not uniformly governed, and were often heavily taxed, conscripted, and materially requisitioned.

Malabar and Finland regions reveal how maritime societies converted terrestrial resources and dispersed practical expertise into vessels. Both demonstrate that maritime power depended upon an institutional capacity to coordinate forests, labour, finance, and technical knowledge. Both also expose the relationship between commerce and coercion. Ships transported pepper, timber, tar, textiles, and metals, but they also carried artillery, soldiers, captives, and enslaved persons. Shipbuilding belonged simultaneously to histories of creativity, exchange, environmental adaptation, warfare, extraction, and forced mobility.

The comparison is however, immensely productive because it begins with difference. The two areas illustrate how maritime societies modified land resources and how experience was transferred from the land into the boat. Both demonstrate the need for an institutional capacity to combine forests, labour, finance and technical knowledge to create maritime power. Both them reveal the relation of trade to force. They transported pepper, timber, tar, textiles, metals, artillery, soldiers and captives, and enslaved people. Shipbuilding was a part of histories of creativity, exchange, environmental adaptation, warfare, extraction, and forced mobility. This is a first step towards Maritime Knowledge Systems. The typologies of sewn vessels and nailed vessels, frame-first and shell-first construction, square rigs and lateen rigs, merchantmen and warships, and others have all been used to organize the history of technology

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in the field of shipbuilding. While these differences remain crucial, particularly in nautical archaeology, they are not enough to explain the operation of a maritime technological system, namely typology. Ships were not works of art and/or a fixed expression of civilizational identity. They were born out of the relationships between materials, environments, customary practices, economic needs and political demands. Comparing the design of water transport, Sean McGrail observed that the design of a vessel should be considered according to its purpose, materials available, knowledge of construction and operating conditions. Much of the knowledge of the sea was not formalized but rather embodied in the person, as Dionisius Agius has demonstrated with his interdisciplinary movements between texts, languages, images, archaeology, and extant craft practice, in order to bring western Indian Ocean shipping back into view. It went through apprenticeship, observation, demonstration, repetition and collective memory. The concept of a knowledge system does not imply that the shipwrights, forest workers, merchants and officials had one unified theory. There was still a social distribution of knowledge. A timber worker could know something about the maturity, the curvature, the weakness and the resistance to rot of a timber without knowing anything about the geometry of a hull. A shipwright could reason about proportions and foresee stresses to a ship's hull without being aware of engineering theory. A seaman may have a detailed knowledge of currents, reefs, seasonal winds, and anchorages, but not make a map. Freight, risk, insurance, credit and probable return were all calculated by merchants and financiers. The rulers and corporate officials rendered ships to be taxable, regulated, seized, and military commodities. The ship was an embodiment of the interdependence of these epistemic communities. It was constructed by the synchronization of processes in different locations at different times. The trees were to be identified, approved for cutting, be cut down at the right time, be dragged to water, floated or hauled to shipyards, be seasoned or seasoned according to local practice and to be made into keels, frames, planks, beams, masts and fittings within the ship. Iron had to be smelted and forged, fibers had to be processed into ropes, cloth had to be used to make sails, oil, pitch, resin, tar and other substances had to be prepared for protection and waterproofing. Food, wages, house and supervision had to be provided to the labour force. Once launched, navigational knowledge, repair systems and provisioning systems were the factors that determined the ability of the vessel to stay afloat. The building of ships became a part of the earth and sea. The oceans began to move in the forests and workshops. This power of the sea was not only in the mastery of sea routes, but in the power of the human hand to make and repair ships of any size. A ruler may purchase or capture a number of ships; however, they cannot create a long-term maritime system. They had to be replaced by ropes and sails, to keep their men, to feed them and to teach them. In this way also, the language in which technological superiority is spoken is made more complicated. European expansion in Asia has been attributed to the superiority of their ships, naval artillery or oceanic navigation. It is clear that European ships and guns took military strides in certain battles. Portuguese and Dutch ship fleets in the Indian Ocean, however, depended on Asian materials, pilots, shipwrights, merchants, food systems and political relationships. The navy of Sweden also took its cues from the Dutch and borrowed heavily from overseas, keeping to local shipyards, and utilising the forests of its vast kingdom. Maritime systems were relational and hybrid even in the era of institutions asserting their knowledge sovereignty and space ownership. Pre and post Portuguese Intervention in Malabar. The Malabar Coast was one of the most important commercial regions of pre-modern Indian Ocean. Its ports were connected to pepper-producing hinterlands, people who came from the Arabian Peninsula, Persian Gulf, Red Sea, East Africa, Gujarat, Coromandel, Sri Lanka, Southeast Asia and even China at times! Europe is not the only region that has documentary evidence that can be used to understand the maritime importance of the coast. Before the

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Portuguese came, groups of traders operated in line with negotiated deals with local rulers, merchants, port officials, religious groups, and local producers. The oceanic system was not a political unit. In fact, coherence became apparent during seasoned navigation, commercial custom, credit and diasporic settlement, as well as the traditional practical wisdom of navigating between remote ports. This world's main temporal organisation was monsoon. Seasonal changes in wind direction made long-distance sailing possible, and involved a period of sailing away, residing at home and sailing back. Merchant groups would remain in foreign ports until the winds were right. Ports were then no longer just places of passage. These were centers of translation, religious patronage, legal negotiation, information exchange, ship repair, and intercultural settlement. In these places of commercial contact, of political co-existence and regional social development, the study of Muslim trading in medieval Malabar by Sebastian Prange demonstrates the birth of maritime Islam.

Portuguese coercion did, however, change the hazards of sea trade. Ships could be seized, cargoes confiscated and crews imprisoned or killed if they were not carrying a valid pass. Armed intervention changed the balance of power between the regional powers, particularly by the Portuguese against commercial rivals. The sea was a more clearly militarized space, but violence had been present in the Indian Ocean prior to European contact. The difference was partly because of the Portuguese's attempt to institutionalize armed shipping as a means of monopoly. Shipbuilding was at the heart of these changes. European fleets had to be continually repaired in tropical conditions. Hulls, ropes and fittings wore out; vessels were damaged by storms, reefs, war, shipworm and overuse. European-built ships were not allowed to sail on forever after they arrived. Portuguese institutions depended on the Indian timber, shipyards, craftsmen, caulkers, pilots and sailors. Vessels were built locally and were used in transport, military and commercial activities. The Portuguese maritime presence was thus literally dependent on the regional knowledge systems it sought to subdue. Malabar's Shipbuilding Ecology The Malabar Coast had the environmental conditions that were favorable for shipbuilding, but also had significant technical challenges. Hardwoods such as teak were provided by the Western Ghats and adjacent forest areas, and rivers linked some of the inland areas to the coast. The timber resources were good, but extraction was dependent on political permission, labour, transport and local knowledge of terrain. Seasonal flooding, rapids, sandbars, and channel changes made transportation difficult, but rivers could help transportation to move downstream. Teak was particularly appreciated in ship construction in the Indian Ocean. It was strong, durable, dimensionally stable and resistant to decay and marine organisms, making it ideal for large structural parts. The category "teak-built ship", however, can hide the complexity of material selection. Different woods were selected by shipwrights for various reasons, such as availability, cost, curvature, weight, strength, and structural function. Masts, frames, planking, beams, internal fittings and small craft were not necessarily made from the same materials. The first selection of timber was based on ecological knowledge. The right trees needed to be identified, assessed and removed. Natural curves were especially useful as they were needed in the construction of ships, which had to withstand stress at varying angles. A curved branch or root might be stronger than a straight timber that has been cut into the shape desired. Forest knowledge thus became directly incorporated into naval architecture. The ship's future hull was first conceived as a set of possibilities that were known in living trees. After felling, trimming, transport, storage and seasoning were done. Durability may be impacted at each stage. Improperly seasoned wood might split, warp, or decay. However, there were differences in the way the seasoning was done depending on the species, climate, construction time, and institutional demand. If there are large orders from state or company, this may speed up the extraction process and affect regular time cycles.

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The need to get ships ready for war or trade in a hurry could result in compromises in the preparation of materials. Metal fastenings, wooden dowels, fibres, caulking materials, sails and rope were also needed for shipbuilding. Although sewing and lashing are significant in some areas of the Indian Ocean, south Asian vessels cannot be simplified to a single "sewn-boat tradition." The construction methods were different in different regions and at different times. Some ships used stitched or sewn planking, others used iron nails, wooden fasteners, framing or a combination of these. European descriptions frequently imposed general categories on a variety of regional practices. The sea environment of Malabar affected the design of the hull and the way ships were used. Strong monsoon seas, significant surf, heavy rain and shifting river mouths were all experienced on the southwest coast. Not all ports had natural harbours that were deep and sheltered. The vessels had to sail through anchorages, estuaries, coastal shallows and off-shore conditions. The construction was in line with the intended function: fishing, coastal transport, river traffic, pilgrimage, pepper carriage, warfare or long-distance trade. The characteristics of a small craft for landing on the beach were different from those of an ocean-going merchant ship. The social structure of shipbuilding is more elusive to reconstruct than that of timber or type of vessel, since the artisans are rarely mentioned in colonial records except indirectly. Shipwrights might have been hereditary, caste associated, familial, guild-like, patron-based or mobile, but these categories should be assumed only if there is evidence. Practicing was the way to pass on skilled knowledge. The shipyard was a learning environment where younger workers learned to measure, use tools, sequence and make judgements in collective labour. Shipwrights were also important to the merchants and rulers. Skilled builders possessed knowledge that was not available to the financier, who determined size, function, schedule and expenditure. Negotiation between capital and craft authority was therefore a part of shipbuilding. European firms often tried to standardise labour, work out costs, and record materials. These records codified craft processes into administrative categories, but they did not kill craft autonomy. Dutch Corporate Expansion and Malabar Maritime Infrastructure. The VOC furthered the merging of commerce, warfare, documentation, and territorial control. The company had the authority to wage war, make treaties, build fortifications, govern settlements, and have judicial power, which was not granted to a traditional merchant association. It was a business model that relied on information gathering. The prices, cargoes, harvests, shipping movements, military strength, labour costs and political alliances were now continuously documented. Dutch conquest of Cochin in 1663 changed the political situation in Malabar but it did not result in the complete domination of the region. VOC power was based on negotiated relations with the Cochin kingdom and other political actors, access to pepper-producing areas and local intermediaries. The company tried to crush its rivals and impose contracts, but producers, merchants, rulers, and other European institutions had capacities for evasion and resistance. The VOC's scattered Asian colonies were connected by ships. Spices, fabrics, metals, foodstuffs, officials, soldiers, letters, and slaves were transported by company ships from Batavia to Ceylon, Malabar, Coromandel, the Cape and Europe. This network required a large network of construction and repair. The dockyards, timber supply, warehouses, labour force and provisioning systems were vital to corporate survival. The VOC did not bring a self-sufficient European technological system to Asia. It adapted and took advantage of Asian environments and capacities. Local pilots and sailors brought knowledge of tricky coasts and Asian built vessels were often used for company business. European woods may not be as suitable as tropical timbers for certain structural applications. Local materials and labour were inevitably used in the repair practices.

This adaptation is not to be romanticized as an

equal exchange. The inequities of contract, monopoly claims, the use of force, and administrative control were all methods of corporate appropriation. The company tried to make the knowledge of practice visible in terms of cost, inventory and labour. Trees were turned into timber allotments, craftsmen into wage entries, ships into depreciating assets, routes into schedules, ports into regulated nodes. Administrative abstraction was also a type of maritime knowledge, but one that was constructed on the partial abstraction of information from local communities. The Baltic Maritime Order is a Swedish Finland. The area of Finland today was once the eastern part of the Swedish kingdom from 1500 to 1700. The term "Swedish Finland" is not a political term, but rather a geographical and administrative term. The area was populated by Finnic and Swedish speakers, and was internally linked by forests, rivers, lakes, coastal settlements, archipelagos, and seasonal paths. The maritime geography stretched out towards Stockholm, Tallinn, Riga, Lübeck, Amsterdam and the North Sea, including Turku, Vyborg, Åland, the Gulf of Finland and the Gulf of Bothnia. Politically it was a time of the strengthening of the Swedish monarchy, the rivalry with Denmark, the wars against Muscovy and Russia, involvement in the Thirty Years' War and the creation of an empire in the Baltic. The development of Sweden as a military state demanded a large-scale mobilization of finances and administration. Jan Glete has suggested that the strength of a navy in the early modern period should be seen as an organizational ability, not as a matter of numbers of ships. A navy that was going to be sustainable needed to be taxed, to be procured, to have shipyards, stores, trained manpower, command structures, and systems of maintenance.[5] Finnish territories played a role in these processes in several ways. They supplied soldiers, sailors, taxes, timber, tar, agricultural supplies, and coastal transportation. They were also strategically important in wars with Russia due to their eastern location. The sea routes, harbours and fortifications along the Gulf of Finland were turned into a military frontier. The Baltic was very different from the Indian Ocean. It was hampered by winter ice in northern and eastern waters during its maritime season. Islands, skerries, shallow channels and dangerous rocks broke up the coastline. Navigation depended on a local knowledge of the area. Ships were steered by pilots who had experience navigating through archipelagic waters, a skill that was hard to teach with a map. Maritime intelligence was preserved in coastal communities through fishing, transport, seasonal migration, and frequent crossing. The Baltic was not a closed northern system, however. It played a key role in the trade of early modern Europe. Grain, timber, iron, copper, hemp, flax, pitch, tar, and other products flowed west, manufactured goods, salt, capital, and commercial services flowed in from Dutch, German, English, and other networks. The Dutch merchants and shipping held a particularly significant role. The Dutch Republic's commercial growth was partly based on Baltic grain and naval stores, and the Swedish dependence was on Dutch markets, skills, finance and shipping. Swedish maritime development thus came about as a result of royal centralisation and international interdependence. The state tried to increase its control over resources and shipping, but its navy was linked to transnational markets and knowledge. This is a forest, tar, and Finnish maritime knowledge.This is a forest, tar, and Finnish maritime knowledge. The early modern wooden ship was the main material basis of the forest. Forests provided construction timber, fuel, charcoal, resinous products and raw material for tar in Finland. The exploitation of forest resources was not an easy task of extraction. It demanded knowledge of species, terrain, seasons, waterways, burning methods and transport. Oak was used extensively for large ship construction due to its strength and natural curvature, but was not always available and was state-controlled. Pine and spruce were used for masts, planking, smaller boats, buildings, barrels and tar production. The separation of "naval" and "commercial" timber was based on species, size, straightness, curvature, age and defects. Tar was a particularly important part of the Finnish

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shipping industry. Tar needed a lot of practical knowledge to be produced by the controlled heating of resinous pinewood in low oxygen pits or kilns. Wood needed to be chosen, prepared, stacked, burned, monitored and collected. Yield or batch destruction due to errors in construction or temperature. The production of tar was therefore a craft process, not an extractive one. It was essential to wooden shipping. Tar and other substances were used to waterproof ropes, rigging and timber. With the growth of European merchant and naval fleets, there was a growing need for naval stores. Finnish and Swedish tar-producing areas were linked into commercial networks that linked rural households to coastal towns and export markets. This integration changed the rural landscape. Significant amounts of pinewood were burned and movement into forested areas was promoted. Production could augment agricultural livelihoods, generate tax revenues, and link households to markets, but it also exposed them to merchants, debt, price fluctuation, and state regulation. Maritime expansion thus reached the interior society. A rope used in a naval service was treated with Finnish tar and its performance took place far from the sea. Seasonal intelligence was also needed for timber transport. Snow and frozen ground might help movement, as it would decrease friction and make it easy to haul heavy logs on sleds. The risk of floating was also present with the spring thaw and high water. Rivers and lakes formed transport corridors but logs might be lost, damaged, stranded or blocked. Coastal shipping linked inland resources to towns, dockyards or export routes. The Finnish maritime knowledge system was thus expanded to the Baltic fleets. Its participants included peasants, tar burners, timber cutters, haulers, boatmen, merchants, customs officers, shipwrights, sailors, and naval administrators. Even as the state tried to control and tax it, it relied on this dispersed knowledge. The formation of the Swedish state and the shipbuilding and administration industries. Swedish naval policy began to increasingly treat shipbuilding as an administrative calculation. The Crown needed to know the amount of timber available, the capacity of shipyards, the availability of labour, costs and construction timelines.

Glete's work is especially significant in that it challenges the notion that naval strength is a by-product of economic strength or technological innovation. The key issue was institutional: could a government mobilise resources reliably, and maintain organisational competence?[6] A fleet that fell into disrepair in harbour, without crew or repair facilities, provided little lasting power. The Swedish naval system was a centralized one with geographically distributed production. Ships and parts might be built at several sites prior to assembly or transfer. Regional shipyards utilized local resources and manpower, and major naval centres focused on administration and specialized knowledge. This distribution posed inspection, standardization, transportation, and quality control issues. Shipwrights were in an ambiguous role in administrative systems. They were invaluable in their expertise but hard to put into writing. Drawings, moulding techniques, calculations and formalized proportions became increasingly important in early modern naval architecture, but practical judgement was still paramount. The quality of the timber, deviations from the design and local working conditions demanded continual adaptation. The Swedish state also brought in foreign skills, especially from areas of high commercial and naval shipbuilding. Dutch influence was significant in the northern European maritime technology, but should not be read as a one-way transfer. Foreign shipwrights operated in a Swedish material and institutional environment. Available timber, military goals, shipyard practices and Baltic navigation influenced imported designs. Finnish involvement in this system went beyond providing resources. Coastal shipbuilding, boat construction, pilotage, transport and seafaring were regionally embedded forms of knowledge. Small boats linked islands, farms, towns and bigger ports. They are not often featured in naval histories that focus on large warships, but they were integral to the logistical networks that fleets

relied upon. The materials of teak, oak, pine and tar were compared. The materiality of shipbuilding is inseparable from political economy as is illustrated by a comparison of Malabar and Swedish Finland. Teak, oak, pine and tar were not just resources waiting to be exploited. They were classified as maritime materials, by labour, transport, property, and authority. Teak was very durable and was highly sought after, but only if forest areas and the inland transportation could be controlled. Regional rulers, landlords, merchants, communities, and eventually colonial institutions were involved in the control or utilization of timber. European firms saw the potential of Indian hardwood and used it for repair and construction. The characteristics of teak may also help to improve the life of the vessel, which will change the investment and maintenance calculations. In northern Europe, oak was similarly used for strategic purposes, particularly for frames and hulls of warships. States tried to set aside or control appropriate trees in case there was not enough available to meet naval needs. However, not all oaks were available in Finland, and several timbers were used in Baltic construction. Pine was used for straight masts and other parts, and its resin was used for tar production. Tar is an example of a natural product versus a knowledge-intensive product. Naval tar is not pinewood, it is processed. The value of tar was a result of the forest ecology, domestic labor, technical practice, transport, merchant organization, and international demand. In both areas shipbuilding connected resource frontiers with political centres. Forests in Malabar were linked to coastal ports and to the imperial networks of the Europeans; the production of Finnish forests was linked to the city of Stockholm, the Swedish naval administration, the Dutch shipping and the markets of the western Europeans. Information was thus always linked to environmental extraction. States and companies wanted to know where resources were, who had control of them, how they could be moved and what labour was needed. There are also different temporalities in the comparison. Climatic conditions at tropical shipyards would differ from those in the Baltic, but monsoon rains would have an impact on work and sailing. Winter and ice hampered construction and transport in Finland, but also allowed them to take advantage of frozen terrain for transporting. The maritime calendar started before the ship was launched: felling, transport, seasoning and construction were seasonally organized. Navigation as Distributed Environmental Knowledge The history of shipbuilding and navigation should not be considered as two distinct technological histories. Ship design was affected by the intended navigational environment, and the performance of the ships fed back to ship builders. There was an extended circuit of maritime knowledge, including pilots, sailors, and shipwrights. The Indian Ocean was navigated by monsoon winds and currents, coastal recognition, sounding, and the knowledge of the route gained over time. Seasonal winds were regular enough to make long-distance voyages possible, but not so regular that uncertainty was eliminated. Storms, reefs, shifting coastal conditions, political strife and scarcity were constant threats. Pilots had local knowledge which was not readily available to European navigators. Portuguese pilots introduced the Atlantic and Mediterranean experience, instruments, written route guides and cartography, but adaptation was necessary to operate successfully in the Indian Ocean. The knowledge of the Europeans was expanded through contact with Arab, Gujarati, Malabari and other maritime experts. The making of route books and charts was a process of translation, observation, appropriation and correction. Different skills were needed for Baltic navigation. The waters of the archipelago offered many islands, rocks, narrow channels, shoals and changing depths. Seasonal ice may cause damage to vessels, slow down movement and change routes. Local pilots thus played a crucial role. They knew the topography, hydrology and seasonal knowledge. The comparison shows that navigational knowledge was not universal and not local. Some techniques, like astronomical observation or calculation, might spread. Other types of knowledge were still tied to repeated

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bodily experience of specific coasts. This knowledge was tried to be documented and codified in charts, sailing directions, pilot regulations, and Although the written word did not completely replace practice, it was used for hydrographic surveys. Technological Encounter and the Problem of Diffusion A diffusionist approach to the history of early modern maritime technology has been used on many occasions, in which innovations spread from one civilization to the others. Such stories have the potential to reinforce a Eurocentric model of technical change, with Asia as the site of tradition. The evidence from Malabar and the Baltic is more relational. Foreign ships were regularly seen in the waters of the sea in the form of trade, repairs, capture, shipwreck, war, and employment. A ship entering a dockyard revealed its hull shape, fastenings, rigging and materials to observation. Shipwrights were able to take on some of the characteristics without having to replicate a whole vessel tradition. The sequence of sails, the arrangement of artillery, pumps, anchors or construction sequences could be changed separately. Commercial value, local repair and suitability to local conditions were the reasons for the use of Asian-built ships by European companies in the Indian Ocean. Wherever there was a clear purpose, Asian shipwrights introduced iron, rigging, hull features, or organizational methods. Hybridization did not necessarily result in a stable mixed type; it might be temporary, local, and/or function-specific. There was also a great deal of interaction with Dutch and other foreign expertise in the development of Swedish maritime. The Dutch had a lot of experience in commercial shipbuilding, freight efficiency and maritime finance. Foreign experts were brought in and foreign designs observed by the Swedish authorities. However, knowledge was adapted to the Swedish naval strategy, resources, and institutional structure. The process of technology movement was thus a translation of the selective kind. Builders assessed foreign practices based on their current knowledge. The factors influencing adoption were material compatibility, labour skills, cost, political demand and operational environment. Comparisons of ships do not, of course, establish direct borrowing. Credible transmission must be established through archaeological, documentary, linguistic or biographical evidence. The ship as an economic object is the subject of this book.This book is about the ship as an economic object. Concentrated investment was needed in shipbuilding. The capital needed to be invested in materials and labour before a ship could earn a profit. Construction thus required the support of merchants, rulers, corporate institutions, or entities that could raise credit and bear risk. In Malabar, ships were launched for various purposes and functions. The merchants' customers needed ships to transport pepper, cloth, rice, horses, pilgrims, and regional trade. Rulers needed transports and fighting ships. Portuguese and Dutch institutions constructed, acquired, chartered and seized ships. Ownership may be personal, family, communal, royal or corporate. Design was influenced by the financial structure of shipbuilding. A merchant who was interested in carrying goods and in operating cost had different priorities than a naval authority interested in artillery platforms and structural strength. However, there was some overlap between commercial and military applications. Weapons could be carried aboard merchant vessels, and cargo and provisions aboard naval vessels. European corporate records made ships into accounting objects. Construction, repair, wages, provisions, depreciation and loss costs were recorded in administrative systems. This documentary practice rendered vessels comparable across time and space, but it was often accompanied by the suppression of informal payments, forced labour, local negotiation, and ecological harm. Naval construction in the Swedish realm was based on fiscal mobilization and administrative appropriation. Merchant capital and Baltic markets were essential to commercial shipping. Tar and timber linked rural production to international credit networks. Merchants might sell goods or money to producers, establishing dependency and bringing commercial discipline into forest communities. The ship was therefore

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a material object, a technical accomplishment, an investment of capital, a taxable asset, a military asset, and a legal entity. It was registered, owned, flagged, and had routes that were of political importance. Maritime power was not just about controlling ships, but also the categories in which they were recognized. Labour, Artisanship, and the Politics of Archival Visibility Labour was the key to shipbuilding, but labour is hard to come by. Administrative archives are the ones that focus on the interests of officials, merchants, rulers, and institutions. Artisans are listed in the wage lists, collective designations, costs, complaints, or disciplinary cases. Archives, therefore, need to be read against the grain of their classificatory logic in a labour history of shipbuilding. A payment record can show that shipwrights exist, but it does not show how they got their skills. A timber account can mask the forest labour needed to make each piece. A naval order can be a routine of administration and conceal the impact on households. Skill created social stratification in the labor market. The authority of master shipwrights was based on limited knowledge. Specialized competence was found among caulkers, smiths, sawyers, rope-makers, sailmakers, and pilots. Less-skilled or unskilled workers carried wood, dug docks, loaded stores, and did repetitive, backbreaking work. Where shipyards were officially identified as male, women's labour could have been involved in provisioning, fibre processing, household production and commercial support. Labour relations in Malabar were influenced by caste, patronage, local politics, debt, slavery, and European corporate involvement. To label all shipyard labour as free wage labour or slavery is misleading. There were multiple types of dependency. In Swedish Finland, rural communities were taxed, conscripted to the military, and required to be transported and requisitioned. Sailors could be mobilized by systems that would have been very costly in terms of demographics and economics to local communities. The organization of the naval state was therefore a history of forced extraction as well. It is important to remember that the comparison should not obscure the difference between colonial slavery and state conscription. It, instead, questions the ways in which various maritime systems gained the capacity to command labour. Maritime expansion relied on a differential control of time, mobility, and body.

e Indian Ocean and Ships, Slavery, and Forced Mobility. Slaves were carried by Portuguese and Dutch maritime systems via the Indian Ocean. Indian Ocean slavery was a complex phenomenon involving various legal statuses, types of work, pathways, and social settings. It is not a wholly Atlantic plantation complex, but neither should its scale and violence be understated. Richard Allen, Markus Vink, Kerry Ward, and Matthias van Rossum have shown how European slave trading and forced migration played a significant role in the Indian Ocean. VOC networks transported enslaved Africans, Malagasy, South Asians and Southeast Asians between coastal settlements, islands, garrisons, households, workshops and agricultural areas. The Malabar Coast was also part of broader networks of enslavement, as evidenced by Dutch records of “Malabars.” (Cambridge University Press) These forced mobilities were made possible by ships. Captives were carried on the same sea transport as pepper and textiles. The slave-trading system included ports, warehouses, company records, credit, guards, and naval protection. Maritime and artisanal labour was also done by enslaved people, but this must be evaluated with care in each place. The connection between shipbuilding and slavery is thus direct and structural. Slaves could have worked in dockyards, transportation, provisioning or maritime service. In general, ships created the ability to capture, buy, and transport people over long distances. The ship was not only a neutral carrier later used for slave trading, but it was also a mobile and enclosed space that was a tool of social reorganisation. The Swedish-Finnish comparison sheds light on the particularity of this colonial system. Finnish subjects were conscripted, taxed and required to perform labour but were not in the same legal

situation as enslaved people carried in VOC networks. Comparative history is helpful here because coercion cannot be lumped together as one undifferentiated category. Maritime Archaeology and the Material Archive Written records document the classification of ships, labour and materials, but not the whole technological process. Maritime archaeology provides a material archive that can question documentary narratives. The Baltic is an ideal place for preservation. Wooden hulls and organic materials have been preserved by cold water, low salinity and the lack of destructive marine organisms. The sequence of construction, timber conversion, fastening, repairs, cargo, armament, and repeated use can be revealed by shipwrecks in the waters of Finland. Riikka Tevali's reinterpretation of two wrecks from the late sixteenth century in the Gulf of Finland illustrates the value of the historical process of going back to the archaeological record and not accepting inherited vessel identifications. The research on maritime archaeology in Finland has resulted in a significant amount of work on shipwreck documentation, underwater landscapes, cargoes and preservation methods. (Research Portal of the University of Helsinki) Official categories get complicated with shipwrecks. A ship that is documented as a commercial ship can be carrying weapons, while a ship that is presumed to be a warship may be displaying ordinary cargo, and repairs may demonstrate a long life of service over a series of different functions. Timber analysis can be used to identify construction areas or repair periods. Tool marks reveal the order of labour. Reused parts show economies of scarcity and maintenance. Tropical Indian Ocean is a more challenging preservation environment. Much organic evidence has been lost due to warm saline waters, marine life, coastal development, sediment transport and heavy re-use. This imbalance between Baltic and Malabar archaeology must therefore be handled in a methodological way. The more Baltic wrecks there are, the more sophisticated the technology in the north was not, since it is at least partly a function of differential preservation and archaeological investment. The reconstruction of malabar shipbuilding must be done by triangulating documentary evidence, archaeological remains, iconography, linguistic data, surviving tools, and ethnography, which is carefully contextualized. Later boatbuilding practices may retain elements of earlier knowledge, but cannot be extrapolated over time. Craft traditions were altered by colonial rule, mechanization, new materials, market changes and environmental degradation. Environmental Consequences and Resource Governance Forestry transformed forests into strategic landscapes.Forestry transformed forests into strategic landscapes. Trees turned into naval resources, rivers into transport routes, communities into sources of labour and knowledge. States and companies thus tried to control environments by means of surveys, monopolies, reservations, taxation and contracts. European demand in Malabar meshed with preexisting systems of forest access and political control. Competition for desirable species may increase as timber is harvested for ships, forts, buildings and trade. However, the extent and impact was different in different areas and times. To apply contemporary concepts of deforestation without re-creating past usage, regeneration and market demand patterns would be anachronistic. Naval timber and tar production helped commercialisation of forest resources in Finland. The burning of tar used resinous wood and might stimulate the spread of production to other districts. Strategic timber was a concern for the state, leading to regulatory activity, especially when oak supplies seemed to be at risk. These policies were early examples of resource governance, but their implementation was not consistent. Environmental knowledge might be co-opted via legislation. Forest inventories, estimates of available timber and information on transport were sought. However, local communities had practical knowledge that was not fully documented in administrative reports. The state science was thus dependent on the local expertise, and not just dominant. The maritime knowledge system was productive and destructive to the environment. It created advanced knowledge of wood, water, weather and preservation, and it also speeded up the

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extraction process. Technical knowledge did not necessarily produce conservation. If the value of trees increased, such as for commercial or military use, the ability to identify valuable trees could aid in their removal.

The module is designed to enable students to compare, connect, and understand the history of the world's oceans. There was no single bilateral trade between Malabar and Swedish Finland during the study period. They were connected to each other historically through broader Portuguese, Dutch, Swedish and Asian networks. An important connecting structure is provided by the Dutch commercial expansion. The Dutch Republic was dependent on supplies from the Baltic and at the same time had an Asian corporate empire. Dutch ships, capital, merchants and administrative practices were exchanged between maritime worlds even if Finnish timber did not reach Malabar, and Malabar teak did not regularly supply the Swedish shipyards. History, in other words, does not have to be based on the transportation of a particular object from one area to another. It can analyze institutions that functioned in various resource systems. European naval stores, international credit, shipbuilding capability, and Asian commodities were the sources of Dutch maritime power. The VOC's operations in Malabar and the Dutch involvement in Baltic trade were part of a broader political economy of shipping. The comparison also undermines the traditional dichotomy between European innovation and Asian tradition. Before the Portuguese came, Malabar had well established systems of long-distance trade, ship building, navigation, and merchant organization. The Swedish navy also grew not out of national genius but out of the ability to call upon the resources of Finland, the skills of the Dutch and the markets and labour of Europe. Both maritime worlds were not homogeneous in cultural or technical aspects. The terms “Indian Ocean,” “European,” “Malabari,” “Dutch,” “Swedish” and “Finnish” refer to analytically useful but internally diverse formations. Ports spoke more than one language, crews were interracial, ships were sold and resold, materials were transported across borders, artisans moved, and ships were captured and added to new fleets. A maritime knowledge-system approach thus moves away from civilizational comparison to institutional and material comparison. The questions that are relevant are not which society had better knowledge, but how knowledge was shared, who had access to resources, how labour was organized, and which institutions could develop maritime capacity over time. Conclusion Shipbuilding was at the heart of changes that are often referred to as the development of international trade, the formation of naval states and the rise of European empires between 1500 and 1700. But ships were not born out of the sea. They were brought together in terrestrial environments and social relations: forests, rivers, mines, farms, workshops, households, credit networks, dockyards, administrative offices, labour regimes. Two contrasting examples are Malabar and Swedish Finland, which are analytically connected. Malabar's shipbuilding heritage was part of a world of the Indian Ocean before the Europeans, and after European attempts at control. It was a maritime system that relied on hardwood ecologies, local shipwrights, merchant capital, pilots, port polities, and far-flung Asian commercial networks. European companies benefited from military and institutional benefits, but relied on local materials, labour and knowledge. Swedish Finland was involved in a Baltic system that was defined by forest resources, tar production, coastal transport, archipelagic navigation and the expansion of the Swedish navy. The territories of Finland were not just part of an independent Sweden. Their rural communities, sailors, craftsmen, forests and waterways were integral components of the material infrastructure that enabled Sweden to become a great maritime and military power. Maritime knowledge was shared and distributed in both areas. It was not only the navigators, officers, or educated specialists who used it, but also the timber cutters, tar burners, haulers, shipwrights, caulkers, smiths, rope-makers, pilots, sailors, merchants, and provisioning communities. Administrative

institutions tried to capture this knowledge by making materials and labour inventories, contracts, passes, regulations and accounts. This documentation helped states and companies to raise resources, but it did not end reliance on embodied knowledge. Commerce and coercion are also inextricably linked in the shipbuilding process. Commodities and ideas were transported by vessels, but so were weapons, soldiers, captives, and enslaved people. Monopoly, naval violence and forced mobility were all combined in Portuguese and Dutch maritime expansion in Malabar. The development of the Swedish navy was based on taxation, conscription and the exploitation of resources in a composite realm. These coercive systems were quite distinct but both illustrate the unequal ability to command labour, material and movement in the sea. The idea of shipbuilding as a maritime knowledge system thus provides a more comprehensive rethinking of early modern globalization. Merchants across oceans and empires taking over ports were not the only means of global connection. It relied on the reproductive systems that enabled ships to float: knowledge of how to find a tree, how to form a hull, how to keep a rope in good repair, how to pay for a voyage, how to navigate a coast, how to repair a ship after it was damaged. The comparison of Malabar and Swedish Finland brings shipbuilding back to historical analysis, and makes environment, science, labour, capital, and empire materially inseparable.

Notes

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