A NAUTICAL ARCHAEOLOGICAL STUDY OF
KUBLAI KHAN'S FLEETS

A Thesis
by
TAKAHIKO INOUE

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A NAUTICAL ARCHAEOLOGICAL STUDY OF
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Approved as to style and content by:

Kevin J. Crisman
(Chair of Committee)

Craig W. Kallendorf
(Member)

F. H. van Doorninck, Jr.
(Member)

Vaughn M. Bryant, Jr.
(Head of Department)

December 1991
ABSTRACT

A Nautical Archaeological Study of Kublai Khan's Fleets

(December 1991)

Takahiko Inoue, B.A., Hosei University at Tokyo

Chair of Advisory Committee: Dr. Kevin J. Crisman

A study of Kublai Khan's fleets constitutes the subject of this thesis. The purpose of this study is to collect, analyze, and interpret all available information pertinent to the Kublai Khan's invasion fleets of 1274 and 1281. Primary sources from China, Japan, and Korea, as well as secondary sources, have been consulted.

Chinese ships were the most advanced seagoing vessels in the world at the end of 13th century. However, little is known about Kublai Khan's fleets. Although many general works on the history of Kublai's invasions of Japan are available in the literature, there are no detailed studies of Kublai's fleets that combine data from both historical and artistic representations.

Discovery and excavation of one or more ships from Kublai Khan's fleets could greatly expand our knowledge of east Asian naval history, ship types and ship design. It is hoped that this study will assist in the search by providing a better understanding of what we should be looking for.
ACKNOWLEDGEMENT

The following treatise was realized only through the efforts of many people, to all of whom I am deeply indebted. To my wife and daughter, Sachiko and Miho, for their constant support and patience, to my parents for their unflagging encouragement and support, and, to Torao Mozai, professor at Tokai University, for persuading me to undertake studies in nautical archaeology, I am deeply indebted.

I am especially thankful to Dr. George F. Bass, Professor at Texas A&M University, for his constant guidance in completing my thesis study. I must also mention special thanks to Dr. F.H. van Doorninck, Jr., Professor at Texas A&M University, for his several leads and his painstaking work during the preparation and the final corrections of my thesis. I owe thanks to Dr. Patricia Stranahan, who served as a member of my advisory committee; to Dr. Craig W. Kallendorf, who agreed to replace Dr. Stranahan when she went on leave; and to Dr. Kevin J. Crisman, who stood in for Dr. Bass for my thesis defense.

During thesis research many Japanese individuals, institutes, and societies have also helped me with the warmest encouragement and instruction. To Dr. Shoji Kawazoe, Professor at Kyushu University, I owe thanks for introducing me to prominent scholars and valuable
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Three persons deserve special mention. Dr. D. Bruce Dickson, Professor of Anthropology at Texas A&M University, backed me up as a sophisticated editor. Dr. Donald H. Keith, Director of Ships of Discovery, advised me from time to time and gave suggestions on the basic ideas of my thesis. Dr. Li Jinping, Professor of Modern Language Department at Texas A&M University, helped me in interpreting difficult passages in ancient Chinese literature.

I would also like to thank Dr. Vaughn M. Bryant Jr., head of Anthropology Department, Dr. Gentry D. Steel, Professor of Anthropology, Mrs. Karen Taylor, student advisor, and Dr. Fred Hocker of the Nautical Archaeology program, for all the help afforded me during my thesis study.
Finally, I greatly appreciate my friends and colleagues for asking the right questions and providing appropriate criticisms throughout the course of the development of my thesis.
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I INTRODUCTION

In 1274 (all dates in this thesis are anno Domini) the Mongol Emperor Kublai Khan sent a fleet of 900 ships and nearly 40,000 Mongol, Chinese and Korean troops to Hakata Bay, Kyushu, Japan. His purpose was to conquer Japan (Song, 1912, vol. 208:13). After a day's successful fighting on land at Hakata, the Mongolian troops returned to their ships for the night (Ikeuchi, 1931:117-151). During the night, however, a fierce storm arose and the Khan lost 200 or more ships, 13,500 troops and, as a result, was forced to halt the campaign and withdraw (Ikeuchi, 1931:151). He vowed to return when better prepared. Seven years later, in 1281, the Great Khan arrived in Takashima (Fig. 1), Kyushu, with a mighty invasion fleet of as many as 4,400 ships and 140,000 troops (Ikeuchi, 1931:219-220). During the interlude between invasions, the Japanese shogun, Tokimune Hojho, had prepared coastal defenses, consisting of a stone rampart 2.5 m high and 20 km long, along the coast of Hakata Bay. Recognizing the strong defenses, the fleet chose instead to land at Takashima Island ca. 50 km to the southwest. In opposition to the vast army of the mighty Khan, the

This thesis follows the style and format of the International Journal of Nautical Archaeology and Underwater Exploration (IJNA).
Figure 1. Map showing Hakata Bay and Takashima Island.
Japanese could mount only a token defense. After a violent battle only a few Takashima residents were left alive.

However, before all of the troops landed, the vast fleet was destroyed by a monstrous typhoon, or kamikaze, known as the "divine wind". Estimates of the losses of men and ships suffered by the Mongolian fleet vary in different reports. Perhaps 4,000 ships were wrecked and 100,000 troops were lost. Kublai Khan was again forced to cancel his invasion plans and never mounted another attempt. Japan might have become a part of China had it not been for this timely and fortuitous intervention by nature; thus the kamikaze assumed its position as an incident of major significance in Japanese history (Ikeuchi, 1931:308-316).

To help clarify this momentous historical event, the Takashima seabed was chosen as one of the experimental research areas for a basic, underwater archaeological study. This study was part of the 700th anniversary celebration of the Mongolian invasion. Although scientific research has not been done in this area before, several kinds of artifacts such as jars, bowls, and stone anchor-stocks have been found accidentally on the seabed by the local fishermen (Takashima Kyoiku Iinkai, 1984:1).

Three seasons (1980, 1981 and 1982) of underwater archaeological surveying of the Takashima seabed were undertaken by a Tokai University team, but no direct evidence of the ships sunk by the kamikaze was found (Mozai
1982:634-648). Although other surveys have been conducted since 1982, the ships have remained elusive. To date, a number of artifacts thought to represent the remains of the Khan's fleet have been found in the area, both in the sea and on land: a bronze statue, Mongolian metal helmets, a sword, a bronze seal, an iron ingot, iron stirrups, iron and copper nails, earthenware jars, stone anchors, stone bowls, stone mortars, and other objects (Oe, 1982:173).

Chinese ships were the most advanced seagoing vessels in the world at the end of 13th century. However, little is known about Kublai Khan's fleets. Although many general works on the history of Kublai's invasions of Japan are available, there are no detailed studies of Kublai's fleets that combine data from both historical documentation and artistic representations. Little is known concerning types of vessels, such as battleships, troop and horse transports and water carriers. Nor is much known about their sizes, or whether they were Chinese- or Korean-built ships. Furthermore, what kind of propulsion they used, what kind of wood was employed in them, and what methods and materials were used in caulking and sheathing them remain unknown.

Little is known about Chinese, Korean or Japanese ships in the late medieval and early modern periods (South Song, Yuan, and Ming dynasties). Two archaeological examples of Chinese ships built between 1271 and about 1340
(Fig. 2 and Fig. 33 which appears on Page 91) indicate that they were the largest and most technologically advanced seagoing vessels in the world (Keith, 1980:43).

The purpose of this thesis is to collect, analyze, and interpret all available information pertinent to the Kublai Khan's invasion fleets of 1274 and 1281. Primary sources from China, Japan and Korea, as well as secondary sources, have been consulted.

Discovery and excavation of one or more ships from Kublai Khan's fleet could greatly expand our knowledge of east-Asian naval history, ship types and ship design. The present study, based on nautical archaeology, will provide a better understanding of the fleets used in Kublai Khan's invasions and help researchers who search for Kublai Khan's fleets to know what to look for.

Sources of Information

Information came from primary and secondary sources in Chinese, Japanese, Korean and English. Historical documents were mainly derived from Song's **Yuan Shi** (History of the Yuan dynasty), written sometime between 1368 and 1398 and reprinted in 1912; Chung's **Koryo Shi** (History of Koryo), first published in 1451 and reprinted in 1908; Seo's **Dong Kuk Tong Gann** (The total history of the East Country), printed in 1485 and reprinted in 1667; Kim's **Koryo Sa Jul Yo** (Summary of Koryo history), published in
Figure 2. Plan of the Song ship recovered at Quanzhou Bay in China (Quanzhou wan Song dai hai chuan fagu yu yanjian, 1987:7, Fig. 3).
1452 and reprinted in 1932; and an anonymous 13th-century (c. 1285-1290) Japanese description of Kublai Khan's invasions known as the *Hachiman Gudoki*, reprinted in 1889. Ikeuchi's modern analysis, *Genko no Shinkenkyu* (A new study of the Mongol invasion, 1931) was also informative.

The historical and artistic sources of information about Chinese vessels are found in ancient Chinese literature dating to the Song, Yuan and Ming Dynasties. The sources most useful to a study of Kublai Khan's fleets either directly or indirectly include: Xu's *Xuan He Feng Shi Gao Li Tu Jing* (Illustrated record of an embassy to Korea in the Xuan He period, 1123-1153, reprinted 1921, and commonly referred to as *Gao Li Tu Jing*); Chou's *Lin Wai Tai Ta* (Information of what is beyond the passes, 1178, reprinted 1921); Tseng's *Wu Jing Zong Yao Jian Ji* (Collection of the most important military techniques, 1044, reprinted 1959); Song's *Tian Gong Kai Wu* (The exploitation of the works of nature, 1637, reprinted 1929); Shen's *Nan Chuan Chi* (Records of southern ships, 1541, reprinted 1982); Mao's *Wu Bei Zhi* (Treatise on armament technology, 1621, reprinted 1672); Xuan's *Cao Chuan Shi* (History of rowing ships, 1521-1565, reprinted 1941); Zheng's *Zhou Hai Tu Bian* (A pictorial book on sea and sea warfare, 1563, reprinted 1974); and Li's *Lung Chiang Chuan Chang Chih* (Record of the Lung Chiang Chuan shipyards, 1551, reprinted 1985). Pao's modern analysis, *Cheng Ho Xia*
Xi Yang Chi Pao Chuan Kao (On the ships of Cheng Ho, 1961), was also useful.

The Moko Shurai Ekotoba are illustrated scrolls that depict the Mongol Invasions of Japan. They were composed some years after the invasions and constitute one of the most important sources of evidence about Kublai Khan's fleets (Takeuchi, 1931). In addition, Kegon Engi Emaki, an ancient Japanese scroll (Ishii, 1959), Shiba's 1966 article on the basic structure of Song shipping, "Sodai Unsen-gyo no Kiso Kozo", and Yabuuchi's Ten Kou Kai Butsu no Kenkyu (1955), a modern interpretation, are valuable Japanese sources.

Some explanation regarding the ancient Oriental sources is necessary. Those consulted have been reprints, mainly from the 19th and 20th centuries. Date of publication or authorship (whichever best indicates the period in which the material was composed) must be converted to the Gregorian calendar. In many cases, the best date obtainable is an estimation of the author's lifespan or of the historic period in which the document was compiled.

The accounts of European and Arab visitors to China during this period have also been consulted. These include Travels of Marco Polo (Yule, 1929) and Travels of Ibn Bututa (Lee, 1829). Needham's Science and Civilisation in China (1971) has also been valuable. Finally, the
following archaeological sources have been cited: Quanzhou
wan Song dai haichuan faqu yu yanjiu (Excavation and study
of Song dynasty shipwreck at Quanzhou Bay, publication of
Fujian shen hai wai jiao tong shi bo wu guang, 1987),
"Quanzhou wan Song dai hai chuan fu yuan cu tan " (The
reconstruction of the Quanzhou Bay ship after recovery,
publication of Quanzhou wan Song dai hai chuan fu yuan xiao
zu Quanzhou zhao chuan chang, 1975), and Sinan Haejeo Yumul
(Artifacts from Shinan sea bottom, 1984 and 1988).
II HISTORICAL BACKGROUND

In the late 12th century a powerful Mongolian king, Genghis Khan, had a special organization of troops that was peculiar to the Mongols. He started some large-scale wars to conquer other countries; as a result, he extended his territory to Manchuria in the east and to central Asia and to South Russia in the west (Nihon no Rekishi, 1953:252-281).

In 1260 the grandson of Genghis Khan, Kublai Khan, succeeded to the Mongol throne. He conquered the Song dynasty of southern China within twenty years and succeeded in ruling the whole of China. Under him the Mongol empire controlled a vast territory spreading from the east to the west on the Eurasian continent (Nihon no Rekishi, 1953:253).

The Koryo Kingdom (Korean Peninsula) in east Asia abandoned its policy of resistance to the Mongols in 1257 and became an obedient tributary state (Table 1). After his conquest of Korea, Kublai Khan turned to attack Japan. His motive in this was his desire to extend his territory and secure commercial dominance in east Asia (Nihon no Rekishi, 1953:257). Kublai heard from the Italian traveler, Marco Polo, that Japan had unlimited wealth, so he planned to possess the island (Yule, 1929:253-255). It appears, then, that Kublai's design was not just for
TABLE 1. CHRONOLOGY OF DYNASTIES

CHINA          KOREA          JAPAN

<table>
<thead>
<tr>
<th>Year</th>
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<tr>
<td>1300</td>
<td>MING 1368-1662</td>
<td>1300</td>
<td>LI 1392-1909</td>
<td>1300</td>
<td>MUROMACHI 1336-1573</td>
</tr>
<tr>
<td>1200</td>
<td>YUAN 1234-1368</td>
<td>1200</td>
<td>MONGOL DOMINATION 1259-1356</td>
<td>1200</td>
<td>KAMAKURA 1185-1333</td>
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<tr>
<td>1100</td>
<td>SONG 1127-1279</td>
<td>1100</td>
<td>SOUTH SONG 918-1391</td>
<td>1100</td>
<td>TAIWA 1160-1185</td>
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<td>SONG 960-1126</td>
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<td>HEIAN 794-1159</td>
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political conquest but also for gold, mercury, pearls, and other products that were produced in Japan in those days (Mori, 1948:515).

Kublai sent messengers five times between 1266 and 1270 with letters to urge Japan to pay him tribute, and he ordered Koreans to guide them and to persuade Japan (Takeuchi, 1931:6-8); however, the words in his letters which hinted at an appeal to arms stiffened the attitude of Shogun Tokimune Hojo in the Kamakura Shogunate. The Shogun hacked the messengers to pieces with swords to demonstrate his firm resistance to the desires of the Great Khan (Takeuchi, 1931:6-8). As a result, Kublai sent several of his commanders to Korea in 1270 and planned to station Mongolian soldiers in the Kin district, a point of departure for ships, and let Korean vessels gather there. In this way, he prepared to advance on Japan (Song, [1368-1398] 1912, vol. 208:13).

Early in 1274, the government of Korea was ordered to build 900 vessels: 300 big vessels, 300 fast lighters called batur, and 300 small water carriers. The warships were built according to Korean design because Chinese-styled vessels cost much more (Ikeuchi, 1931:124). The shipyards were at Byun San and Chon Ack San Mountain in Chon Chu Do (Chon Ra Do). Both places were near abundant wood supplies (Yamada, 1891:32). On October 3, 1274, 39,700 soldiers of the two countries, Yuan and Korea,
boarded the 900 warships and left Hapoo (Masan) for Japan. After they landed and took Tsushima and Iki Islands, they approached Hakata Bay in Kyushu on the morning of October 20 (Yamada, 1891:10-13). Both the Mongolian and Japanese troops fought very hard (Fig. 3).

Fortunately for the Japanese, the Mongolian troops did not stay in Hakata, but returned to their ships for the night (Ikeuchi, 1931:151). That evening, a big storm came up, and many warships were driven against the quay and wrecked. This greatly shocked the Mongolian troops. The dead of the allied Mongolian and Korean forces was more than 13,500, including both those killed in battle and drowned at sea. The rest fled back to Hapoo in Korea (Ikeuchi, 1931:148-151). The Hachiman Gudoki said that "every Mongolian vessel went away" ([1285-1290] 1889, vol. 1: no page number).

After the Mongolian departure, the Kamakura Shogunate built a stone rampart along Hakata Bay, c. 2 m high, 1.2 to 1.8 m wide, and 20 km long, to prepare for the next Mongolian attack. In addition, they drove 2-meter stakes at the mouth of a river where the enemy could easily land. They also moored large and small warships there in preparation for the attack (Aita, 1958:184-207).

In 1279, Kublai Khan again ordered Korea to build 900 ships (Ikeuchi, 1931:210). Preparations were made to permit the troops to stay on board the ships for a long
Figure 3. Battle on the land between Mongolian soldiers and Japanese warrior (From Takeuchi, 1931, plate 13).
time; besides daily necessities, spades, hoes, and seeds for cultivation were loaded on the vessels (Nihon no Rekishi, 1953:269).

In 1281, Kublai's forces were separated into two groups and attacked Japan with 4,400 warships and 140,000 soldiers. They organized 40,000 Mongolian, Korean, and Northern Chinese soldiers, called East Route troops, with 900 ships; and 100,000 former South Song soldiers, called South Route troops, with 3,500 ships (Ikeuchi, 1931:226-227). The 3,500 warships of the South Route troop were made in China (Ikeuchi, 1931:275). Marco Polo wrote: "When I came to Zaitun (Quanzhou city, Fujian province), many of Kublai's warships were equipped near the river" (Yule, 1929:142).

On May 3, the East troops gathered in Happo (Masan) in Korea. They departed for Japan, next moored at a small island called Gu Jae Do, and invaded Tsushima Island on May 21 and Iki Island on May 26 (Ikeuchi, 1931:226-227). The East troops, who approached Hakata Bay in June 6, fought hard against the Japanese troops on the sea and the land around Shiga Island and Noko Island. The East Route troops invaded Hakata Bay first. However, they found a fort there and so planned to occupy Shiga Island first. They tried to advance toward Hakata not only from the sea but also from the land, but the Mongolian troops could not achieve their purpose and at last retreated to Takashima (Ikeuchi,
1931:232-234). In *Hachiman Gudoki* the circumstances were described thus:

Mongolian troops attacked Tsushima Island. After the attack was reported to Hakata, most all people were confused, wept and cried out —— the Japanese Samurai Jiro Kusano with two boats tried to attack Mongolian vessels in the night. He boarded an enemy vessel, and he returned after burning the vessel. After that, the Mongolian vessels were very carefully chained together against Japanese attack. —— [The Mongolians] hurled stones and arrows from their big vessels against the attackers; since the Japanese boats were small, they were damaged. —— The Mongolian fleet finally rowed to faroff Takashima ([1285-1290] 1889: no page number).

On June 16 (Song, [1368-1398] 1912, vol. 154:4), the South Route troops set sail near Qing Yuan (Ningpo). However, they made a mistake in the military operation and met in Hirado Island on July 3 or 4, behind schedule by about half a month. The meeting place was also changed from Iki Island to Hirado Island (Ikeuchi, 1931:296-305). They gathered their troops on Takashima in Imari Bay on July 27, and they finally intended to start a genuine war by advancing to the Japanese mainland (Ikeuchi, 1931:296-305).

On August 1, 1281, a horrible wind arose at midnight and the Mongolian fleet was terribly damaged (Song, [1368-1398] 1912, vol. 161:39). The *Hachiman Gudoki* described the event:

> From midnight a strong wind blew up. Most all of the enemy's vessels drifted and sank in the sea. The commander's boat ran away trembling with fear. The remaining vessels were broken and thrown up on the shore. The rest of them drifted
like scattered poles on the surface of the sea. The bodies of dead soldiers were piled up like buildings on an island ([1285-1290] 1889: no page number).

The *Koan Yonen Nikki-sho* ([1281] 1917: no page number) also described how the enemy ships met a terrible wind during a day and a night and said that most of them were wrecked and broken everywhere. The commander, fearing the storm, chose strong vessels, left behind more than 100,000 soldiers, and hurried back to Korea (Song, [1368-1398] 1912, vol. 208:15). Casualties were more than 100,000 among the Yuan troops and more than 7,000 among the Korean troops (Dong Kuk Tong Gann, 1915:21). The Mongolian troops lost 70 to 80 percent of their forces; the survivors returned to Happo in Korea. The remains of Yuan's wrecked ships covered the whole surface of the sea in Takashima. If the accounts are correct, Kublai's invasion ended in one of the greatest maritime disasters in world history.

Location at Takashima

Takashima (Eagle Island) is located at the entrance to Imari Bay on the northwestern part of Kyushu Island. It covers an area of 17.6 square km and supports a modern population of 3,500 (Takano, 1991:3).

The safest anchorage is on the southern coast of Takashima at the entrance to Imari Bay. At this point the average current velocity is only 0.2 km per hour, since Takashima itself serves as a huge breakwater. This
suggests that the anchorage for Kublai Khan's fleet was limited to the southern coast of Takashima. Thus, it is reasonably certain that the main fleet of Kublai Khan moored off the southern shore (Koga, 1982:23).

A number of artifacts were found in this area by the local fishermen long before the Takashima area was recognized as the probable staging area for the Mongolian invasion. However, no artifacts have been found on the seabed of the west coast of Takashima during the last 100 years (Takano, 1991:3). Artifacts found on the south shore indicate that vessels might also have sunk in this area and that the remains of the sunken fleet lie on the seabed of Takashima.

Most scholars agree that both the archaeological research and existing ancient documents identified Takashima as the staging area for the Great Khan's invasion. In 1982 this consensus led the Japanese government to declare a portion of the area as a cultural resources management area. Altogether some 7.5 km of the south coast of Takashima, from Higaribana in the east to Cape Ikazuchi in the west, were included in this area. The protected area extends outward 200 m from the beach (Takashima Kyoiku Iinkai, 1984:1).

In 1984, in order to construct a breakwater at Tokonami Harbor at Takashima, emergency excavation and research was carried out. The emergency excavation and
research team excavated animal bones, porcelains, earthenware, jars and two small pieces of wood with tool marks and nail holes (Takashima Kyoiku Iinkai, 1984:9-17). In March 1990, the study of the cultural resources management area where Mongolian sites may be found was begun by the Japanese Ministry of Education Foundation. Under the direction of Tadashi Nishitani of Kyushu University, research with the use of a side-scanning sonar was begun. The purpose of this research was to examine annual changes in the seabed at Takashima. The team searched the entire cultural resources management area from Higaribana to Ikazuchi Cape, which faces Imari Bay (Oyo Chishitsu Co. Group, 1990:1).

A number of anomalies were identified buried 10 m to 12 m beneath the seabed in the cultural resources management area offshore of Funatotsu, Urashimo-ura, and Tononoura Harbors (Oyo Chishitsu Co. Group, 1990: 1-35). This is where the field research stands at present.
III LITERARY AND REPRESENTATIONAL EVIDENCE

Ships from Historical Records

There is no definitive record of the ships used by the Mongol invaders; however, the Gao Li Tu Jing provides some useful clues. It is a document written by Xu Jing between 1123 and 1153, while he stayed in Korea for a month as the ambassador from China during the Song dynasty (960-1280). This text contains an important description of a type of large Chinese seagoing vessel used very frequently in the East China Sea, a passenger vessel called kho chou, a Fujian-built ship that carried the ambassador's staff. The specific dimensions and structure of the seagoing merchant vessel are provided. It is reasonable to assume that it represents a typical Chinese seagoing vessel of its time (Shiba, 1966:448-449).

During the Yuan dynasty (1280-1368), shallow-draft seagoing vessels were used to transport rice collected as a tax (Fig. 4). The structure of government' rice-carrying vessels remained the same through the following Ming dynasty (1368-1644). The construction of such vessels during the Ming dynasty is described in the Tian Gong Kai Wu (Song [1637] 1929).

Let us now turn to the design and structure of Chinese vessels as described in various passages in the literature of the Song, Yuan and Ming Dynasties.
Figure 4. A rice-carrying vessel at the beginning of the Ming Dynasty depicted in the *Tian Gong Kai Wu* (Song, 1929:38, vol. 9).
Dimensions and Capacities

According to the Gao Li Tu Jing (Xu [1123-1153] 1921, vol. 34:4), the passenger vessel was about 10 chang (c. 30 m) long, 2 chang and 5 chi (c. 7.5 meters) wide, and 3 chang (c. 9 m) deep. It carried a crew of 60 people and had a carrying capacity of 2,000 shi (c. 140 tons, see Table 2).

Ships from South China were reported to have huge cabins and masts. One ship could carry several hundred people and a year's provisions. Pig raising and liquor brewing were done on board. The cargo capacity of these ships was great. They did not have to fear big waves, but had to be careful in shallow water. In the country to the far west (scholars disagree where this is) there was a ship which could carry 1,000 people (Chou, [1178] 1921:7-8). Wu also noted the following:

There are various sizes of ocean-going merchant vessels, and their sizes are not uniform. The large ones, 5,000-liao ships, can carry about 500 to 600 people, and the medium ones, 1,000 to 2,000-liao ships, can carry about 200 to 300 people. The zuan-feng chuan (Boring-into-Wind ship) was capable of carrying around 100 people ([1127-1278] 1890, vol. 12:13).

Liao is a timber measure unit in China. One liao is equivalent to 7 cubic chi or 2.15 cubic meters (see also Table 2). Ibn Batuta also states that Chinese vessels could carry over 1,000 people (Lee, 1829:172). Marco Polo talks about Chinese vessels carrying crews of between 200 and 300 men (Yule, 1929:250).
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<th>SONG</th>
<th>YUAN</th>
<th>MING</th>
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<tbody>
<tr>
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<td>3.11 m</td>
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<tr>
<td>chi (尺)</td>
<td>0.3072 m</td>
<td>0.311 m</td>
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<tr>
<td>cun (寸)</td>
<td>0.03072 m</td>
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<td>0.0311 m</td>
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<td>WEIGHT</td>
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<tr>
<td>shi (石)</td>
<td>71.618 kg</td>
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<tr>
<td>jin (斤)</td>
<td>596.82 g</td>
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<td>liang (两)</td>
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<td>qian (钱)</td>
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<tr>
<td>liao (石)</td>
<td>28.99 l</td>
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<td>30.08 l</td>
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<td>7.0 cubic chi</td>
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The Song Hui Yao Ji Gao states: "The 1,000-liào hai-hu (Sea-hawk) vessel was 11 chang (c. 33 m) long. It can carry 108 soldiers and 42 crewmen. The 400-liào tie-bi hua-zui chuan (Iron-Wall Mouth ship) was 9 chang 2 chi (c. 27.6 m) long. Seventy soldiers and 20 crewmen were carried" (Xu, [1403-1425] 1936, vol. 50:33). According to the Lao Xue-an Bi Ji (Lu, [1125-1209] 1965, vol.1:2-6), 400-liào ships with eight oars were 8 chang (c. 24 m) long, and Sea-hawk ships with 4 oars were 4 chang and 5 chi (c. 13.5 m) long. The Lao Xue-an Bi Ji also speaks of warships 36 chang (c. 108 m) in length, 4 chang and 1 chi (c. 12.3 m) in width, and 7 chang 2 chi and 5 cun (c. 21.75 m) in height. The enormous length and 9 to 1 length-to-width ratio attributed to these warships do not seem credible.

Hull

A section of the Gao Li Tu Jing describing the passenger vessel states that it was built with huge timbers. It further states that the upper part of the bow was flat (most likely referring to a transom), in contrast to the bottom of the bow which was angular in order to minimize resistance to the waves. The forwardmost and aftermost sections of the vessel consisted of empty space for buoyancy. The hold was divided into three compartments. The forward compartment was located between the fore- and
mainmast and may have been uncovered; however, a galley and a water container were located in the bottom of this compartment. A space beneath the compartment was used as a cabin by the crew. The main compartment was divided into four sections and used, most likely, for cargo storage. The after compartment was a cabin for officers or special guests. A deckhouse used for similar purposes rose to a height of about three meters above the deck. It was surrounded by windows and doors and was furnished with railings and paintings to improve the atmosphere. A windlass, supported by two bitts, was located at the bow. This windlass was used to haul up the wooden anchor, which was connected to the ship by a 500-chi (c. 153.60 m) rattan rope (Xu [1123-1153] 1921, vol. 36:4-5).

According to Marco Polo, Chinese vessels that sailed to the Indian islands had only one deck. One large vessel described by Polo had a hold with thirteen compartments constructed from thick, strong planks and had a double-planked hull. Planks were fastened tightly with iron nails (Yule, 1929:249-250).

According to the Song Hui Yao Ji Gao section on warships, the hold of the 1,000-liao Sea-hawk vessel was divided into eleven compartments. The widest bulkhead was 1 chang 8 cun (c. 5.4 m) wide and the middle of the hold was 8 chi 5 cun (c. 2.55 m) deep. Bottom planking was 4 chi (c. 1.2 m) wide and 1 chi (c. 0.3 m) thick, and a
rudder was 3 cun (c. 9 cm) thick. The 400-liao Iron-Wall Mouth ship also contained 11 compartments. The widest bulkhead was 1 chang 5 chi (c. 4.5 m) wide and 5 chi (c. 1.5 m) deep. The ship bottom was 8 chi 5 cun (c. 2.55 m) wide and 6 cun (c. 18 cm) thick. The rudder was 3 cun (c. 9 cm) thick (Xu [1403–1425] 1936, vol. 50:33).

Construction - Materials

In Zhong Muji, Lu mentioned that the provinces of Fujian and Guangdong were known for their advanced shipbuilding technology.

The timber from the southern region is good for shipbuilding; therefore, the Fujian ships were the best seagoing vessels. Ships from Guangdong and further to the west are second in rank, and ships from the Wen and Ming districts are third. Timber from the northern regions was not suited to shipbuilding as seawater ruined the wood; therefore, vessels made of it lacked durability and were inappropriate for sea voyages. These vessels also were incapable of adequately coping with wind and waves and, therefore, ran a considerable risk of capsizing ([1134] 1934, vol. 2:14).

Chou describes the rudders as follows:

Two unusual kinds of trees can be found in the Qin district. The tsu-ching-mu (purple thorn tree) is as hard as iron or stone. Therefore, it is used for beams, and often lasted for several hundreds years. The wu-lan-mu tree is also used for rudders on big vessels. These types of wood from the Qin district were purchased and sold at high prices to shipyards around Wen and Guang districts ([1178] 1921, vol. 6:10).

According to Marco Polo, fir trees and pine trees were used to build Chinese ships that went to the Indian islands (Yule, 1929: 249-251).
Tian Gong Kai Wu also stated that:

Straight cedar wood was used for masts. When the wooden timbers were not long enough, they were joined together with other timbers and bound with iron bands every 1 gun (c. 3 cm). Nan-mu, chu-mu, camphor, elm, and sophora wood were used for hull timbers and bulkheads. All kinds of wood were used for deck planking. Elm, palm, iron, and chu-mu wood were used for rudder posts, and zhou-mu and palm for tillers. Oars were made from catalpa, fir and juniper wood (Song, [1637] 1929, vol.9:34).

During the Yuan dynasty, Sa made detailed records of the materials and rigging of a 100-liao ship. According to him, these ships were 40 chi (c. 12 m) long, 1 chan and 2 chi (c. 3.6 m) wide, and 3 chi (c. 0.9 m) deep. One example was composed of 223 planks, 24 pieces of bottom planks, 12 timbers for the bulkheads, 24 pieces of "wall pillars", 1 piece for the tiller, and 4 timbers for the rudder post. Other materials included miscellaneous oils, lime, linen, poles, bamboos, sails, and nails (Sa, [1338] 1922:13-14).

According to the Cao Chuan Shi, the materials required to build a 1000-liao seagoing vessel were as follows:

302 fir timbers, 149 miscellaneous timbers, 20 trunk timbers, 2 elm-wood rudder posts, 2 chestnut timbers, 38 branches of wood for steering oars, 35,742 cable yarns, 3,012 jin and 8 liang (c. 1,800 kg) of tung oil, 9,037 jin and 8 liang (c. 5,395 kg) of lime, 1,253 jin and 3 liang (c. 1,253 kg) of linen for caulking, 1,294 jin (c. 772.5 kg) of hemp fibers, 885 jin (c. 528.3 kg) of yellow rattan, 20 jin (c. 11.9 kg) of jute fibers, and 2,283 jin and 12 liang (c. 1,362.98 kg) of palm fibers (Xuan, [1521-1565] 1941:29-32).

There is also mention of 161 pieces whose function remain unidentified.
Materials for building a 400-liao zuan-feng hai chuan

(Boring-into-sea ship) were as follows:

228 fir timbers, 2 masts, 20 branches of wood for steering oars, 5 pine timbers, 18,580 cable yarns, 94 pieces of miscellaneous—, 1,001 jin 15 liang (c. 598.2 kg) of tung-fish oil, 3,005 jin 13 liang (c. 1,794.5 kg) of lime, 729 jin 8 liang 8 qian (c. 435.5 kg) of linen for caulking, 574 jin 14 liang 4 qian (c. 343.7 kg) of hemp fibers, 383 jin 8 lian (c. 228.9 kg) of yellow rattan, 703 jin (c. 419.7 kg) of palm fibers, and 10 jin (c. 5.97 kg) of jute fibers (Xuan, [1521-1565] 1941:29-32).

Here too, there were 94 pieces whose function remain unidentified.

Construction - Method

The Tian Gong Kai Wu said:

Shipbuilding begins by constructing the bottom of the hull. Construction continues by adding additional strakes up to the level of the deck. Bulkheads are placed to partition the ship into appropriate spaces. The upper part of the hull is covered by large timbers. The position of the mast is in front of a bulkhead called the 'anchor altar'. The base of the mast fits between the horizontal bars of the mast step. The ones [bars] located in front and back [of the mast] are called fu shi [lion-tamers], and the one below [them] is called na shi [lion-grasper]. The wood closure pieces under the fu shi are called lian san fang (triple tie-bars). There is a square hatchway in the bow called shui jing. Ropes and cables are stored below.

Two posts were placed near the bow, and bowlines were tied around them. These were called general's posts. The part below the stern that was slanting upward (probably the transom) was called the grass-sandal bottom (Song, [1637] 1929, vol. 9:30-33).

Caulking

According to Chou, large amounts of nails, lime, small
pieces of linen, and tung oil were used to caulk the hull ([1178] 1921, vol. 6:9). According to Marco Polo, the bark of the Chinese black pine was used as caulking material. Polo mentioned that linen was cut into small pieces and mixed with lime and resin. The resulting mushy substance was applied over the entire surface to seal and protect the hull. This method was considered better than simply using pitch (Yule, 1929:250).

Tung and fish oils were mixed with lime which had been sifted through a sieve. Fine linen was added to the mixture. This mixture was then used to saturate shredded white jute fibers. These fibers were pounded and inserted in the seams between the planks with a mallet and a dull chisel. In the Wenzhou, Taizhou, Fuzhou, and Guangzhou districts, oyster-shell ash was used instead of lime. Lime was used only after it was refined by fire, for after refinement lime does not change in quality when put into water. After caulk ing, a protective coating was usually applied. In some cases tung oil was used because of its toxicity (Yabuuchi, 1955:336).

Maintenance

According to Marco Polo, large vessels were inspected and repaired after a year of voyaging. Ships were recaulked and additional wooden sheathing was sometimes applied over all the original double planking. The
sheathing was fastened by nails. This was repeated until six layers of planking had been added to the ship. At that point, the ship was discarded and never used again for sea voyages (Yule, 1929: 251). According to the Wu Bei Zhi, bottoms had to be burned by brushwood. The purpose of breaming was to kill shipworms and to remove seaplants from the bottoms (Mao, 1672:16, vol. 116). This same method was used to maintain Western ships (Goelete, 1986:238-242).

Rigging and Propulsion

For Gao Li Tu Jing's passenger vessel, sails provided the main propulsive force, but when the vessel was entering a port or encountering a fast current, ten oars were used on either side. There were two masts. The mainmast was 10 chang (c. 30 m) tall, and the foremost was 8 chang (c. 24 m) tall. When the wind was fair, 50-fu cloth sails were used (Needham [1971:602] interprets "50-fu" to mean having 50 strips of cloth; Professor Li Jinpeng informs me that in ancient China a 1-fu strip of cloth was roughly 1.5 to 1.7 chi in width). When the wind blew variably, mat sails were hoisted and the sails stretched left and right like wings. Another sail, the small, 10-fu topsail, also known as ye hu fan (wild fox sail), was deployed above the mainmast (Xu, [1123-1153] 1921, vol. 34:5).
Tian Gong Kai Wu also mentioned the following:

A large ship with a length over 10 chang (c. 33 m) always needed 2 masts. The mainmast was set 2 bulkheads before midships. The foremast was placed 1 chang (c. 3.3 m) in front of the mainmast. The mainmasts of rice-carrying boats were about 8 chang (c. 26.4 m) tall. Mainmasts 10 to 20% shorter than 8 chang (c. 26.4 m) were occasionally used. The bottom of the mast, over 1 chan (c. 3.3 m) in length, was within the cabin. The sail was about 5 to 6 chang (c. 15-18 m) in height. The foremast was shorter than half the size of the mainmast, and the dimensions of its sail were less than 1/3 that of the mainsail. Above the helmsman on the afterdeck was the wild fox sail. One person sat and controlled the sheets of the sail during the voyage. The front of the cabin had a vacant space that was convenient for setting the mast. Mainmasts were layed on a row of a few boats, and they were stepped by attaching a long rope at their ends. Anchors, cables, sails and masts were made according to strict standards (Song, [1637] 1929, vol. 9:30-33).

According to Marco Polo, Chinese vessels that went to the Indian islands generally had four masts. In addition, two auxiliary masts were used when necessary during a voyage. Long oars were used when there was no wind. Four rowers were necessary to move each oar (Yule, 1929:250).

In a discussion about taxes on a rice-carrying vessel, the Tian Gong Kai Wu reveals that the standard of a sail's length was determined by the width of the hull. If a sail was too short, sailing efficiency suffered. Conversely, if a sail was too long, it was dangerous to use. A sail was made from split and interwoven bamboo. The mainsail of a rice-carrying boat needed a crew of ten to hoist it to the top. However, only two crewmen were required to hoist the fore- sail (Song, [1637] 1929, vol. 9:31-32).
When Lu Yu went to Shu (Shi Chuan) district, during the Song dynasty, he sailed on a ship with a mast 5 chang and 6 chi (c. 16.8 m) tall that used a 20-fu sail (Lu, [1125-1209] 1934:227).

Steering

According to the Gao Li Tu Jing, a passenger vessel carried two rudders, one large and one small. The different rudders were used according to the depth of water (Xu, [1123-1153] 1921, vol. 34:5). A rudder post could be up to several chang in length. A single, straight piece of wood was used (Chou, [1178] 1921:10). The 33 m rice-carrying boat had a rudder 3 chi (c. 90 cm) wide and 1 chang (c. 3 m) long. A tiller was inserted in the upper part of the rudder post, and a deep cutting was made in its lower part into which the rudder was inserted and fastened with iron nails. As a result the rudder with its post is shaped like an axe (Song, [1637] 1929, vol. 9:33).

According to Needham, steering oars, which were also employed, were called san fu duo, literally meaning the third-assistant rudder. One of these projected from either side of the after section of the deckhouse. They were used when the vessel was under sail (Xu, [1123-1153] 1921, vol. 34:5).
Anchors

Wooden anchors were constructed by putting a long, square, stone stock between two hook-shaped pieces of wood. A single anchor was used under most circumstances, but when the winds and the waves were strong, secondary and tertiary anchors were used (Xu, [1123-1153] 1921, vol. 34:5). A temporary anchor was used in an emergency. Such anchors were made of tung wood, and because tung wood is light in weight, they would have been easily handled by only a few crewmen in an emergency. The surface of these anchors was charred to a depth of 1 cun (c. 3 cm). The purpose of charring was to harden the wood and make it more resistant to abrasion (Mao, 1672:23).

Korean-built Ships

The shipbuilding techniques of Korea were simple; ships with only 1 mast were usually made. Xu also described an official Korean boat:

The roof of the official boat is covered with a type of grass. Below that there is a cabin with a door and a window. A fence surrounds the ship's deck. The upper part of the cabin is more spacious than the lower part. Bulkheads are not used in the hull; instead, slightly-curving thwarts are used. There is a windlass for the anchor in the bow. The mainmast used a cloth sail of over 20-fu. The bottom one-fifth of the sail is left unsewn in order to ease strong wind resistance. The size [of these boats] is the same, but the decorations vary (Xu, [1123-1153] 1921, vol. 33:1, Official Boat).
Two Basic Types of Chinese-built Ships

The two basic types of Chinese ships are those made in Guangdong and those made in Fujian (Pao, 1961:40-41).

The Guangdong ship was the general name for all ships built in Guangdong. The hai-xiang chuan (Gigantic Sea-eagle ship) of the Yuan dynasty and 1,000-liao seagoing vessel of the Ming dynasty were examples of this type (Fig. 5). Guangdong ships were made from ironwood which grew in the region. This expensive wood was harder and more durable than pine or fir. Consequently, the cost of Guangdong ships was twice the cost of Fujian ships. The bow and stern were in the shape of a sea-eel (Pao, 1961:41). The lower part of the hull was narrow, and the upper part of the hull was wide and spread out like two wings. Although it was stable in shallow seas, it was not in the deep sea. Therefore, the seagoing ship called kai-lan chuan (Open-wave ship) had a Guangdong style bottom and Fujian style top. Moreover, because Fujian ships used pine and fir, they were easily damaged by ship worms and had to be breamed frequently (Mao, 1672:6).

Fujian ship was the general name for all ships built in Fujian. Fujian ships were as grand as castles. One reportedly carried 100 people. It had a sharp bottom, a wide top, up-curving bow, and tall stern with 3-story poop (Fig. 6). There were two masts and sails. The masts were supported by mast partners. The ship had four decks. The
Figure 5. A vessel of the Guangdong type from Zhou Hai Tu Bian (Zheng, 1974:3, vol. 13).
Figure 6. A vessel of the Fujian type from Zhou Hai Tu Bian (Zheng, 1974:4, vol. 13).
lowest one had the ballast. The next deck held the soldiers' quarters, water containers and the galleys. The sail was hoisted from this deck. Low fences and a fighting deck were established above the main deck. A wooden anchor tied to a hawser was placed at either side of the main deck. There was a balcony on the uppermost deck, reached by climbing a ladder from the main deck (Mao, 1672, vol.116:18). Outriggers (probably outboard platforms) were placed on either side of the ship for battle. The ship was good when the wind was favorable, but it had one fault: its large size inhibited movement when there were only a few crew members to work it. Because its draft was deep -- 1 chang 2 chi (c. 3.6 m) -- it was suited for use in deep, not shallow, water (Pao, 1961:42-43).

In 1274, during Kublai Khan's first attempted invasion of Japan, a huge fleet of 900 hundred ships was assembled. This fleet consisted of 300 one thousand-liao vessels, 300 fast warships, and 300 water carriers (Song, [1368-1398] 1912, vol. 208:13). Another source, apparently generalizing, claims there were 900 combat ships of various sizes. This information agrees with Koryo Shi. The 1,000-liao ships were large transports which carried soldiers, military horses, and provisions. These vessels played a most important role in a fleet (Kawagoe, 1972:108). According to Koryo Shi, the 900-ship fleet of
1274 had 1,000-\textit{liao} vessels, built in the Korean style, as the primary force.

In 1274 the southern branch of the Song Dynasty was not yet conquered by the Yuan, so Kublai Khan must have been unable to obtain ships from this part of China. Consequently, he depended on the Korean king to build his ships (Ishii, 1975:3). The Korean-built ship was somewhat simpler than the ships built by the people of the Song Kingdom (Xu, [1123-1153] 1921, vol. 33:2). The \textit{Tian Gong Kai Wu} also pointed out the difference between Chinese and Korean styles of shipbuilding (Song, [1637] 1929, vol. 9:34).

\textit{Batur} means "a brave and fast ship" in Mongolian, and seems to refer to sea-worthy ships such as the scouts and warships with eight oars used during the Song and Ming dynasties. These must have been used in battle against the Japanese navy (Ishii, 1975:3). Water carriers transported drinking water for the fleet: they were probably rowed boats similar to sampans, but there was a possibility that they were towed by 1,000-\textit{liao} vessels (Ishii, 1975:3).

The shipbuilding techniques of China reached their peak during the Song and Yuan dynasties. During the Yuan dynasty, there were ships that could carry 8,000 to 9,000 \textit{liao} (c. 560-630 tons) and 400 people. Especially large were ones capable of carrying 1,000 people. Warships of
the Yuan Dynasty generally had up-curving bows and stern castles. Niwa discussed the number and scale of the seagoing vessels used by the Yuan dynasty for an expedition into Java in 1292. According to Yuan Shi, there were five hundred seagoing vessels of various sizes and 20,000 soldiers. During voyages, propulsion power was usually derived from the seasonal monsoons, occasionally augmented by oars. Shiba states that the rigging of Chinese seagoing vessel was durable and strong (1966:450). Navigation was accomplished by observing the stars and moon, and the compass, which appeared around the late 11th century or early 12th century, was used (Niwa, 1953:99-100).

The Composition of the Fleet

Kublai Khan's fleet consisted of various ships with specific functions such as 1,000-liao vessels, water carriers, and fast combat ships. The fleet would have also included horse transports, supply ships, and a flagship. Mongolian vessels shown in Moko Shurai Ekotoba are relatively small, but that is because they were a type of ship that actually participated in battles, larger, slower vessels being unable to do so. Kublai's fleet included vessels that could carry 200 to 300 men (Kawagoe, 1972b:108-109).
Horse Transports and Supply Ships

Naval vessels were constructed expressly for the transportation of horses (Li, [1551] 1985, vol. 2, part 26:128). The *kuai chuan* (Fast boat) and *mu kuai chuan* (Fast Horse boat) during the Ming Dynasty were in this category. In the *Nan Chuan Chi*, it is stated that the *kuai chuan* is c. 20 m long.

One thousand-*liao* vessels, which were not used as battleships, carried soldiers, horses, and provisions. One thousand-*liao* vessels could carry at least 200 men, and according to Kawagoe's calculation, the large hull weighed 2,108 tons (Kawagoe, 1972b:108-109). *Hachiman Gudoki* is in agreement about the number of men carried: "from two vessels came 400 men..." ([1285-1290] 1889: no page number). In *Zhou Hai Tu Bian*, Zheng points out that even the 500-*liao* vessel was unsuitable for sea battle ([1563] 1974, vol. 12:16). Still larger vessels such as the 1,000-*liao* vessel were obviously unsuitable for sea battles where swiftness was required (Kawagoe, 1972b:108-109).

Patrol Boats

The *gao-ba shao chuan* (High-stern patrol boat) was effective for close combat (Zheng, [1563] 1974, vol. 13:7). The *hai-cang chuan* (Blue-water ship), whose design was similar to that of the High-stern patrol boat, was a
fast, maneuverable warship using both sails and oars. The vessel appears to have had a high tiller (Kawagoe, 1972a:46).

The *ba-lu shao chuan* (Eight-oared patrol boat) was a warship with eight oars on either side. This patrol boat was 7 *chang* 3 *chi* (c. 22.70 m) long, 1 *chang* 4 *chi* (c. 4.51 m) wide, and 5 *chi* (c. 1.56 m) deep. It carried a crew of 50. The *shi-jiang fei chuan* (Flying boat) had ten oars on either side; the name came from its extreme speed. This vessel was 4 *chang* 5 *chi* (c. 14 m) long, 8 *chi* (c. 2.49 m) wide, and 4 *chi* 5 *cun* (c. 1.40 m) deep and carried 35 men. It would appear, as Kawagoe (1972a:46) has noted, that the number of oarsmen per oar was different for the two types of vessels. It is clear that the Ten-oared Flying boat had only one man per oar, but the Eight-oared patrol boat probably had longer oars with 2 men on each oar and in this case may have been faster than the Flying boat with ten oars.

The Eight-oared patrol boat was used for both patrol and battle. As we have already noted, the Ten-oared Flying boat was structurally similar to the Eight-oared patrol boat but smaller (Kawagoe, 1972a:47). *Wu Bei Zhi* mentions that an Eight-oared Flying boat could not attack the enemy but was used only for scouting (Mao, 1672, vol. 117:6). Kawagoe (1972a:47) thinks that the Ten-oared
Flying boat also was probably not used as a battleship or transport.

Landing Craft

The *jiu-jiang shi shao chuan* (Nine-river scout boat), illustrated by Fig. 7, is very similar to the landing craft appearing in Fig. 10 from *Moko Shurai Ekotoba*. The boat was 3 chang 7 chi (c. 11.10 m) long, 6 chi 7 cun (2.01 m) wide, and 2 chi 7 cun (0.81 m) deep. The vessel had one mast, a movable bipod mast, slightly forward of midships. Its height, calculated from the vessel's length was roughly 7.7 m. Seven oars were positioned on either side of the vessel. A side rudder was probably positioned on the starboard quarter.
Figure 7. A Nine-river scout boat with bipod mast and side rudder (Shen, 1982, 2: no page number, no Fig. number).
Ships from Artistic Records

This section will examine the artistic record for clues about dimensions, hull and superstructure of Kublai Khan's vessels. Sources of information include Japanese drawings and paintings that date roughly to the period in question.

*Moko Shurai Ekotoba* is a scroll narrative believed to have been created by Suenaga Takezaki, a Kyushu general. It is based on his memory of the battle with the Mongols in late 13th century after the Mongolian invasion. The illustrations contained in the manuscript are the most valuable graphic records available of the battle conditions, armor, weapons and the Mongolian Fleets.

*Kegon Engi Emaki* is an ancient Japanese scroll, believed to have been drawn by a Japanese artist during the late 12th century and early 13th century. The artist apparently used a large seagoing vessel of Song Dynasty as a model. The detailed depiction of the vessel is remarkable.

Dimensions and Capacity

The illustration from *Moko Shurai Ekotoba* reproduced by Fig. 8 shows a battleship with 10 oars ports on the side depicted; one of the oar ports is hidden by an attacking Japanese craft. Although the actual length of
the vessel is unknown, an estimate can be made on the basis of the distance between oar ports in the side of the hull. If we assign to this distance a value of 0.9 m, an oar spacing often encountered in oar-powered warships, the ship as depicted would have had an overall length of c. 15 m. It is noteworthy that the Ten-oared Flying boat had a similar overall length of c. 14 m. The vessel shown in Fig. 8 may be an example of this or some other similar vessel type.

The illustration from Moko Shurai Ekotoba reproduced by Fig. 10 shows landing craft. As already noted, these vessels are very similar in appearance to the Nine-river scout boat. Although only a few of the landing crafts' oars are shown in Fig. 10, it does appear that the vessel fully depicted in this illustration most probably had seven oars on either side. It seems likely, therefore, that these landing craft, like the 7-oared Nine-river scout boat, had an overall length of c. 11 m.

Figure 12 depicts a large seagoing vessel. Ishii (1959: 38) calculated its overall length based on the description of the passenger boat found in the Gao Li Tu Ching. In the Gao Li Tu Ching, the author stated the deck house on the passenger boat was 1 chang (c. 3 m) in length. Since the length of the deck house depicted in Figure 12 is roughly one-tenth the overall length of the ship, the length of the ship can be placed at roughly 10
chang (c. 30 m). A vessel of this size probably would have carried a crew of between 50 and 70 men (Ishii, 1959:38).

Hull and Superstructure

The battleships in Figs. 8 and 9 have a strongly up-curving bow and stern; the stern is markedly higher than the bow. The bow and stern are not pointed but broad and flat in the manner of the Chinese junk, and both end in a transom. The sheer strakes (the uppermost strake on either side of the hull) project well out beyond the bow. There is some indication of planking strakes, but their actual number cannot be estimated from the drawings. The vessels have a main deck and a quarterdeck and poop deck at the stern. Despite a strong hull sheer, the maindeck is flat and is set at a height so that amidships it is a short distance above the sheer strakes; this can be seen most clearly in Fig. 9. A palisade of woven bamboo along either side of the hull serves both as a bulwark for the deck and as a covering for the space between the sheer strake and the deck above. In Fig. 8, this covering is shown with several windows in it to let light and air into the hold. In this same depiction, the artist has omitted a large area of deck planking just aft of midships, permitting us to look down into the hold. No bulkheads are visible, but a thwart shown just above the level of
depicted in Fig. 11 curve strongly upward. The bow is not flat but pointed. Nevertheless, it terminates in a transom. Just as in the case of the landing craft in Fig. 10, the sheer strakes project well beyond the transom, curve outward and support some transverse planking. The stern curves upward and then outward before terminating in a transom. The sheer strakes project well beyond this transom as well. In this case, the projecting sheer strakes continue to curve upward and support not only transverse planking but also a stairway leading up to a poop deck perched precariously on the after end of the projecting structure. The projecting sheer strakes in the bow and the poop deck at the stern are features mentioned in Moko Shurai Ekotoba. The ends of six through-beams project out slightly from the side of the hull just under the sheer strake. It is reasonable to assume that these through-beams mark the positions of bulkheads within the hull. Just forward of where the up-curving stern begins to curve outward, there stands on the deck a deckhouse that calls to mind the description of the deckhouse on the passenger vessel in Gao Li Tu Ching.

Rigging and Propulsion

The vessel in the background in Fig. 9 is equipped with two masts; the foremast is raked forward and the mainmast aft. The mainmast is stouter than the foremast.
the deck amidships may be the upper termination of a bulkhead. Immediately forward of the thwart, an open hatch in the deck is shown; what may be the upper end of a ladder or stairway appears in the hatch opening. A box is shown at the transom bow in Fig. 8; this might have been a locker for anchors and ropes. The forward side of this box, the transom above, the inside of the bulwark along the deck and, in Fig. 9, the stern transom are highlighted in several different colors of paint.

The two landing craft in Fig. 10 have a hull that curves up strongly toward either end. The under side of the bow, the only end of the vessels visible, is broad and only slightly convex and terminates in a transom; a horse ring is suspended beneath the transom's center. The sheer strakes project well beyond the bow transom and end with a crosspiece; the one crosspiece curves upward toward either end, while the other one is straight. This projecting structure curves outward and is planked, forming a bridge by which the soldiers could disembark. Above the sheer strakes between the bow and stern there is a bulwark on which the oars were mounted. Beam ends can be seen projecting through the planking strake beneath the sheer strake on the vessel in the foreground. On the side planking of the vessel in the background, some colored decoration can just barely be seen.

Both the bow and stern of the seagoing vessel
Figure 8. A battleship of Kublai Khan's fleet from Moku Shurai Ekotoba (Takeuchi, 1931, Plate 26).
Figure 9. Other battleships of Kublai Khan's fleet from *Moko Shural Ekotoba* (Takeuchi, 1931, Plate 25).
Figure 10. Landing craft of Kublai Khan's fleet from *Moko Shurai Ekotoba* (Takeuchi, 1931, Plate 28).
Figure 11. A typical seagoing vessel in Song Dynasty from *Kegon Engi Emaki* (Ishii, 1959:7, 41, Fig. 1).
Figure 12. Another Song seagoing ship from *Kegon Engi Emaki* (Ishii, 1959, 7:41, Fig. 3).
The sails and halyards are not drawn. Four oars project from oar ports in the sheer strake on the port side of the vessel in the foreground, and two oars can be seen at the stern on the starboard side. On the deck, three oarsmen can be seen rowing, one man at each oar.

A foremast and mainmast are shown on the seagoing vessel in Fig. 11. From the information given in the Gao Li Tu Ching, it is possible to conclude that if the vessel is 10 chang (c. 30 m) long, the mainmast is 10 chang (c. 30 m) and the foremast is 8 chang (c. 24 m) tall.

Each mast is braced by a forestay and a backstay and carries a sail. Crosshatching and a series of parallel horizontal lines indicate that the sails are mat sails strengthened by battens; the legend between the sails states they are of bamboo. A sheet is attached to the end of each batten on the leech side of the sail. Either sail has a total of eleven sheets that run down from the leech of the sail to the deck. The sails are set 'wing-to-wing', with the leech of the mainsail let out to starboard and the leech of the foresail let out to port. The sails would be set in this way when there was a fair wind blowing from the stern. Normally, cloth sails were used with a fair wind, bamboo matting sails being used with abeam winds (Ishii, 1959:40).

Seven oar ports can be seen in the sheer strake of the seagoing vessel in Fig. 11, but Xu in the Gao Li Tu
Ching states that ten oars were used ([1123-1153] 1921, vol. 34:5). The six through-beams projecting out just under the sheer strake are located midway between the oar ports.

Steering

In the case of the battleship in the foreground of Fig. 9 and the seagoing ship in Fig. 11, a stern rudder is clearly visible. In both cases, the rudder post is hung from the under side of the stern roughly midway between the water and the transom. In the case of the battleship in Fig. 9, the rudder is hung within a wide slot extending over the entire upper half of the underside of the stern. In Fig. 13, quarter rudders, the 'third-assistant' rudders described in Gao Li Tu Ching, are being used. At the same time, what may be a sketchy indication of a stern rudder hung somewhat closer to the water than those in Figs. 9 and 11 can also be seen. Whether we have here valuable evidence for the simultaneous use of a stern rudder and quarter rudders must remain uncertain.

Anchors and Windlasses

The vessels shown in Figs. 11, 12, 13 and the center vessel in Fig. 14 all have a single visible anchor suspended by rope off the bow between the projecting ends of the sheer strakes. In the case of the anchors in Figs.
11 and 14, a stone stock placed low on the shank and perpendicular to the plane of the arms is clearly visible.

In Fig. 11, it can be seen that the shank consists of twin timbers set back to back and fastened together at the upper and lower ends by rope bindings; mortises have been cut into the timbers to accommodate the center of the stock sandwiched between them. The anchor in Fig. 14, on the other hand, appears to be placed on one side of the shank, perhaps in a mortise made in the side of the shank for that purpose.

According to Qin (1990:114-119), compound anchors made of wood and stone were frequently used in Chinese seagoing vessels during Song and Yuan dynasties. Wood and stone could be obtained easily, and wooden anchors with stone stocks were masterpieces among the mooring systems employed during that period. The idea of compound anchors came from ancient seafarers who frequently voyaged over both the soft, muddy seabeds and the hard coral reefs of the Eastern Sea. The advantage of the Chinese wooden
anchor with its stone stock is obvious. The wooden arms of the compound anchor held firmly to the seabed and kept vessels in position when the anchor was on the bottom (Qin, 1990:117). Since the stone stock was set in the lower part of the shank between the arms, the force needed to swing the shank up to a vertical position and free the anchor from the seabed was less than needed for an anchor with its stock high up on the shank (Kapitän, 1990:244-245).

Vessels in Figs. 8, 9, 11, 12 and 13 are equipped with windlasses between bitts for hoisting the anchor at the bow. The arrangement is that described in Gao Li Tu Ching. In Figs. 8 and 9, the windlass bitts stand on the decks flush against the inside of the sheer strakes just aft of the bow transom; the bitts are in the shape of an inverted L. The windlasses are octagonal in section.
Battle Scenes

In Fig. 8, Japanese warriors have boarded a Mongolian battleship from a small craft and are engaging Mongolian soldiers in close combat. The combatants are using both swords and spears. Since they are in close combat with the enemy, the Japanese are not using the bows and arrows they also carry, but arrows shown flying in their direction reveal that they are being fired upon by archers stationed on neighboring Mongolian battleships. The Japanese have taken the Mongolians by surprise. Although the Japanese have already gained control of the main deck, a Mongolian soldier below deck still stands with open mouth staring out a window at the attacking Japanese craft. In Fig. 9, we see other, perhaps neighboring, Mongolian battleships. On the ship in the foreground, a group of soldiers with a banner, drums and a gong are calling their comrades to battle stations, and already archers have taken positions behind shields in the stern of this vessel and of the vessel in the far background and are shooting arrows at the enemy. On the center vessel, a
soldier with a sword can be seen reporting the attack to an officer sitting on the poop deck.

In Fig. 10, the best of the Mongolian troops are shown preparing to land on the shores of Japan. Japanese archers, out of sight, are attempting to repel the landing; their arrows can be seen in great numbers embedded in the high, protective bow of the landing craft in the foreground and in some of the shields carried on the landing craft in the background. One of the soldiers on the landing craft in the foreground is returning fire with his own bow. The shields on the landing craft in the background have been set close together along bulwarks, but since the craft is about to reach shore, some of the shields have been moved to the bow and now face shoreward. (Following are Figs. 13 and 14).
Figure 13. A *san fu duo* (third-assistant) rudder appearing on either quarter on a ship from *Kegon Engi Emaki* (Ishii, 1959, 7:41, Fig. 5).
Figure 14. An anchor appearing at the bow of one of Kublai Khan's ships in the Moko Shurai Ekotoba (Takeuchi, 1931, Plate 30).
Summary

From Moko Shurai Ekotoba, it can be concluded that Kublai's battleships must have been c. 15 m long. The artistic record illustrates some of these vessels. They have strongly up-curving, broad, flat bows and sterns ending in transoms and stern castles with up to three decks. For propulsion, they carried about ten oars on either side and a foremost and a mainmast. A large axial rudder was hung within a slot on the under side of the stern about midway between the water and the stern transom. It is not certain if third assistant rudders were used on Kublai Khan's vessels. A single wooden anchor with stone stock is shown suspended by a rope from a windlass mounted over the bow. In the battle scenes, gongs, drums and flags are used to summon soldiers to their battle stations. The weapons employed in combat are swords, spears and bows.

The landing crafts were c. 11 m in length and most probably carried seven oars on either side. No masts or sails are depicted. These vessels also had strongly up-curving bows and sterns. Only the bows are fully shown; they are broad, slightly convex, and end in a transom. The forward ends of the sheer strakes projecting out beyond the bow transom curve outward to form the framework for a planked bridge by which the soldiers could disembark. It can not be determined from the artistic
representations how these vessels were steered.

There are no artistic representations of the transport ships of Kublai's fleet, but they may have been something like the seagoing vessel in the Kegon Engi Emaki. The 1,000-liao transport ships were probably about the same length as this ship: 30 m. The seagoing vessel again has a strongly up-curving bow and stern ending in a transom. The bow, however, is sharp rather than broad and flat and the upper part of the stern curves outward. For propulsion, the seagoing vessel has seven oars on either side and a foremast and mainmast. A huge rudder hangs from the underside of the stern roughly midway between the water and transom. Just forward of the rudder on the deck stands a large deck house. A windlass carrying a single wooden anchor is mounted over the bow.
IV ARCHAEOLOGICAL INVESTIGATION

Previous Discoveries and Searches

Artifacts have been recovered off the south coast of Takashima in water 3 to 30 m deep. From examination of the artifacts, described below, it can be assumed that they may have been carried by Kublai Khan's fleet.

Stone Projectiles

Roughly circular stone projectiles, c. 15 cm in diameter, were used in catapults by Mongolian troops. The record in Hachiman Gudoki recounts how Mongolian forces destroyed Japanese boats with the catapults on their large vessels. The Zhong Guo Bing Qi Shi Gao describes the use of catapults by the Mongolians during their invasion of Jin country (Zhou Wei, 1957:155). Wu Jing Zong Yao describes sixteen types of catapults, capable of throwing stones weighing between 2 jin (c. 1.19 kg) and 90 jin (c. 54 kg).

Medium-sized projectile balls 11 cm in diameter and small ones about 8 cm in diameter have been recovered from the seabed of Takashima (Fig. 15).
Figure 15. Stone projectile recovered from the seabed at Takashima (Courtesy H. Matsuoka).
Bronze Seal

In about 1975, Mr. Mukai, a fisherman in the town of Takashima, accidentally discovered a bronze seal while he was collecting clams at the fishing port of Kozakimen (Fig. 16). The dimensions of the seal are 6.4 cm square by 1.5 cm thick; its handle is 4 cm high and 1.2 cm thick; it weighs 726 g. In 1981, during the survey of Takashima, the seal was brought to the investigation committee by Mr. Mukai. Professor Takashi Okazaki of the University of Kyushu deciphered the Mongolian characters carved on its surface. The seal was made in September of 1277, four years before the second Mongolian invasion into Japan. Kublai Khan presumably conferred the bronze seal to someone above the rank of a captain of a company. Very likely the seal belonged to a commander of the Yuan forces (Oe, 1984: 173-174).

Anchor Stocks

About forty anchor stocks have been discovered in the Kyushu area, centered on Hakata Bay. The design of all the stocks is basically the same: a long stone, rectangular in section, with a broader center and somewhat narrower, tapered ends (Fig. 17). The center contains a groove for holding the anchor shank, which had two wooden hooks to hold the stock in place (Yanagita, 1988:195-196).
Figure 16. Impression of a stamp seal found at Takashima seashore (actual size) (Courtesy K. Mukai).
Figure 17. Anchor stocks showing tapered shape and having notches at the center (From Fukuokashi Kyoiku Insho, 1988:55, Fig. 1).
Stones commonly used for anchors included granite, sandstone, and tufa (Yanagita, 1988:196-197).

The stocks ranged between 2 and 3 m long, with a central width between c. 27 and 38 cm, and weighed between 190 and 584 kg (Yanagita, 1988:198). However, several smaller anchor stocks have been discovered on the seabed of Takashima, one being only 83 cm long. The 12th-century Gao Li Tu Jing describes the use of wooden anchors on Song vessels, and Japanese scrolls dating to the 13th century portray the wooden anchor and windlass; the Moko Shurai Ekotoba and Kegon Engi provide similar information. Since stone anchor-stocks were certainly used also on merchant vessels that sailed between China and Japan, we can not be certain which of the anchor-stocks recovered from the Kyushu area belonged to the Mongolian fleet (Yanagita, 1988:198). Apparently, anchor types changed from wooden anchors with stone stocks to iron anchors after the 14th century (Yanagita, 1988:196-197).

Ceramics

The brown-glazed jars found off the coast of Takashima are called Tung jars or octopus jars (Fig. 18).

According to Matsuoka et al. (1978:23), brown-glazed jars can be classified as eggplant-shaped, melon-shaped and cylindrical (Fig. 19). The eggplant-shaped jar illustrated as number 1 in Fig. 19 has a gradual curve
Figure 18. Brown-glazed jar in situ on the seabed of Takashima (Courtesy H. Matsuoka).
Figure 19. Illustrations showing types of brown-glazed jars found on Takashima seabed (Matsuoka et al., 1978:28, Fig. 4).
from its shoulder to its flat bottom. It is 21 cm high, has a mouth diameter of 6.7 cm, and is 11.7 cm wide at the largest part of its body; the bottom is 5.8 cm in diameter. Roughly finished, it is lightly coated with a brown iron glaze. Its gray clay contains iron (Matsuoka et al., 1978:23).

Another type of brown-glazed jar raised from the Takashima seabed (Fig. 20) usually has four small, ear-like handles through which a string to support the jar could be passed (Matsuoka et al., 1978:23). Sometimes probably used for grain or water, such jars, according to Matsuoka (1978:23-32), were also used as containers for an antiscorbutic "tea".

The chief characteristic of the four-handled cylindrical jar is a shoulder region wider than its bottom (Fig. 21). The four vertically attached handles are either separated by equal distances or are close together on opposite sides. The bottom is flat, with a depression in the center. The jar is well fired, of coarse clay, and has a glaze applied over its entire surface (Matsuoka et al., 1978:26). The specimen illustrated as number 5 in Fig. 21 is 29.8 cm high, 5.7-7 cm in diameter at the mouth, 14 - 14.7 cm in diameter on the body, and 7-8.2 cm in diameter at the bottom.

The jars discovered at Takashima in Imari Bay were typical of the Song Dynasty (Fig. 21). The jars date to
Figure 20. Brown-glazed jar with four handles found on Takashima seabed (Courtesy H. Matsuoka).
Figure 21. Brown-glazed jars with four handles found on Takashima seabed (Matsuoka et. al., 1978:29, Fig. 5).
the late 13th century, the time of the 1281 invasion. Therefore, it is possible that the jars were transported by Kublai's fleet (Matsuoka et al., 1978:26-27).

The specimen illustrated as number 6 in Fig. 21 is 23.7 cm high, 10.4 cm in diameter at the mouth, 17.8 cm in diameter at the body, and 8.9 cm in diameter at the bottom. The body of this specimen is short and rounded. The attachment of four handles and the condition of the bottom are the same as those of the four-handled cylindrical jars. Dark-brown iron glaze was applied over the entire surface of the jar, which was made of gray clay containing iron (Matsuoka et al., 1978:26).

A blue porcelain bowl was excavated at Tokonami Harbor at Takashima in 1984 (Fig. 22). It was found in a sand layer 43 cm deep. Since no attachment of mollusks was observed, the bowl presumably was buried in the sand shortly after it sank into the sea. The bowl appears to have been produced during the late South Song or Yuan Dynasty in China (Takashima Kyoiku Iinkai, 1984:25-28).

The specimen is 7.3 cm high, 18.4 cm in diameter at the mouth, and 6.9 cm in diameter at the bottom. It has a lotus-flower pattern on its external surface. Production process and carving are crude, and the bowl has a contorted shape. A color tone characteristic of blue porcelain can be partially recognized, but most of the bowl is discolored to yellowish brown. A glaze was
Figure 22. Blue porcelain bowl with a lotus flower excavated from Tokonami Harbor at Takashima (Courtesy Takashima Kyoiku Iinkai, 1984:27, Fig. 15).
applied over its entire surface and it was well fired
(Takashima Kyoiku Iinkai, 1984:250).

A black-glazed jar was found in 1984 at Tokonami
Harbor at Takashima. When it was excavated, mollusks were
attached to the rim of its mouth and its shoulder,
suggesting that it was partially exposed above the bottom
after it was lost (Takashima Kyoiku Iinkai, 1984: 24).

Illustrated in Figure 23, the specimen is 22.3 cm
high, 9.2 cm in diameter at the mouth, and 7.6 cm in the
diameter at the bottom. Its interior is blackish brown
and the external surface is dark brown to entirely
charcoal brown. The shoulder is rather wide, but the jar
narrowed toward the bottom. Its production was crude, but
it was well fired and quite durable (Takashima Kyoiku

Wood

Several pieces of wood have been excavated from the
seabed at Tokonami. Two showed evidence of human
workmanship. Microscope examination revealed that these
were of oak and pine (Takashima Kyoiku Iinkai, 1984:33-
35).

The oak specimen is 8.5 cm long, 6.2 cm wide and 5.7
cm thick (Fig. 24). Both edges were broken off and the
wood was badly preserved. It contained circular openings
of various sizes and was worm-eaten. The mark at the
Figure 23. Black-glazed jar found in Tokonami Harbor at Takashima (Courtesy Takashima Kyoiku Iinkai, 1984:24, Fig. 13).
Figure 24. Oak specimen found in Tokonami Harbor at Takashima (Takashima Kyoiku Iinkai, 1984:33, Fig. 17).
lower end may have been made by an adze, but this is not certain (Takashima Kyoiku Iinkai, 1984:33-35).

The pine specimen is 18.1 cm long, 7.7 cm wide and 4.3 cm thick. Both ends exhibit a great deal of decay (Fig. 25). Gravel had penetrated into the wood grains, and parts are mineralized. Marine-borer damage is seen at several places. Two nail holes, c. 6 mm square, run perpendicular to the grain of the wood. One hole is 5 cm long and ends in what appears to be a nail head. The other hole, with a preserved depth of 4 cm, was made by a nail driven from the opposite direction (Takashima Kyoiku Iinkai, 1984:34-35).

These wood fragments were excavated at the same time as the jars and bowls from the Tokonami harbor bottom at Takashima. Because the wood exhibited apparent signs of human workmanship, it was concluded that they date to the same time period as the jars. It is possible that they were parts of hulls in the Mongol fleet, but there are too many uncertain factors to make that possibility definite (Takashima Kyoiku Iinkai, 1984:35).
Figure 25. Pine specimen found in Tokonami Harbor at Takashima (From Takashima Kyoiku Insho, 1984:34, Fig. 17).
Archaeological Excavations

In this section, two Chinese seagoing vessels excavated recently in China and Korea will be discussed and compared to the historical and artistic records in a search for clues concerning the basic design and structure of the ships of Kublai Khan's fleets. Although artistic representations give us knowledge about rigging, superstructure and on-deck equipment, little information about hull structure and hull design below the waterline can be obtained from such sources. Information in literary sources is for the most part general and imprecise and is often unclear. For these reasons, historical and artistic records are incomplete and must be supplemented by archaeology.

Song Dynasty Seagoing Vessel at Quanzhou Bay

In 1974, at Quanzhou City, Fujian Province, China, a seagoing vessel of the Song Dynasty was excavated (Fujian shen hai wai jiao tong shi bo wa guang, 1987). The vessel was a practical Fujian-built ship (fu boat) of southern China and had an estimated carrying capacity of about 200 tons. It is presumed that the vessel was used as a merchant ship in the trade between China and Southeastern Asia at the end of South Song Dynasty in around 1271 (Li, 1989:277).
The Quanzhou vessel was originally about 34 m long and 11 m wide, had a 3.50 m draft (loaded), and displaced 393.40 tons (Fujian shen hai wai jiao tong shi bo wa guang, 1987:59).

The upper structure and main fittings of the vessel, including mast, sails, rudders, and anchors, were missing. The hull was constructed of cedar, pine and camphor (Fujian shen hai wai jiao tong shi bo wa guang, 1987:16). The hold was divided into thirteen compartments by twelve bulkheads, one at each frame (Fujian shen hai wai jiao tong shi bo wa guang, 1987:16).

The keel of the Quanzhou vessel was made of pine and had an overall length of 17.65 m. It was composed of two parts: a main keel and an aft keel. The main keel was 12.40 m long; the aft keel, 5.25 m long. Both parts were sided 0.42 m and molded 0.27 m (Fig. 26). Both ends of the main keel had extremely complex scarf joints in which no nails were used. A square rabbet along both sides of the keel was for the garboard strake (Green, 1983:254).

Both the stem and the sternpost raked upward and were scarfed longitudinally to the keel. The stem was made of camphor. The upper vertical part of the scarf at either end of the main keel contained seven small holes in which a total of seven copper and iron coins were found. A single big hole in the lower vertical part of either scarf contained a copper mirror (Fig. 27). The seven small
Figure 26. Plan of the Quanzhou ship showing top view (A), side view (B) and cross section (C). Top and side views show 12 bulkheads and 13 compartments. Foremast is in first compartment, mainmast step in sixth compartment. Reel and frames are also shown (Quanzhou wan Song dai haichuan faqu yu yanji, 1987:17, Fig. 10).
holes presumably represent the constellation called the Big Dipper, and the larger bottom hole represents the full moon. These symbols express the belief that the moon and seven stars illuminate the dangerous rocks of the seven oceans and protect the vessel from accidents during a voyage (Fujian shen hai wai jiao tong shi bo wa guang, 1987:16-18).

The hull was planked in multiple layers. The first and second strakes were of camphor, but the others were of cedar. The largest planking strake was 13.5 m long and 0.35 m wide (Fujian shen hai wai jiao tong shi bo wa guang, 1987:19).

Remnants of sixteen port and fifteen starboard planking strakes survived. The strakes on either side of the keel had been subdivided into five bands of planking by offsets so that each of the first three successive bands projected out from the hull 5 cm more than the band below it, while the fifth band of planking projected out 10 cm beyond the band below it. The first band consisted of two strakes; the second through fourth band, three strakes. The fifth band, as reconstructed, consisted of eight strakes (Fig. 28; Quanzhou wan Song dai hai chuan fu yuan xiao zu Fujian Quanzhou 2hao Chuan Chang, 1975:28). The first through eleventh strakes were double-planked; the rest were triple planked (Fujian shen hai wai jiao tong shi bo wa guang, 1987:19). That is, the part before
Figure 27. Cross section of the keel of the Quanzhou ship. Illustration shows one big and seven small holes, representing the moon and the Big Dipper (Quanzhou wan Song dai haichuan faqu yu yanji, 1987:16, Fig. 9).
Figure 28. Cross section of the Quanzhou ship showing V-shaped bottom and two to three layers of hull planking (From Keith, 1981, 10.2:129, Fig. 11).
the turn of the bilge was double planked (Green, 1983:254), and the part from the turn of the bilge to the main deck was triple planked. The three layers of planking had a total thickness of 18 cm. Strakes were tenoned together both longitudinally and transversely (Keith, 1981:124).

Except at the offsets, the planking is set edge to edge in the carvel fashion. However, in the case of the innermost layer of planking, the outer edge of the lower strake and the inner edge of the next higher strake are cut back to form a rabbeted joint (Green, 1983:255).

There were thirteen compartments, which have been numbered in sequence starting from the bow. All but the aftermost two were roughly equal in size (Fig. 26). The greatest distance between bulkheads, 1.84 m, was in the eleventh hold; the smallest distance, 0.80 m, in the twelfth hold. The deepest hold, the eighth hold, was 1.98 m deep; the shallowest, the first hold, 1.50 m deep. Bulkheads were constructed from edge-joined horizontal planking (Green, 1983:256). They were for the most part made of cedar, but the lowest planks were made of water-resistant camphor to prevent decomposition. A total of six planks belonging to the bulkhead between the eighth and ninth holds survived; the bulkhead was 1.86 m high. There were movable planks in the bulkhead between the twelfth and the thirteenth holds so that crew could enter
and exit (Fujian shen hai wai jiao tong shi bo wa guang, 1987:19).

Waterways were cut into the bottom plank of each bulkhead near the keel. The opening measured 12 by 12 cm square. Bulkhead planking seams were filled with lute (Green, 1983:256). In the middle of the upper plank of the bulkhead between the fifth and sixth holds, there was a rectangular notch 70 cm wide and 34 cm deep. This was probably used as a mast crutch (Fujian shen hai wai jiao tong shi bo wa guang, 1987:20).

A frame was erected at each of the bulkheads. They were of camphor wood. It is interesting to note that forward of midships, where the seventh hold was located, all frames were placed aft of the bulkhead, while aft of midships, they were all placed forward of the bulkhead. This is similar to the pattern of floor timber and first futtock placement used in Western ships.

The outer layers of planking were fastened to the inner layer with iron nails, and the rabbeted edges of the inner planking were joined together by driving nails diagonally. The bulkheads and hull planking were connected by L-shaped iron brackets, each bracket fastened by five iron nails (Fig. 29; Green, 1983:258-259). The use of treenails has never been reported (Green, 1983:258).

Linen, tung oil, and ash were used for caulking, and
Figure 29. Illustration showing fastening method using brackets between bulkheads and outerplanking of the Quanzhou ship (Quanzhou wan Song dai haichuan fagu yu yanjin, 1987:20, Fig. 14).
iron nails were driven in the caulking. The nail heads were square or round, and flat. Various methods of driving in the nails were used, including countersinking (Fujian shen hai wai jiao tong shi bo wa guang, 1987:19).

Li mentions use of tung putty on the Quanzhou ship as archaeological evidence of this practice. Tung putty, applied directly or mixed with shredded bamboo and linen, had at least three different uses (Li, 1989:277). The first use was to caulk seams. Great amounts of putty chunks, which must have been used for caulking, were recovered in the vessel's compartments (Li, 1987:277). The second use was to fill in the surfaces of hull planks. The type of putty caulking used for this purpose was obviously different from that used to caulk seams, as no addition of linen was made (Li, 1987:279). The third use was to cover the exposed heads of fasteners. Nails driven into the planks were sealed with putty to prevent the iron from corroding. Putty was also applied on all exposed metal fasteners and their recesses in a similar fashion. This putty did not include any linen or shredded bamboo (Li, 1987:279).

Steps for both the mainmast and foremost were present in the Quanzhou ship. Both were constructed from gigantic camphor-wood logs. The foremost step, located in the first hold, was 1.76 m long, 0.50 m sided, and 0.36 m molded. There were two mortises, each 24 cm by 21 cm,
present on the surface of the mast step for mast partners. The mortises were 40 cm apart (Fig. 30). The mainmast step, in the sixth hold, was 2.74 m long, 0.56 m sided, and 0.48 m molded. In this case, the mortises were 32 cm by 24 cm, and the distance between them was 48 cm (Fujian shen hai wai jiao tong shi bo wa guang, 1987:20). Both mast steps were placed against bulkheads (Green, 1983:258). From the placement of these mast steps, Keith (1981:125) suggests that another small mast was present at the stern. Agreement with this idea has been expressed in the excavation report (Fujian shen haiwai jiao tong shi bo wu guang, 1987:59).

The stern transom was constructed from three large camphor-wood logs (Fig. 31). These blocks have a groove elliptical in section carved into them (Fujian shen hai wai jiao tong shi bo wa guang, 1987:21). This groove was
used to attach the axial rudder. This method of attaching the rudder was a Chinese tradition. The rudder could be moved up and down without affecting its operation (Green, 1983:257-258).

A partially preserved windlass drum made of camphor wood was excavated from the eleventh hold (Fig. 32). The drum remnant was 1.40 m long and 0.35 m in diameter. A notch with a diameter of 13 cm was found on the drum; it was probably a bar hole (Fujian shen hai wai jiao tong shi bo wa guang, 1987:21).

Caulking tools were also found from the Quanzhou ship: an iron hook, ax, wooden hammer, caulking trowel, wooden chisel grip, and nail punch.

The following illustrations show the mainmast step and foremost step arrangements, the rudder groove in the stern transom, and windlass drum on the Quanzhou ship.
Figure 30. Illustrations showing mainmast step (left) and foremost step (right) of the Quanzhou ship (Quanzhou wan Song dai haichuan fagu yu yanjiin, 1987:21, Fig. 16).
Figure 31. Illustrations showing the rudder groove in the stern transom of the Quanzhou ship (*Quanzhou wan Song dai haichuan fagu yu yanjin*, 1987:21, Fig. 17).
Figure 32. Windlass drum found on the Quanzhou ship (Quanzhou wan Song dai haichuan fagu yu yanjiang, 1987:22, Fig. 18).
Yuan Dynasty Seagoing Vessel at Shinan

In 1976, a ship carrying a large cargo of ceramics was excavated off the coast of Shinan Province, Korea (Fig. 33). Recovery from the wreck of a bronze counterbalance weight inscribed with the name Qingyuanlu, a medieval port located near the modern port of Ningpo, suggested that the ship had set sail from the Chinese coast near the Yangtze river, China (Keith, 1980:39). Wooden identification tags for the cargo with the names of Japanese temples further reveals that the ship's destination was probably Hakata, Japan (Nishitani, 1987:6). The vessel was most likely a Chinese merchant ship that was engaged in trade between China, Korea, and Japan during the Yuan dynasty c. 1323 (Sinan Haejeo Yumul, 1988:282-303).

The Shinan seagoing vessel was approximately 30 m long, 9.4 m wide, and 3.7 m deep (Sinan Haejeo Yumul, 1988:282-303). Thus the vessel was similar in size to the Quanzhou vessel.

The bottom half of the hull was well preserved, but like the Quanzhou vessel, the upper part above the deck was completely missing (Matsuki, 1984:4). The hull strakes and decking were of pine, but the bulwarks were of China fir (Sinan Haejeo Yumul, 1988:269-271). This ship, like the Quanzhou vessel, had a V-shaped bottom (Matsuki, 1989:61), but unlike the Quanzhou vessel, appears to have
Figure 33. Plan of wreck site at Shinan, Korea (*Sinan haejeo yumul*, 1984:121, Fig. 1).
had a transom bow (Matsuki, 1984:8). What has been interpreted to be a bow transom was found detached from the hull. It is a double-planked structure in the shape of an inverse triangle 3.0 m high and 2.5 m wide; the sides are rabbeted to receive the ends of planking strakes (Fig. 34). This interpretation can not, however, be proven beyond doubt.

The keel, of pine, consisted of two sections, the main keel and the aft keel; the main keel was inversely rocker (Fig. 35). According to the excavation report, this curve was not caused by an accumulation of ocean gravel beneath the keel but had been made intentionally by the builder (Sinan Haejeo Yumul, 1988:293). The aft keel and the stem were scarfed to the main keel; the scarfs were similar to those in the Quanzhou vessel. Seven copper coins and a nickel mirror were inserted in the horizontal part of the scarf, whereas on the Quanzhou ship, the coins and the mirror were put in the upper vertical part of the scarf (Green and Kim, 1989:36).

The Shinan vessel had seven bulkheads made of pine and eight compartments (Fig. 33). The compartments were not of equal size, but the distance between bulkheads was, generally speaking, much greater than that on the Quanzhou vessel. The bulkheads consisted of edge-joined horizontal planking (Sinan Haejeo Yumul, 1988:295). It is interesting to note that a forward cant frame was
Figure 34. Transom bow of Shinan vessel (Sinan haeieo yumul, 1989:292, Fig. 7).
Figure 35. Plan and side view of the keel of Shinan vessel (*Sinan haejeo yumul*, 1989:292, Fig. 6).
recovered from the eighth hold at the bow in the Shinan vessel *(Sinan Haejeo Yumul, 1984:135-136)*.

Although both carvel and lapstrake construction were used on the Quanzhou vessel and the Shinan vessel, the manner in which they were used is different. The Quanzhou vessel used regular carvel construction above the turn of the bilge; below the turn of the bilge, a mixed carvel and rabbeted lapstrake construction was used. In the Shinan vessel, on the other hand, there was a transition from lapstrake to carvel construction toward the bow (Fig. 36; Green and Kim, 1989:35). Unlike the Quanzhou vessel's multiple layers of hull planking, a single layer of planking about 10 cm thick was used on the Shinan vessel (Matsuki, 1984:6). Strakes were mostly butt-joined, using a lapjoint. The garboard and a few other strakes were mortise-and-tenon joined (Green and Kim, 1989:35), but iron nails were the primary fasteners; nails with square shanks were used more commonly than nails with round shanks.

Each bulkhead was fastened to a frame placed immediately forward of it and to a series of stiffeners that penetrated through the thickness of the hull planking just aft of bulkhead (Fig. 37; Green and Kim, 1989:34-35). Treenails were used to fasten the bulkheads to the stiffeners *(Sinan Haejeo Yumul, 1984:135-141)*. The stiffeners served the same function as did the brackets on
Figure 36. Illustrations showing rabbeted lapstrake and rabbeted carvel joints of Shinan vessel (Sinan Hasieo Yumul, 1989:298, Fig. 16).
Figure 37. Construction of bulkhead stiffeners in the Shinan vessel (Sinan Haejeo Yumul, 1984:134, Fig. 13-2).
the Quanzhou vessel but required more time and effort to construct and increased the potential for leakage into the hull (Fig. 38).

Holes, some 15 cm in diameter, were discovered in a detached remnant the bulwark of the Shinan vessel. The exact placement of this remnant on the ship is not certain, and the purpose of these holes remains uncertain. It is possible they served as scuppers or oar ports (Fig. 39). The possibility that these holes were used for mooring lines has also been suggested (Sinan Haejeo Yumul, 1984:134). If the position of the remnant could be precisely determined, the purpose of these holes might become clear (Green and Kim, 1989:39).

The caulking on the Shinan vessel was a mixture that included white paint and lime to discourage shipworms; oakum was used for planking seams (Sinan Haejeo Yumul, 1984:141; Matsuki, 1989:62). A thin planking of cedar 1.5 to 2.5 cm thick covered the exterior surface of the hull.

It has been concluded that the Shinan vessel was equipped with 2 masts. A mast step was attached to one of the bulkheads (Sinan Haejeo Yumul, 1984:138). According to Green and Kim (1989:36), the mast complex consisted of three vertical elements: the mast and a mast partner to either side of it (Fig. 40). The mast partners were
Figure 38. Cross section of hull planking from Shinan vessel (*Sinan Haejeo Yumul*, 1989:300, Fig. 20).
Figure 39. Portion of bulwark from the Shinan vessel
(Sinan Haeleco Yumul, 1984:132, Fig. 9-1, 9-2).
inserted into mortises in the mast step. Pins were then used to fasten the base of the mast in place. A parallel can be found, however, in the *Tian Gong Kai Wu*. Fig. 40 shows a cross section of the mast step; it resembles the 'anchor altar' mentioned in *Tian Gong Kai Wu*. The forward-raking foremost was set against the bulkhead just forward of it; the bulkhead was inclined at the same angle of rake (Green and Kim, 1989:34-35).

A wooden tank was recovered from the fifth hold. This container occupied a large space in the center of the ship. The bottom of the tank had several plugs 4-5 cm in diameter. The author of the *Sinan Haejeo Yumul* (1984:140-141) suggests that some kind of valuable liquid was carried in the tank.
Figure 40. Illustration showing step arrangement for mainmast (Sinan Haejeo Yumul, 1984:139, Fig. 21).
Summary

There were four distinct types of seagoing vessels during the Yuan Dynasty: the Shallow-draft vessel, the Crow ship, the Fujian ship, and the Guang vessel (Li, 1979:263). The Quanzhou vessel was a typical Fujian ship (Li, 1979:263). It is unknown into which category the Shinan vessel falls. Both the Quanzhou and Shinan vessels were c. 30 m in length. I consider it likely that the 1,000- Liang vessels used as transports in the Kublai fleet must have been about this size as well.

Both the Quanzhou and Shinan vessels had V-shaped hulls and huge keels. Their timbers were made of cedar, pine, camphor, and partly China fir. Seven coins and a mirror were inserted into the keel of both vessels. The seven coins represent the seven stars of the Big Dipper and the mirror represents the moon.

In both the Quanzhou and Shinan vessels, the hull structure was divided into compartments by bulkheads fastened to frames and to the hull planking. Division by bulkheads increased the hull's lateral strength and also its safety by impeding the flow of water into other compartments if one compartment was damaged by accident (Matsuki, 1984:5-6). The Quanzhou vessel had thirteen bulkhead compartments, just as did a large Chinese ship described by Marco Polo.

The thickness of the strakes in the two vessels is
also different. The planks of the Quanzhou vessel were in three layers that had a total thickness of 18 cm (Keith, 1981:124), whereas the Shinan ship had a single layer 10 cm thick (Matsuki, 1989:8).

The use of a forward cant frame on the Shinan vessel is interesting; nothing in the literature or artistic records mentions such frames.

Iron nails and treenails were used for fastening the hull. Lime, oils and linens were used for caulking. All of these materials are mentioned in the historical records. It is interesting to note that the Shinan vessel provides us with an example of the covering of the hull with wooden sheathing as described by Marco Polo.

The mast steps were huge and this suggests that the masts were also large. The foremost was raked forward as it appears in contemporary artistic depictions. Raked masts would be efficient for running before the wind.

The stern transom and a windlass were found on the Quanzhou vessel. An elliptical groove on the stern transom suggests that an axial rudder was used. Both axial rudders and windlasses are commonly mentioned in the literature and illustrated in artistic representations.
V CONCLUSIONS

In the historical documents containing details about the different types of ships in Kublai Khan's fleets, it is suggested that the composition of the fleet might be as follows: a flagship, supply ships, horse transports, patrol boats, battleships, landing craft, and water carriers.

The flagship was the command ship that carried officers such as the admiral and the commander of the troops. Supply ships were employed to carry weapons, food and troops, and horse transports carried horses. It can be assumed that food and horses had to be carried separately, as horses would need sufficient space on the vessels and a large amount of feed and water. Horse transports might have been designed with fewer bulkheads to make sufficient space for horses. Moreover, the crew was faced with the problem of disposing of the horse dung and urine. Therefore, specific transports must have been exclusively used for carrying horses.

Nagahama Gudoki mentions an incident in which 400 soldiers disembarked from two vessels. 1,000-lich vessels in the Meng Liang Lu could carry about 200 individuals. According to Kawagoe (1972b:108), a 1,000-lich vessel had a huge hull of 2,108 tons. It can be assumed that 1,000-lich vessels were not appropriate in size for seabattles,
which required speedy responses. Therefore, the most likely reason for the participation of 1,000-\textit{liao} vessels in Kublai's invasions must have been their huge carrying capacities of 60 tons (Fujian shen hai wai jiao tong shi bo wu guang, 1987:79). From this it must be concluded that supply ships and horse transports were 1,000-\textit{liao} vessels. These vessels were probably c. 30 m long and must have had 2 to 3 masts. The number of oars they carried remains uncertain. These vessels probably had V-shaped hulls, huge keels, and a large axial rudder. Wooden anchors with stone stocks were mounted from windlasses at their bows.

I do not agree with scholars who claim that there was not a single patrol boat used in Kublai Khan's fleet. The role of patrol boats was to lead the fleet safely and to scout the enemy's activities. It is unlikely that Kublai's military would abruptly land on a part of Japan and fight Japanese forces without scouting the territory first.

Kublai Khan's fleet formation was probably both well-organized and complex. The flagship, supply ships, horse transports, and water carriers were probably positioned in the middle of the fleet where battleships could better guard them.

I suspect that the battleships of Kublai Khan's fleets were moderate-sized vessels c. 15 m long, much like
the battleships called batur in the Moko Shurai Ekotoba. It is mentioned in literature that battleships used both sails and oars and moved easily. From this it can be concluded that the battleships were speedy and maneuverable and able to use their oars effectively while fighting against an enemy. Temporary palisades were placed along either side of the hull of the ships to defend the soldiers from enemy attack. Such palisades are depicted in the Moko Shurai Ekotoba and Wu Jing Zong Yao. In addition, the decks of the battleship were level so that the soldiers could move easily about them.

It is sometimes stated that there was no difference between battleships or merchant vessels at that time, and like battleships, merchant ships were equipped with shields and spears on either side of the deck. It is most likely, however, that the Moko Shurai Ekotoba does not describe merchant vessels but purpose-built battleships. The Yuan Shi and Koryo Shi also make specific mention of battleships or batur. Therefore, it must be concluded that battleships or batur must have been employed for attacking the Japanese navy before establishing a safe landing for weapons, food, and soldiers from 1,000-liao vessels.

The landing craft were c. 11 m in length and most likely carried seven oars on either side. Moko Shurai Ekotoba depicted these vessels with strongly up-curving
bows and sterns. These craft had a planked framework to form a bridge for soldier's easy disembarkation at the bow transom. It can be assumed that these landing craft were of shallow draft for landing. Palisades and a number of shields were placed along the either side of hull of the vessels to protect from an enemy's attack. The use of sails and the kind of steering gear used are uncertain.

Although there is no definite evidence of water carriers, tender-class boats equipped with special water containers or barrels were probably used for this purpose. The function of water carriers was very important because of their role in supplying water to soldiers, ship's carpenters, crew members, and horses. The daily consumption of water by a fleet of that size must have been enormous.

According to Marco Polo, a large vessel carried small boats to act as tenders. These small boats were set on board or towed. Tenders would have been necessary for communication between vessels and shores.

For the second invasion in 1281, it is reported that 900 vessels were built in Korea and 3,500 vessels were built on the southern coast of China. According to Korai no Kansen yo Zaimoku Jiyo (1988: 19), Chon Ack San Mountain in Korea became treeless because so many trees were used for Kublai's shipbuilding activities. However, it is doubtful that all of the vessels were, in fact,
newly built for the invasion. It is likely that private merchant ships were also drafted into the fleet as transports.

Fir, cedar, pine and camphor wood must have been used in the construction of Kublai Khan's vessels. According to Marco Polo, fir and pine were used for building Chinese vessels. The Quanzhou vessel used cedar, pine and camphor, and the Shinan vessel was mainly of pine.

Hulls were divided into many watertight compartments by bulkheads. Bulkheads were supported by frames resulting in a hull structure that was very strong. Outer planking was lapstrake in one to three layers. Lime, linen, and tung oil were used for caulking. Thin wood was used for sheathing and iron and treenails were used for fastening.

The number of masts varied. In general, ships had two masts, although it is likely that some of the transports had three. The foremost was placed toward the bow, and mainmast just forward of midships. Foremasts were usually raked forward. Both bamboo matting and cloth sails were used as fore-, main-, and topsails. In the absence of wind, vessels were rowed. Generally, vessels carried from seven to ten oars on either side. Oars were rowed through oarports. On small boats, paddles were used instead of oars. Axial rudders were used, and some vessels had both a large and a small rudder. It is
uncertain whether Kublai's fleet used third assistant rudders. Small boats might have been equipped with side rudders.

Wooden anchors with stone stocks were used. Windlasses and bitts were placed at the bows for hoisting these anchors. *Gao Li Tu Jing* and *Sodai Unsen-gyo no Kiso Kozo* mention using stone anchors during anchoring. However, the term "stone anchor" may be wrong. Since a stone stock constitutes part of an anchor, it should be called a wooden anchor with a stone stock.

It is sometimes stated that these ships used special compartments for water storage rather than water containers. However, the probability that bilge water would come into such a compartment makes this unlikely. It is interesting to note that a tank for liquids was found on the Shinan seagoing vessel.

A section of the *Gao Li Tu Jing* describes that the crew's space was below the cargo hold. However, that may be wrong. The reason is that ballast usually filled the bottom of vessels, and the space above the bottom would have been damp, uncomfortable, ill-ventilated and unsuitable for use as a crew's cabin. *Gao Li Tu Jing*, *Sodai Unsen-gyo no Kiso Kozo*, and *Kegon Engi Emaki ni tsuite* also mention that the aftermost hold was a deckhouse. Perhaps they mean that the aftermost hold had a deckhouse.
Future Study

The study of Kublai Khan's fleet by means of nautical archaeology is far from complete. Future study must involve field work on the Takashima seabed. The continuing study of the fleet should involve the following:

Before surveying Takashima, all data pertaining both to Kublai Khan's fleet and to the artifacts already found on the seabed at Takashima should be collected. It would be important to study local Takashima traditions and legends about the fate of the fleet.

Study of the Mongol fleet should include further research in the museums and libraries of China, Korea and Japan. Direct contact, correspondence and discussion between Chinese, Korean and Japanese archaeologists and historians might provide a great deal of insight and new information about Kublai Khan's invasion of Japan.

A reconstruction of the events affecting the movement, dispersal and eventual loss of the fleet must be made. Such a reconstruction must take into account the probable directions from which the typhoon winds blew, and the places where the ships may have been driven ashore. A comparative study of known cartographic representations of the bay should be made. Such a study might help to determine the nature and extent of physical changes that have taken place in the last 700 years.
Previous sonar searches have identified a number of anomalies, or places where abnormal reflections were registered. At least some of these sonar anomalies may be ships or artifact deposits related to the ships of the Mongol fleet (Oyo Chishitsu Co. group, 1990:12). Therefore, an effort should be made to relocate and redefine the anomalies registered by previous expeditions. All targets could then be prioritized (Murphy, 1980:1-14).

All available modern and ancient geographical, meteorological and oceanographic data must be amassed and analyzed. In addition, future work must include a study of underwater environments. Over a period of seven hundred years, for example, the sediments accumulated (Oe, 1982:174) may have undergone considerable changes.

The search for the ships destroyed by the typhoon will require more refined methods and techniques than those that were available when the previous surveys were undertaken. The vessels probably contained little iron, so it may be very difficult to find them with a magnetometer. The bay is as deep as 30 meters in some places (Oe, 1982:171), and this, too, decreases the usefulness of a magnetometer. A tightly-controlled survey using a sub-bottom-penetrating, high-resolution, density-distinguishing sonar probe is the method of choice for this research.

The first step in conducting a survey of the
Takashima seabed would be to divide it into manageable units. The overall search area is approximately 16 square kilometers (Oe, 1982:172). As a next step, a positioning system and survey lanes could be used. The result of each survey would be combined with positioning information and the locations of anomalies would be plotted on a base map. Anomalies possibly due to the presence of a shipwreck would get the highest priority (Murphy, 1984:97-141).

The destruction of Kublai Khan's invasion fleet was one of the most important events in Japanese history. The modern study and understanding of that great fleet is one of the most interesting challenges facing contemporary Japanese nautical archaeology.
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APPENDIX

LETTERS OF PERMISSION

Kadokawa Shoten
5-24-5 Hongo
Bunkyo-ku, Tokyo
Japan (113)

24 July 1991

Mr. Takahiko Inoue
Nautical Archaeology Program
Texas A&M University
College Station, TX 77843-4352
U.S.A.

Dear Mr. Inoue:

Regarding the request for permission to use the figures on the Kegon Engi Emaki in your thesis at Texas A&M University, please go ahead citing the book reference as the source of the illustration. Please include a credit line in your publication.

Your Faithfully,

Toshinao Takatori
Chief of the Editorial Staff

(Translation)
24 July 1991

Dear Mr. Takahiko Inoue:

Regarding the request for permission to use the illustration on the *Shina Haeleo Yumul* in your thesis at Texas A&M University, please go ahead citing the book reference as the source of the illustration. I am very glad to agree to use of them.

Sincerely,

Dr. Zae Geum Kim

(Translation)
INOUYE TAKAHIKO様

お問合せの件、新案導入在庫、周囲兼使用の点、
善くご同意致します。
これからの国際会議の実施に際し、協力のほど、
お願いいたします。

基本検討及び最終段階を迅速に、
御用者様及び関係各位、

敬具

老朽劣化

敬具

25 April 1991

Dear Mr. Takahiko Inoue:

Regarding the request for permission to use the illustration on the 'Kyushu Imari-wan no katsuyu-tsubo ni tsuite' and photos in your thesis at Texas A&M University, I would agree you to use of them. Please go ahead.

Sincerely,

Hitoshi Matsuoka

(Translation)
私啓
水中考古学に関する資料について、論文に使用したいとの御依頼承知いたしました。

1 イラスト各種（九州伊万里湾の褐鉄壺、掲載）
2 写真（石塔・四耳壺・褐鉄壺の海底写真）
貴殿の論文に役立ててください。

永田貴士さん
連絡先 東京都品川区五反田2～9～7
ドルミ五反田アンメンゾン603
TEL 03～493～2617
以上

1991年4月25日

井上 陸彦 殿

松岡 史
Takashima Education Committee
Takashima-machi, Kitamatsuura-gun
Nagasaki-ken, Japan
(859-43)

22 March 1991

Mr. Takahiko Inoue
Nautical Archaeology Program
Texas A&M University
College Station, TX 77843-4352
U.S.A.

Dear Mr. Takahiko Inoue:

Regarding the request for permission to use the illustration on the Tokonami Kaitei Iseki in your thesis at Texas A&M University, please go ahead citing the book reference as the source of the illustration. I am very glad to agree to use of them.

Sincerely,

Ichie Kondo

(Translation)
前回は、その後の進捗を元気にして研究所内に報告書を提出し、大変嬉しく思います。

そこで、研究者であると元気にしてきたがって、研究を続けます。

今月の開催予定の「海洋海洋学講座」についての研究を

掲載の件承知のいたしました。

どうかお忙しい中、よろしくお願いいたします。

さらに、海洋研究センターの成績に貢献するために

してあります。海洋研究では、海洋ポリシーを立てて

と発表の検討、また、大学に依頼して検討中です。

どうぞお元気で、 elkaarが、忙しいですを申し

しています。

わけだから、見守りなさいよう、宜しくお願いします。

井上隆彦

鶴見市役所 近藤市議

平成16年3月22日

| 東京都教育委員会
| 鷹見町公民館 |
17 July 1991

Dear Mr. Inoue:

Regarding the request for permission to use the figures on the *Fukuoka-shi no Bunkazai* in your thesis at Texas A&M University, please go ahead citing the book reference as the source of the illustration. Please include a credit line in your publication.

Your Faithfully,

Yoshitaka Yanagita

(Translation)
福岡市の文化財
—考古資料—

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July 25, 1991

Dear Mr. Takahiko Inoue;

I am glad to received your letter of 11 July. I would like to make an answer to your letter. I would agree you use those figures from our book.

I am interested in your academic research and enjoy it. I send you my another paper. If you need, you can use it's figures.

I hope we can keep in contact from now on.

I congratulate you getting success!

Sincerely

Li Guo Qing
VITA

Takahiko Inoue received his B.A. in economics from Hosei University in Tokyo, 1966.

After 1966 he worked for an insurance company in Japan until 1986. During his enrollment at Texas A&M University, Takahiko Inoue has participated in Institute of Nautical Archaeology field projects at Ulu Burun, Turkey (1988), and Port Royal, Jamaica (1989). He also participated in Kyushu University's survey for Kublai Khan's Fleet at Takashima Bay, Kyushu, Japan (1990) and in the Monte Cristi Shipwreck Excavation, Dominican Republic (1991).

Mr. Inoue's permanent address is 1-5-15 Ouse-cho, Hitachi-shi, Ibaraki-ken, Japan.

Publications
