

Ship & Ocean Newsletter

Selected Papers

No. 3

Institute for Ocean Policy, SOF

Director's Message

As mankind moves into the 21st century, integrated policies of ocean governance are necessary for the sustainable development and use of our oceans and their resources and the protection of the marine environment.

Towards this end, the Ship & Ocean Foundation has launched an "Institute for Ocean Policy", with the mission statement "Living in Harmony with the Oceans".

The Institute for Ocean Policy aims to conduct cross-sectoral research in ocean related issues in order to initiate debate on marine topics and formulate both domestic and international policy proposals.

We publish a Japanese-language newsletter called the "Ship & Ocean Newsletter" twice a month. The "Ship & Ocean Newsletter" seeks to provide people of diverse viewpoints and backgrounds with a forum for discussion and to contribute to the formulation of maritime policies to achieve coexistence between mankind and the ocean.

Our Institute believes that the Newsletter can expand effective communication on these issues through its function as editor, publishing timely research and welcoming responses from readers, which might then be published in turn.

"Ship & Ocean Newsletter Selected Papers No.3" is an English-language versions of papers from the Japanese Newsletter edition, published from No.29(2001.10.20) to No.40(2002.4.5).

It is our sincere hope that these Selected Papers will provide useful insights on policy debate in Japan and help to foster global policy dialogue on various issues.

Hiroshi TERASHIMA

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■Publisher

Hiroshi TERASHIMA

Executive Director, Institute for Ocean Policy, Ship & Ocean Foundation

Institute for Ocean Policy, Ship & Ocean Foundation

Kaiyo Senpaku Building, 1-15-16 Toranomon, Minato-ku, Tokyo, JAPAN 105-0001
Tel. 81-3-3502-1828/Fax. 81-3-3502-2033

URL. <http://www.sof.or.jp/english>

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Traditional Local Performing Arts for Paying Homage to the Sea

Masahiro Hikita

Executive director, Communication Design Institute

There are three types of traditional events/traditional performing arts in fishing villages, and all of them have been connected with their livelihood, such as a prayer for good catches. The significance of these has somewhat faded. I wish to utilize these traditions as shared intangible assets in the local communities to convey respect for the sea and as a symbol of unity.

Local festivals and traditional local performing arts were once closely linked with the livelihood and lifestyle in each local community. People in a fishing village prayed to the village shrine for safety on the sea and a good haul of fish. If they got a good haul, they expressed their appreciation to the shrine.

Three different ways of expressing their appreciation should be noted:

- * People perform one's ablutions, walk into the sea as they carry a portable shrine on their shoulders and hold a festival on the beach.
- * People parade on the sea with the portable shrines set on boats, which resembles the festival in which people parade by riding floats in a row on the streets.
- * People pay a visit to the shrine on the sea as they play traditional local performing arts.

"Midwinter Ablutions" : people walk into the sea as they carry the portable shrine on the shoulders and hold a festival on the beach.

A typical festival held on the beach is the "midwinter ablutions," a tradition coming down to us from the Tenpo Period for almost 130 years in the Samekawa Shrine, Kikonai Town, in the southern part of Hokkaido. Four young males are chosen as the "disciplinants," and they shut themselves up in the shrine a few days before the start day of the festival, perform the "cold water ablutions" by repeatedly pouring cold well water, just about to freeze in frosty weather, on themselves and walk into the sea as they



Midwinter Ablutions (provided by the Commerce, Industry and Planning Section, Kikonai Town Office, Hokkaido)

carry theshintai or the object of worship in their arms on the last day, and wash theshintai with the seawater. After completing their ablutions in the sea, they return to the shrine, and the main part of the festival begins at last. People pray to the god for a rich harvest, a good haul, safety on the sea, and so forth. In the last part of the festival, the Matsumae Kagura (sacred music and dance) is dedicated to the shrine. The climax of this festival is the ablutions in the sea. Spectators praise the courage of the young males who walk into the sea during a cold wind or even in a snow-storm. Four young males chosen as the disciplinants must fulfill the demanding responsibility for performing the ablutions every year over a four-year period, one of them being replaced with a newly chosen disciplinant every year.

Just about the same time, the "midwinter ablutions" are also performed at the Sosogi beach of Wajima City in Ishikawa Prefecture. People walk into the severe cold sea as they carry the portable shrine on their shoulders; they perform the ablutions in the sea while carrying the portable shrine. As they perform the ablutions, drums are played on the beach.

People perform the ablutions in seawater because it is thought that seawater has a purificatory power, greater than that of pure water. Our ancestors had a special deep respect for the seawater and salt. In the coastal regions in various parts of Kyushu, the customs called "shiokaki, shiokeri and shioitori" (seawater paddling, seawater kicking and seawater well digging) are still widely practiced. This shows that they have the same respect for the sea tide and salt and continue to hand their customs down from generation to generation. Even in villages among the mountains, customs called "hamafuri and hamayuki" (beach going) are still practiced: before the start of festivals, people walk a long way to the beach and perform the ablutions there. These customs are also based on the respect for the sea and seawater. A tiny pile of salt that we see on a gala occasion or at the entrance of a fancy Japanese restaurant today is the vestige of such a custom.

"Ine Festival" : parading on the sea with the portable shrines on boats

A typical festival in which people parade on the sea with the portable shrines on boats is the "Ine Festival" (summer festival). The tradition started in the Yasaka Shrine, Ine

Town, in the Tango Peninsula in Kyoto Prefecture. Ine Town is well known for the legend of Urashima Taro and the unique scenery of the fishing port: "funaya" or houses with the first story used as a fish warehouse and the second story used as a residential quarter stand side by side. On the festival eve called Yoinomiya, people get aboard boats decorated with lanterns. As they parade on the sea, they enter the Yasaka Shrine from the sea with lively playing on their drums and flutes. In this festival, main boats with town people aboard and the kagura boats with drum and flute players aboard parade on the sea. This festival is held on a much larger scale, though that is not held every year, and this large-scale festival is called the Taisai or a big festival, which was held in 1995. The Taisai is known for four large, gorgeous boat floats parading on the sea and is called the "Sea Gion Festival" after the Gion Festival in Kyoto.

"Visit to the offshore island" : people pay a visit to the shrine on an offshore island as they play traditional local performing arts on boats.

A typical festival in which people visit a shrine on an offshore island is the "Okinoshima mairi, Oshimasan mairi or Ongamisan mairi" (a visit to the shrine on an offshore island) practiced in Kashima City, Saga Prefecture. In the Sea of Ariake where the sea level at low tide differs greatly from that at high tide, there is a small stone shrine on an offshore island that appears above the sea only at low tide. People get aboard fishing boats decorated with lanterns before dawn and navigate their boats to reach the offshore island before others. In Saga and Nagasaki Prefectures, people perform the traditional local performing arts called "furyu." "Kane furyu and taiko furyu" (playing gongs on boats and playing drums on boats, respectively) are named in reference to musical instruments, while "odori furyu and mai furyu" (dancing on boats) are named in reference to body actions. In addition, "men furyu," or dancing with masks on faces, and "tentsuku mai furyu," or dancing with extremely tall masks, are performed. Of all these performing arts, the "kane furyu," or playing gongs on boats, is performed on boats before the boats start sailing or when they are waiting for low tide.

Traditional events and local performing arts associated with sea can be categorized as described above, and all of them are based on the respect and appreciation for the sea.

The industrial structure is now undergoing a change in fishing villages: the population engaged in fishing has decreased, and that in manufacturing and service industries has increased. In this situation, people engaged in fishing and other fishing-related jobs are finding it increasingly difficult to maintain and inherit the traditional events and



Visit to the offshore island (provided by the Commerce, Industry and Sightseeing Dept., Kashima Municipal Government, Saga Prefecture)



Ine Festival, called the Sea Gion Festival (provided by the Future Section, Ine Town Office, Kyoto Prefecture)

traditional local performing arts associated with the sea. However, the new move is emerging that people from various walks of life make an effort together to maintain and utilize the traditional events and traditional local performing arts as intangible common properties or symbols of cooperation in each community. We know local communities in which people are attempting to involve children in the traditional events and traditional local performing arts associated with the sea and achieving good results in the area of enlightening children on the importance of leading a decent daily life. Specifically, through the activities conducted concerning the traditional events and local performing arts, respect and appreciation for the sea, as well as deference to the traditional local culture and the will to inherit it, are being nurtured in them. This case shows that the traditional events and local performing arts associated with the sea can be put to such good use. It is expected, therefore, that in each local community throughout the country, people will make good use of the traditional events and local performing arts to contribute to the welfare and good living of people.

(Ship & Ocean Newsletter No.29 October 20, 2001)

Rise in the Sea Level and Asia-Pacific Region

Nobuo Mimura

Professor of the Center for Water Environment Studies, Ibaraki University

The report of the IPCC, an organization of the United Nations that assesses the scientific, technical and socio-economic information for the understanding of the risk of human-induced climate change, explains that warming exerts a great influence on the marine and coastal zones of the world. Serious repercussions such as inundation and flooding are expected in the Asia-Pacific region due to the series of sea level rise and flood tide.

1. The 3rd report released by the IPCC

Effects of global warming on the ocean and coastal areas are now our major concern. Particularly, the resultant rise in the sea level and the effects on the frequency of typhoon occurrence are estimated to produce undesired effects on the coastal areas. The Intergovernmental Panel on Climate Change (IPCC), a scientific evaluation organization of the United Nations, released the 3rd report in 2001. This report predicts that the average temperature will increase 1.4 to 5.8 degrees centigrade and the sea level will rise 9 to 88 cm by 2100. This paper provides an overview of the contents described in this report, specifically the effects of the temperature increase and the rise in the sea level on the ocean and coastal areas.

2. Effects on the ocean and coastal areas

The major effects of global warming on the ocean include the increase in the seawater temperature, rise in the sea level, decrease in an area of sea ice, change in the seawater salinity, change in the sea-wave phenomena, and

change in the conditions of the ocean circulation. These effects became manifest in the 20th century: the average sea level rose 10 to 20 cm, an area of sea ice in the Arctic Ocean decreased 10 to 15% since 1950, and so forth.

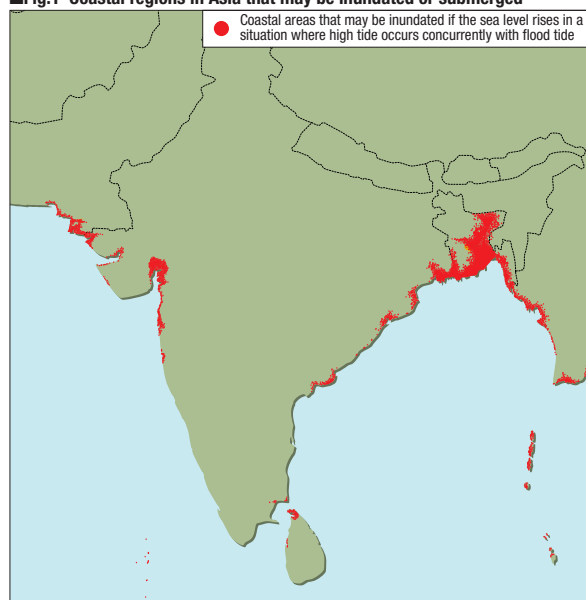
Physical changes occurring in the ocean affect the biological process. If the El Nino event occurs frequently and the seawater temperature increases, plankton and fish eggs will decrease markedly, producing bad effects on fish, sea mammals and sea birds. Although it is known that the catch of sardine and salmon stocks changes in a cycle of about 30 years, the large-scale alteration of fish species now being experienced is thought to be closely associated with the state change (regime shift) of the ocean.

If fisheries are adversely affected by the change in the fish stocks, the catch of fish must be controlled internationally to ensure sustainable fishery. Fish culture is one approach to this problem. Although about 30% of the catch is now fish raised by fish culture, fish culture itself is affected by the catch of herrings and sardines that are used to feed fish being raised by fish culture.

The rise in the sea level and the climate change make the coastal area more vulnerable to inundation, coastal erosion and intrusion of saltwater. The climate change also changes the frequency of typhoon occurrence, which in turn results in a stronger impact on the coastal area. In the island countries in the Asia-Pacific region, the population is concentrated along coastal areas and in low lands along rivers, and the risk of people living in such areas being hit severely by natural disasters is increasing. Furthermore, the cities and infrastructures in such coastal areas will be impacted heavily if natural disasters occur. Another point to be noted is that the climate change may aggravate the environmental problem in overpopulated cities. Effects on the coastal areas in higher latitudes should also be noted though they have until now not been discussed seriously. If an area of sea ice decreases, the sea waves will increase the force of erosion, and the coastal erosion will develop further. Frozen ground and the ice on the ground will thaw, and they may produce another erosion effect.

Coral reefs, wetlands, mangroves, and other coastal ecosystems are also affected by the rise in the sea level,

■Fig.1 Coastal regions in Asia that may be inundated or submerged



increase in the seawater temperature, and change in the frequency of typhoons. Coral bleaching has continued to develop for the past 20 years, and it is estimated that it will develop further, due to the change in the seawater temperature.

3. Effects on the Asia-Pacific region

The author et al. is making a quantitative evaluation of the effects on the Asia-Pacific region, while using data provided by the IPCC as reference data. Our evaluation covers the entire area of Asia-Pacific region, the Arabian Peninsula and the eastern part of Africa in the east-west direction and the majority of the Russian continent, Australia, New Zealand, and other areas in the north-south direction.

We assumed the scenario that the average sea level increases one meter in 2100 from the present level. We calculated the flood tides caused by all typhoons recorded in the past 40 years and defined maximum values for each coastal area as the sea level at flood tide. Areas that may be inundated or submerged and the populations in these areas were identified through calculations, assuming that they are inundated or submerged if their heights above sea level are lower than the sea level at high tide or lower than the sea level calculated based on the total height of high tide and flood tide.

Areas that may be submerged or inundated are distributed in the Mekong Delta in Vietnam, the delta area at the river mouth in the southern part of New Guinea, Bangladesh, and the coastal areas of China (at the mouth of the Chang Jian River and in other areas). More than 10% of the population in each nation of Vietnam, Cambodia, Brunei, Bangladesh, etc., will be affected by inundation or

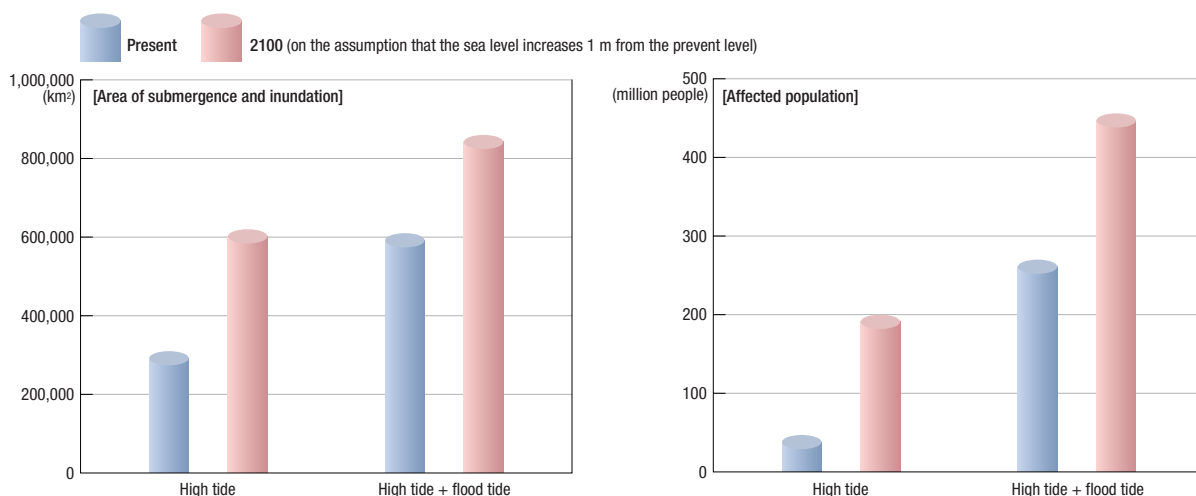
submergence. The coastal areas of the island countries in the southern Pacific will also be affected greatly (Figure 1).

The total land area of the Asia-Pacific region is about 65,000,000 m², and the total population was about 3.8 billion in 1994. In 2100 the total population is estimated to reach about 7.8 billion. The area of the land that becomes lower than the sea level at high tide is 310,000 km² (0.48% of the total land area), and the area of the land that becomes lower than the sea level when high tide occurs concurrently with flood tide is 610,000 km² (0.94% of the total land area). If the sea level rises one meter, 310,000 km² and 610,000 km² will increase to 620,000 km² (0.95% of the total land area) and 860,000 km² (1.32% of the total land area), respectively. This means that the flood tide causes the affected area to increase 250,000 km² if the sea level rises one meter (Figure 2).

The population in the land area that becomes lower than the sea level at high tide is 47 million (1.21% of the total population) and the population in the land area that becomes lower than the sea level when high tide occurs concurrently with flood tide is 207 million (5.33% of the total population). These land areas are vulnerable to flood tide and other disasters. When the total population reaches about 7.8 billion by 2100, the population of 47 million will reach 200 million and the population of 207 million will reach 456 million. This means that the flood tide causes the number of affected people to increase by 249 million if the sea level rises one meter. Global warming is a problem that has a serious impact on the safety and the living conditions of people in the coastal areas of nations in the Asia-Pacific region.

(Ship & Ocean Newsletter No.34 January 5, 2002)

■Fig.2 Area of lands and populations in the Asia-Pacific region that may be affected by inundation or submergence



Effects of Global Warming on Aquatic Resources

Tomoyasu Kawai

Executive board member, Society for Fishery Industry in the 21st Century

The Jomon Period forewarns of global warming to a certain extent. Even then the conditions were not easy, and when global warming progresses in a short time, what will happen remains in the realm of the unknown. Then, the productivity of the sea will decrease for certain.

1. Information on the marine transgression in the Jomon Period

In Japan the sea-warming phenomenon called the "Jomon transgression" peaked about 6,000 years ago. It is thought to be a cyclical phenomenon taking place in the nature, not a global warming phenomenon like what is caused today by the economic activities of mankind. Information on the Jomon transgression, however, is important because it allows us to predict what will actually happen if global warming continues to develop further on the earth today.

1) Expansion of the Bay of Tokyo due to the Jomon transgression

It is thought that the glacial period ended and the interglacial period began about 20,000 years ago, and that about 6,000 years ago the temperature was about 3 degrees centigrade higher than the present one. It is also thought that although the rise in the sea level was different depending on locations, the Bay of Tokyo was greatly affected by the transgression and that it was much larger than it is today (see Figure).

There are many shell mounds in the Kanto region, and information on the Jomon transgression is abundantly available. Shell mounds are distributed northward to Tatebayashi and Fujioka in Gunma Prefecture. It is thought that the transgression occurred in areas at the mouth of and along the Tone River and that the Boso Peninsula was almost an isolated island at that time.

It is predicted that 100 years from now the temperature will increase 4 to 5 degrees centigrade and the sea level will rise about 0.5 m. Considering that the sea level was incredibly high in the Jomon Period, it is reasonably predicted that the sea level will rise a few meters 100 years from now, depending on locations.

2) Change in the aquatic resources shown by the distribution and conditions of shell mounds and other remains

Fish and shellfish remains are distributed in locations from western to southern Japan. It is generally thought that in the Jomon Period they were distributed as far as the Tohoku region.

The typical example of shells is the hai-gai shell. It is

today distributed south of the Bay of Mikawa, while it was distributed as far as the northern part of Miyagi Prefecture, according to data obtained by examining shell mounds. A large number of fish bones are unearthed from the Sannai-Maruyama remains in Aomori Prefecture; the majority of them are the bones of warm-current fish, and the number of yellowtail bones was particularly large.

With all this information put together, it is thought that the Kuroshio Current reached the sea off the coast of Hokkaido when the transgression peaked in the Jomon Period.

2. Decrease in the primary productivity and its effects

1) Abundance of plankton in the Oyashio Current

The results of oceanographic surveys conducted in seas close to Japan show that the quantity of plankton in the Kuroshio Current is largely different from that in the Oyashio Current. Plankton net was dropped to a depth of 150 m to collect plankton samples, and it was found that the quantity of zooplankton in the sea of the Oyashio Current is ten times as large as that in the sea of the Kuroshio Current.

■ Sea in the Jomon Period



Although it was thought that the same phenomenon might be observed as to phytoplankton, the number of phytoplankton samples collected was small, and therefore it was difficult to make a comparison. It should be noted, however, that phytoplankton is caught in nets in such a large quantity as to cause clogging and breaking of nets. This shows that phytoplankton is abundant in the North Sea.

This abundance of plankton is thought to be attributed to the fact that in the cold North Sea, the seawater is stirred smoothly upward and downward, and nutritious substances in lower layers of the sea rise and come to the surface. Although phytoplankton is a main factor responsible for determining the primary productivity of the sea, it proliferates by photosynthesis, and therefore it grows only in surface layers of the sea where solar rays can reach. The temperature of the sea surface in the warm sea is high all the year round, and therefore nutrient-rich water does not rise to the surface. In the cold sea, the water around the sea surface is cold in winter, it sinks to the ocean depths, and in turn the water in the ocean depth rises to the surface, a phenomenon called upwelling.

2) Upwelling stops if the temperature increases 4 or more degrees

The Oyashio Current today runs southward from Kamchatka to the sea off Hokkaido and sometimes further southward to the sea off Fukushima Prefecture. If the Kuroshio Current reaches the sea off Hokkaido, as it did in the Jomon Period, the Oyashio Current will recede northward. As a result, the primary productivity in seas close to Japan will decrease greatly.

Based on the results of oceanographic surveys conducted, I compared the temperature of water 100 meters deep in the sea and that of water around the surface of the sea, and examined the area in which the inversion of water temperature (the temperature of the water deep in the sea becomes higher than that around the surface) occurs. In seas off the Tohoku region and Hokkaido (north of north latitude 38 degrees), the inversion of water temperature was actually observed in about a quarter of the sea area surveyed (during the period from February to March 1960). Simulations were performed in which the temperature of the surface water of the sea was increased, based on certain data, and the following state of temperature distribution was obtained:

- * The temperature increased 1 degree in 42% of the sea area.

- * It increased 2 degrees in 8%.

- * It increased 3 degrees in 3%.

- * A 4-degree temperature increase was not observed in the sea area.

This result is based on the data acquired at the time global warming was not considered as seriously as today, and therefore a different result may be obtained if the latest data is used.

3) Effects on the food chains of sea animals

The ecosystem in the sea functions based on the food chains of various sea animals. At shallow depths, seaweed does not grow and sea animals play the key role in the ecosystem. Because the number of large herbivores is smaller than on land, the decrease of plankton due to warming is estimated to lead directly to the decrease of animal resources. The high fish yield in the sea off the Tohoku region is supported greatly by the explosive proliferation of phytoplankton. If the productivity of the sea area of the Oyashio Current decreases to the level of productivity of the Kuroshio sea area, i.e., a tenth of the present productivity, the overall productivity in seas close to Japan will decrease to about a half.

If this occurs, the effects are serious. The catch of fish and shellfish will be seriously affected. If this phenomenon is viewed from a wider perspective, the global productivity of the sea will drop, and there is the possibility that Japan will become unable to import marine products. It is estimated, according to this scenario, that many countries in the world may suffer a shortage of food.

3. Adaptability of oceanic life to the effects of global warming

Another concern is that global warming is occurring in a much shorter time span than it did in the Jomon Period (a difference between one hundred years and several thousand years). I wonder if the oceanic life has a capacity for adapting itself to the change in the surrounding environment. In Seto Inland Sea, the phytoplankton called heterocapsa proliferated in abnormally large quantities, and bivalves are most seriously affected by the resultant red tide. In Japan this heterocapsa used to be a very weak existence that could hardly over winter. The over propagation of heterocapsa may be associated with global warming. I also note coral bleaching and other phenomena and am afraid that the effects of global warming will continue spreading.

(Ship & Ocean Newsletter No.34 January 5, 2002)

Storing CO₂ in Sunken Places on the Ocean Floor

Izuo Aya

Manager, Osaka Branch Office, National Maritime Research Institute

The vast ocean is a promising place to store huge amounts of recovered CO₂ to mitigate global warming. The National Maritime Research Institute has conducted research on CO₂ ocean sequestration technologies for the past 11 years and proposed the CO₂ Sending Method for Ocean Storage, COSMOS.

Deep-sea disposal of CO₂ : an innovative technique to mitigate protecting the global warming

Carbon dioxide, or CO₂, is generated from the combustion of fossil fuels, typically petroleum and natural gas. CO₂ is a compound that has one carbon atom (C) and two oxygen atoms (O) combined. Because the oxygen atom is 1.33 times heavier than the carbon atom, the weight of CO₂ generated by combustion is about three times as heavy as the unburnt fuel. Japan imports 800,000 tons of crude oil and other fossil fuels every day. This means that four oil tankers, each 200,000 tons in capacity, are required to transport them, and that to transport the CO₂ that these fossil fuels discharge to the atmospheric air when combusted, ten oil tankers, each 200,000 tons in capacity, are required if the CO₂ is to be loaded on these tankers in the form of liquid. If 5% of the CO₂ can be recovered, it fits into one 200,000-ton oil tanker in every two days. Considering that

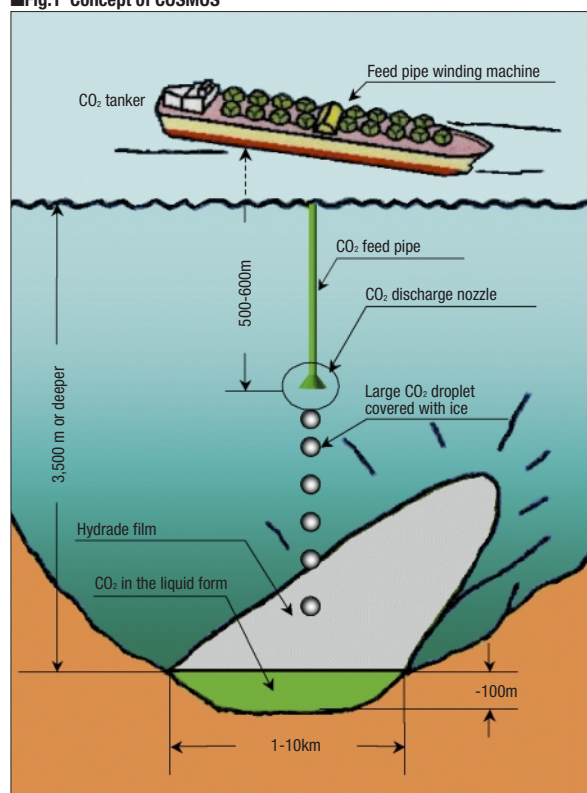
the CO₂ discharged in Japan is less than 5% of the total CO₂ being discharged worldwide, we can understand how difficult it is to solve the global warming problem when viewed only from a technical standpoint. The situation seems more aggravating if we consider the facts: China and other developing countries that consume enormous energies now and in the future are not members in the Kyoto Protocol, and the population explosion is happening in India and Africa.

The number of molecules at the average depth of 3,795 m in the sea is 430 times as large as in atmospheric air. In 1978 American scientists proposed the idea for controlling the climate by disposing of CO₂ in the depths of the ocean. This idea did not attract much attention. However, it was reconsidered after a meteorologist presented evidence on global warming in the U.S. Upper House in 1988. In Japan a deep-sea CO₂ disposal project began in 1990: the first official research project of this kind in the world. In December 1997 the Third Conference of Parties of the United Nations Framework Convention on Climate Change (COP3) was held in Kyoto. In 1998 the deep-sea disposal of CO₂ was added to the Outline of the Battle against Global Warming as one innovative technique to mitigate the global warming.

There is an increasing awareness that the deep-sea disposal of CO₂ must be studied as one of the few techniques that enable us to dispose of environment-disrupting substances in huge quantities. Research and experiments concerning the deep-sea CO₂ disposal are now expanding worldwide as the U.S., Norway and Canada have begun to do research and conduct experiments.

Various methods of disposing of CO₂ in the sea have until now been proposed. They are broadly classified into a dissolution method and a storage method. With the dissolution method, recovered CO₂ in liquid or gas form is dissolved and diffused at a depth of 2,000 m or shallower in the sea; this method takes advantage of the immense capacity of the ocean. Its working principle is that the recovered CO₂ is integrated into the natural circulation process in which part of the excess CO₂ in atmospheric air dissolves in the sea. With the storage method, recovered CO₂ in liquid form is stored in sunken places 3,500 m or deeper on the ocean floor where CO₂ becomes heavier than the seawater with CO₂ dissolved. This method aims to keep the effects of stored CO₂ on the oceanic environment to a minimum.

■Fig.1 Concept of COSMOS



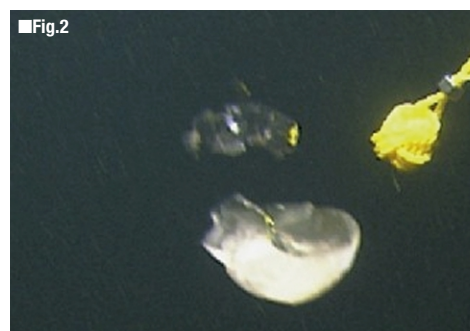
Because both methods are technically viable, the effects on the marine environment and the ecosystem must be evaluated before either method is adopted for disposing of CO₂. Table 1 shows a summary of the features and differences of the two methods. Although the dissolution method is superior to the storage method in technical viability and cost because of the shallow disposal depth, the storage method gains an overwhelming advantage over the dissolution method if we consider the storage period and reversibility (whether the situation can be reversed to the original situation), as well as the precision and ease of environmental impact assessment.

With all this considered, I conclude that the storage method should be used to dispose of CO₂ in the deep sea and that the technical development, including the assessment of impact on the ecosystem in and around the CO₂ storage site, should be undertaken.

Research on the deep-sea disposal of CO₂ at the National Maritime Research Institute

We at the National Maritime Research Institute (former Ship Research Institute) have conducted research on the deep-sea disposal of CO₂ for the past 11 years, assuming that the storage method is adopted. We clarified the properties of the CO₂ hydrate forming at depths 500 m or deeper (at a point in the northern sea of the Pacific Ocean) and 900 m (at a point in the northern sea of the Atlantic Ocean) and proposed the COSMOS (CO₂ Sending Method for Ocean Storage) method, which is designed to overcome the drawbacks of the storage method: the difficulty and high cost in transporting CO₂ to the depths of the sea. (The CO₂ hydrate is a metastable crystalline compound with properties identical to those of ice, and it turns into a sherbet when it mixes with water.)

The net cost of deep-sea storage of CO₂ becomes nearly equal to that of the dissolution method if the COSMOS is used, specifically it is estimated to be about 20% of overall power generation cost. Considering that Japan must reduce CO₂ as specified in the Kyoto Protocol (minus 6% of the result accomplished in 1990) and implement the reduction



■Fig.2
A slurry of low-temperature CO₂ (8 cm in diameter) is sinking by its own weight at a depth of 530 m in the sea.

activities specified in the Energy Saving Law and other laws and regulations, the amount of CO₂ to be reduced by the deep-sea CO₂ disposal is estimated to be about 5% at most. Therefore, the cost of the deep-sea storage of CO₂ is about 1% of the overall power generation cost, which is at an allowable level.

Figure 1 shows the concept of the COSMOS. CO₂ to be transported by a tanker is cooled to around minus 55 Celsius, where it is just about to turn into dry ice, so that the pressure on the tank can be reduced as much as possible. This low-temperature CO₂ becomes sufficiently heavier than seawater at a depth of 500 m. If it can be discharged as a large droplet of one meter or larger in diameter, it will sink by its own weight to the storage site 3,500 m or deeper in the depths of the sea without being affected by the heat from seawater or the buoyant force from ice layers which cover the liquid bubble. Figure 2 shows a low-temperature CO₂ slurry of 8 cm in diameter sinking by its own weight toward a storage site at the speed of 0.3 m/s around the depth of 530 m in the sea, which was photographed in the field experiment jointly conducted with the Monterey Bay Aquarium Research Institute (MBARI). The National Maritime Research Institute with the cooperation of the MBARI plans to begin the work of the COSMOS development using a large high-pressure tank for operations at a depth of 6,000 m. This tank will be completed soon.

(Ship & Ocean Newsletter No.34 January 5, 2002)

■Table 1 Features and differences of the dissolution and storage methods

	Technical viability	Cost	Storage period	Reversibility (presence or absence of a safety valve)	Environmental impact
Dissolution method	○ CO ₂ to be discharged at a depth of 2,000 m or shallower	○	50 to 200 years The period depends on the depth and the sea area	× Basically irreversible because the method is based on an irreversible process	Difficult to clarify the level of environmental impact because 0 × ∞
Storage method	△ CO ₂ to be discharged at a depth of 3,500 m or shallower	△ ○ if COSMOS is achieved	Longer than 2000 years A period longer than the ocean's vertical circulation cycle can be desired	○ CO ₂ can be retrieved, though the work of retrieval involves cost	Possible to clarify the level of environmental impact because of finite × finite

City of Drift Ice Science

—International Drift Ice Research City Concept of Monbetsu City, Hokkaido—

Kunio Akai

Mayor of Monbetsu City, Hokkaido

The Sea of Okhotsk is the southern limit of sea ice. In the past, the local people viewed sea ice as "an uninvited visitor". But, it came to be clarified that sea ice has a profound effect on global environment, productive activity, and so on. From here onwards, sea ice is seen as a new source of marine resources and as a mecca of sea ice research of the world, we are working for the development of the "City Project for International Sea Ice Research".

1. Monbetsu City, the city of drift ice

Monbetsu City is located along the coast of the Sea of Okhotsk, the only place where we can see an icebound sea. With a population of 28,000, Monbetsu City has developed with fishery and agriculture as the basis of the economy.

The Sea of Okhotsk brings the bounties of the sea to the local people, but the production activity of the sea stops as the sea becomes icebound in winter. Although drift ice was once considered a kind of nuisance, people are beginning to understand that drift ice has a favorable effect on the global environment and the production activities of oceanic life. This revelation was made possible by the enduring research efforts made by the Sea Ice Research Laboratory of the Institute of Low Temperature Science, The Hokkaido University. The Sea Ice Research Laboratory was established in Monbetsu City in 1965.

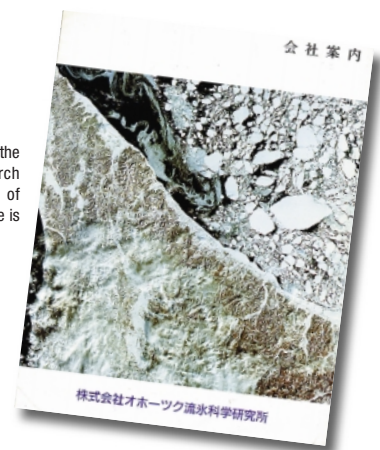
In order to research the functions of drift ice and use drift ice for the development of this city, we drew up the 3rd Monbetsu City development program (1989 to 1998) and the 4th-term program (1999 to 2008). In these programs, we included the "International Drift Ice Research City Concept" as a long-term program.

2. Building the international drift ice research city

Main projects in the "International Drift Ice Research City Concept" program include the following:

- 1) Collecting data on the icebound ocean and making the data open to the public
 - * Fixed-point observation in the Sea of Okhotsk
 - * Wide-area icebound sea observation system
 - * Collection of data on the icebound sea
 - * Hosting of International Northern Region Symposiums
- 2) Promoting the environment protection in the Sea of Okhotsk
 - * Research on the pollution in the sea off Sakhalin
 - * Establishment of observation facilities to protect the environment of the Sea of Okhotsk
- 3) Protecting and conserving the natural environment and conducting the living environment protection activities
- 4) Promoting the wide-area exchange of people and information

The leaflet was issued by the Okhotsk Drift Ice Research Institute. A photograph of drift ice taken by a satellite is shown on the cover.



Concerning the projects 1) and 2), we are conducting comprehensive research and development in the area of icebound ocean science and technology, and spread the information collected through this research and development. We defined these two projects as the "Okhotsk Program" and are implementing them as a nucleus of the International Drift Ice Research City Concept to create a venue for exchanging ocean science technologies internationally.

3. Okhotsk Program

In implementing the "Okhotsk Program," we established the Okhotsk Drift Ice Research Institute, a third-sector organization in 1991. In 1996 we constructed the "Okhotsk Tower," an icebound sea observation tower, which is the base of research and observation on the ocean, the first of its kind in the world. With this tower as a key facility of our research, we are building a comprehensive research system by coordinating the activities being conducted by the Sea Ice Research Laboratory, Okhotsk Drift Ice Science Center, Ocean Exchange Hall, and other land facilities, and "Garinko-go II," an ice-breaking boat which also provides support in conducting ocean experiments.

Specific research activities include the experiments in maneuvering a self-standing underwater robot in the Sea of Okhotsk by the Underwater Technology Research Center of the Institute of Industrial Science, the University of Tokyo, the wide-area drift ice observation using remote sensing techniques by the Tokai University Research &



The 17th International Northern Region Symposium is held this year to discuss the subject on the Sea of Okhotsk and drift ice.

Information Center, and so forth.

In January and February 2002 Mitsui Engineering & Shipbuilding Co., Ltd., and the National Institute of Polar Research jointly conducted tests on an underwater robot in the water under the icebound sea.

The "International Northern Region Symposium" is held every year, starting in 1986, as the place for academic exchanges. Researchers specializing in oceanography, meteorology, fishery, icebound sea science, environmental engineering, remote sensing, etc., visit Monbetsu City from countries in the northern region. Through this symposium, the globalization of international joint research and study is spreading from Monbetsu City to the world.

This symposium is also widely known for the support rendered by volunteers. Open lectures are given, and researchers have the opportunities to communicate with the

local community and know the lifestyle and culture. International exchanges are gradually developing on a citizen level.

This year the symposium will be held during the period from February 24 to 28 in 2002. It was dedicated to Professor Masaaki Aota of the Sea Ice Research Laboratory, who made a great contribution to the drift ice research and is to leave his job on reaching retirement age.

The recent oil spillage in the development of a submarine oil field in Sakhalin constitutes a serious problem that must be discussed in the Okhotsk program to protect the environment of the Sea of Okhotsk. In July last year, training in preventing oil spillage and cleaning spilt oil was carried out with the participation of organizations concerned on the sides of Japan and Russia on the assumption that a large-scale oil spillage accident occurs. We are making efforts to build a more efficient network with the national government, the Hokkaido government, municipalities along the coast of the Sea of Okhotsk, and organizations concerned, so that we will be able to have Monbetsu City function as the base for wide-area disaster prevention and to protect the ocean environment.

4. Drift ice as an invaluable property

We regard the International Drift Ice Research City Concept as not only a city revitalization project, but also an international project that will play a significant role in the world. We will continue to provide strong support in research activities, enlighten people on the importance of drift ice as our invaluable property, and contribute to the development of drift ice and icebound sea research.

(Ship & Ocean Newsletter No.35 January 20, 2002)

"Okhotsk Tower" is an icebound sea observation tower constructed in the Monbetsu port. It consists of a three-story tower and an underwater observation room set in the sea under drift ice. It is the first sea observation facility in the world that allows people to view the drift ice from under the sea. It is also provided with facilities and equipment for conducting basic research and making observations and surveys.



Dolphin School and Its Activities

—Proposal on the Protection of Dolphins in the Mekong River and the Environment—

Keiichi Iwashige

General manager of the HAB Laboratory/Visiting professor, Liaison Center/
Graduate School of Agricultural and Life Sciences, Faculty of Agriculture, the University of Tokyo

Irrawaddy dolphins live in the Mekong River of Cambodia and were on the point of extinction because of the prolonged civil war. HAB21, a volunteer group, established HAB21 Center, a school of dolphins, locally in 1999 while carrying out activities steadily since dolphin research were started locally in 1996. Vigorous activities aimed at village planning are being continued while protecting the nature, where the dolphins live in.

Why did we establish the dolphin sanctuary center in Cambodia?

I remember playing with dolphins in the Bay of Kinko, Kagoshima Prefecture, in my boyhood. My love for dolphins made me establish the "HAB21 Dolphin Association (HAB stands for Human Animal Bond and 21 is the 21st century) with the support of my high school alumni in spring 1991 when I was working for a loan and trust company.

We opened "Dolphin School" in Yokohama, Kagoshima, and Mikurajima, listened to dolphin researchers and specialists working for aquariums, swam with children and dolphins in Mikurajima, and learned how man should associate with dolphins. We continued to emphasize the importance of protecting the habitat of dolphins, while at the same time revitalizing villages and promoting sightseeing. As we were gradually expanding the scope of the HAB21 activities, we knew that dolphins called Irrawaddy dolphins inhabit the Mekong River in Cambodia. These dolphins were on the verge of extinction, due to the long protracted civil war. No research was conducted nor did anyone try to protect them. Starting in 1996 when there were still exchanges of fire in Phnom Penh, I began conducting site surveys.

We gave meetings and told the local people the importance of protecting the dolphins. We appealed to them by saying that if dolphins are shown to tourists, the community gains tourism revenues, they can revitalize the economy of the village, and the dolphin project will become a symbol of the activity for protecting the environment of the Mekong River, like Mikurajima.

At the end of 1997, the International Dolphin Conference was held in Cambodia, and the Campi district was designated as a dolphin sanctuary. After that, we provided the community with a patrol boat to control the boat traffic and to police against dolphin poaching. Making posters and signboards and putting them up, we worked together with the local people. I published a picture book "Wishes of Odeko-chan and Dolphins" to campaign against the dynamite fishing method and poaching. In this book, I described the experience of swimming with dolphins for the first time when I was over 40 years old and the sad feel-

ing I have when I see the sea being polluted more and more every year. (After I published this book, I entered the graduate school of the Tokyo University of Fisheries while working to learn the relation between man and dolphins, and acquired a master's degree in resource management science. I still continue to study as a researcher of the Graduate School of Agricultural and Life Sciences, Faculty of Agriculture, The University of Tokyo.)

On June 30 2001, we established the "HAB21 Center," or a dolphin school, in Krache, which faces the Mekong River. After the Center was completed, the action program named "2002 moi moi" started. ("Moi moi" means slowly in Khmer.)

Economic activity must be linked with local revitalization activity to achieve the goals of our environment protection project.

Although Japan achieved economic growth during the period of high economic growth by increasing productivity and production scale, stock prices declined after the economic bubbles collapsed. As that period of decline is referred to as the "lost 10 years," banking reforms are still incomplete and bad debts remain unsettled; the state of the current economy is a record low deflationary situation. On the other hand, many difficult environment-related problems remain to be solved: garbage war, combined pollution, endocrine disrupting chemicals, mad cow disease, acid rain, global warming, organic tin compound, formalin, antibiotics, chlorinated organic compound, and so forth.

The "toki," or a Japanese crested ibis, and certain dolphin species became extinct. This shows that it is difficult to achieve successive breeding in zoos and aquariums for wildlife, although efforts are being made. If they are raised outdoors, it is not enough to protect only the breeding area. The whole environment in which the breeding area is included should be protected. I believe that people go out of their own fields, work together with the local people, work out good practicable ideas, and put them to practice in order to protect dolphins and other wildlife.

I established the HAB21 Citizen Group with my friends while working for a bank. I continued to work as one citizen volunteer for local revitalization. My philosophy is the



Left: In front of the "Dolphin School" in Cambodia; the author is the fourth person from the left.
Center: Monument in the sanctuary in the Campi district
Right: Irrawaddy dolphin protected in Cambodia



"coexistence and coprosperity of man and creatures" based on the education of children.

In the majority of cases, high economic values sought after by those who produce products contravene the protection of the natural environment. In the case of dolphins, the benefit of the fishery operators contravenes the protection of dolphins and the activity conducted to prevent water pollution. If it is possible to demonstrate that protection of the natural environment brings economic benefits, we may be able to persuade those who produce products or destroy the environment into cooperating with us to protect the environment. In writing a graduate school paper, I introduced the concept regarding investments for public interest, which I learned as a bank clerk, so that I would be able to prove my concept and activity theoretically, to build a local development model, and thereby to contribute to the development of local economic activities. To protect dolphins, we must first think of how we can revitalize the local community and bring economical benefits to it.

Caring for other lives is the base philosophy of environment protection.

Consideration for others is an impediment to a frantic mind seeking for higher productivity. It is pointed out that the pursuit for higher productivity resulted in the aggravation and destruction of the environment. I agree with this view. Before we talk about protecting dolphins and the environment of the Mekong River, we should have a caring mind for other people and nature. Caring for other lives must be the basis on which we develop activity for protecting the environment. I was able to make my long-cherished dream come true in Krache because I always cared for people and all lives on the earth in conducting activities.

The HAB21 activity was given the award for civil activities conducted to improve the global environment from Yokohama City and the award for activities conducted to improve the global environment from Kanagawa Prefecture. It was also given the prize for contribution to the improvement of the global environment from the Cambodian government and a letter of appreciation from Prime Minister Hun Sen. I provide part of the capital required to

establish the center. The success of our activity was made possible by the people in Japan and Cambodia who love dolphins and support our activity and dolphin specialists who provide us with appropriate guidance. I am very grateful to them all.

Another project that I would like to carry out is the "dolphin sanctuary river museum project" of using the Mekong River as an aquarium museum and having people come for all parts of the world to rediscover the charms of the Mekong River. In carrying out this project, we plan to improve the HAB Center as the base of local information, to share the values of the Mekong River, to build a system in which we can learn together, and to establish more bases of local information, and to collect and provide information by making the most of information technology. There is a long way to go, but we will walk "moi moi" or slowly. In spring last year, I resigned from the bank to devote myself more to volunteer activities. I will make surveys to assess the conditions of the environment and dolphins, work out a practical strategy for promoting eco-tourism, and in the "Dolphin School," I will devote myself to the education of children in Cambodia and Japan, while keeping in mind the root philosophy of protecting the Mekong River and educating people in Cambodia.

I wrote a book "We built a dolphin school" and it was published at the end of January. In this book, I described the citizen activities conducted with many cooperating people, the things that we learned in the process, and the dolphins. I keep in mind the following:

- * Money cannot buy the wealth of the spirit.
- * Nature must be preserved for the health of man.

Based on this philosophy, I will work for people and dolphins to accomplish the coexistence and coprosperity of man and dolphins.

(Ship & Ocean Newsletter No.35 January 20, 2002)

Conduct Pioneering Researches to Elucidate and Predict the Ocean Global Circulation!

—The Fastest Computer in the World Performs Large-Scale Simulations—

Hiroshi Matsuoka

Deputy chief of the Earth Simulator Development Team of Japan Atomic Energy Research Institute/
Chief of the system management group of Earth Simulator Center, Japan Marine Science and Technology Center

Global warming is generated as a result of the complicated interaction of various global phenomena. In predicting that, large-scale simulation is necessary to compute in parallel with distinctly various processes such as the atmosphere and ocean circulation. The fastest supercomputer in the world is here in Japan. There is a need for the "Earth Simulator" to be used and to make more breakthroughs.

Prediction of global warming phenomena and supercomputers

The existence of mankind is endangered if we cannot predict the complex effects of global warming on the ocean and take appropriate countermeasures in advance. Prediction of the effects, however, is a very tough task to tackle.

Global warming occurs as a result of complicated interactions of various large-scale phenomena. To predict the effects of global warming, large-scale simulations must be performed. Through such simulations, the circulation in atmospheric air and the ocean, iceberg effects, chemical reactions of CO₂, changes in the ecosystems of forests, plankton, and a great diversity of other natural processes must be computed simultaneously. To predict the effects of global warming accurately, the capacity of currently available supercomputers is far less than the required capacity level; a computation speed far greater than the speed of supercomputers is required to perform such large-scale simulations.

A large-scale simulation program starts to run.

A world ocean map colorfully depicting the oceanographic state of the ocean was put up on the wall of the Earth Simulator Research and Development Center¹⁾ where I work. It represents the results of computations that a supercomputer called the "Earth Simulator" performed to simulate the temperatures of the surfaces of the ocean during the period of four months starting on January 1st in a certain typical year. (see Figure 1) An ocean global circulation simulation program called MOM3 was used to run the supercomputer. Because modifications and improvements to this program were made during the simulation to allow it to operate efficiently on the Earth Simulator, the results shown on the map are not significant in terms of scientific accuracy. It should be noted, however, that a large number of data points are established on the ocean, and data are processed and plotted in ultra-

fine meshes of 0.1 degrees in both latitudinal and longitudinal directions.

We have here the world's fastest computer in Japan.

The Earth Simulator is the world's fastest supercomputer capable of executing 40 trillion steps of addition, subtraction, multiplication and division per second. It was conceived and developed by Mr. Miyoshi, who was the general manager of the Earth Simulator Research and Development Center. It will be completed soon and start operation in March for users who do research to predict changes in the global environment.

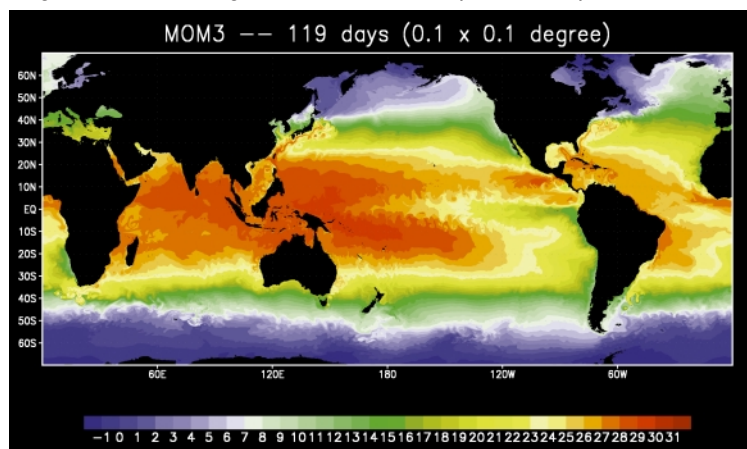
The history of the development of supercomputers in the world has been a development competition between Japan and the U.S. In Japan Mr. Miyoshi was always playing the leading role in developing vector computers and accomplished a great achievement of increasing the computation speed 2.5 million times as fast after enhancing the computer capability in a number of development stages.

Carry out the intention of Mr. Miyoshi, who always pursued high ideals!

Regrettably, Mr. Miyoshi passed away in November last year.

When he was in the hospital, he often said, "The Earth

■ Fig.1 Results of the ocean global circulation simulations (December 2001)



Simulator is merely a box if it is idle. Using such a large-scale vector parallel computer will be a new experience for both the operator and the user. Two to three years from now are a very important period. As the operator, you must think from scratch and develop an efficient operating method. Support the user with the mindset that you educate and raise Japanese user groups who can make a world-class contribution. This is the mission that you at the Earth Simulator Center²⁾ must accomplish."

Now is the time when the operator and user of the Earth Simulator bring their wisdom together and cooperate closely. I hope that the application software suitable for the world's fastest computer system developed by Mr. Miyoshi will be developed and introduced to the world from here. We must carry out the project to provide the operator and the user with the motivation and the will to develop such application software and introduce the true power of the Earth Simulator to the world.

Work together beyond the framework of each organization to realize an ideal science plan now!

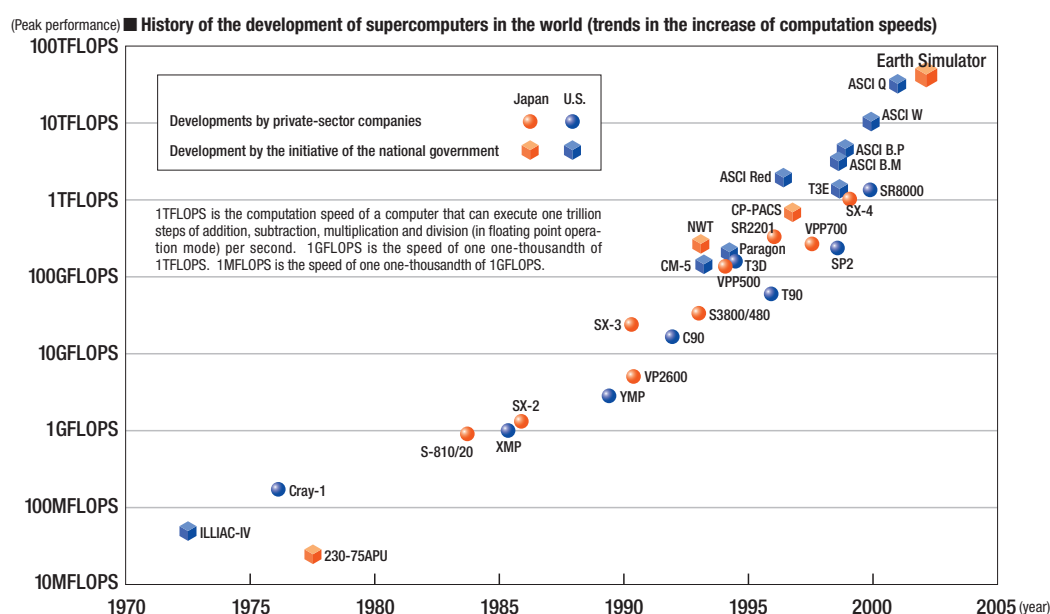
Should true researchers devote themselves only to writing papers? Asked this question, I find it difficult to give a

clear answer. If researchers called to a project site have a very high academic level, each researcher wants to be the first to announce a research paper to the world and gives the highest priority to writing his or her own research papers. I suppose that there are few researchers who have the motivation and latitude to take serious interest in achieving a project goal. On the other hand, a national government responsible for managing the progress of a project does the best to acquire a budget when proposing or starting the project, but the interest in the project that has entered an operation stage wanes off quickly as new projects emerge every year and there are changes in the personnel. To make a project successful by preventing such a situation, it is necessary to gather the people who can perceive the achievement of a project goal as one of the important goals in their life and maintain a strong will to pursue the goal (loyalty to a project). The framework of organizations does not exist; the only thing that exists for them is the science plan (research target) to be carried out.

I also hope that the people who have been playing the world's leading role in the field of collection and analysis of oceanic data use the Earth Simulator to accomplish even higher research goals.

(Ship & Ocean Newsletter No.36 February 5, 2002)

- 1) The Earth Simulator Research and Development Center was jointly established by the National Space Development Agency of Japan, Japan Atomic Energy Research Institute and Japan Marine Science and Technology Center to develop the Earth Simulator, a super-high-speed parallel computer system, as part of the earth simulator project that the Science and Technology Agency (present Ministry of Education, Culture, Sports, Science and Technology) undertook in 1997.
- 2) The Earth Simulator Center is the computer operation center that was established in the Japan Marine Science and Technology Center in April 2001 to operate the Earth Simulator. Preparations are being made to start operation in March 2002.



Set-net Fishing, Friendly to Man and Environment : Transmission from Himi City

Shigeru Douko

Mayor of Himi City

Himi City, where "Etchu" set-net fishing method started, is proposing technical assistance to developing countries and an approach to marine environmental issues through the promotion of the set-net and it is transmitting the human/eco-friendly set-net fishing method at home and abroad. Confidence and pride in the community is generated through these activities.

International cooperation and community revitalization by set-net fishing

Himi City is known for some historic places that appear in the poems in the Collection of Myriad Leaves (Manyoshu), in which Yakamochi Otomo, a famous poet lived in the 8th century, wrote many poems. It is located at the root of the Noto Peninsula, facing Toyama Bay, and blessed with the bounties of the sea from the olden times of the Jomon Period (about from 12,000 years ago to 2,000 years ago). Our ancestors loved the sea and were thankful for the sea resources on which they subsisted, and appreciated the change of the look in each season, though they sometimes had to go through the hardships caused by the sea. They developed the Ecchu-type (Ecchu is the old name for Toyama Prefecture) set-net and handed the techniques of making the net and fishing using the set-net from generation to generation. The set-net fishing should be called a traditional local culture. The sea supported the lives of our ancestors and the lives of us today. In the Himi fishing port, which is the largest fishing port in Toyama Prefecture, we see tunas in summer, winter yellowtails in winter, and other kinds of "kito-kito" (means very fresh in Toyama's dialect) fish being unloaded from boats to the quay. They are delivered as Himi-brand fish to all parts of Japan.

Looking back over the past, we exploited aquatic resources in pursuit of economic affluence, damaged the marine environment, the essence of life, and caused some fish species to become extinct. The number of people engaged in fishery is decreasing, and the aging of fishermen progresses in Japan. Himi City, called "City of Fishery," is also experiencing the diminution of fishermen and the aging.

In this situation, I strongly feel that fishery must be maintained as a main industry and that practical measures must

be implemented to vitalize the fishing industry. It is our responsibility to take good care of aquatic resources, make fishery a sustainable industry, ensure the stable supply of nutrient-rich fish and shellfish, protect the marine environment, and inherit the rich aquatic resources. We must take action to fulfill this responsibility.

International exchange and cooperation projects

Mr. Fuse, professor of the Yokohama City University and manager of the Japanese branch of the International Ocean Institute (IOI), which is an NGO developing international activity, asked Himi City to provide support in helping developing countries learn fishing techniques. We proposed the Ecchu-type set-net fishing by noting the following features:

- * It is a unique fishing method developed in this city.
- * It is designed to catch a limited number of fish species.
- * It is friendly to the marine environment, that is, it does not damage the marine environment, while other fishing methods cause the ecosystem to lose its balance.

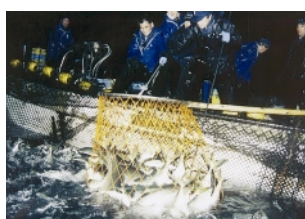
With the Ecchu-type set-net fishing as a nucleus of the aid program, we formulated the following projects:

- * International cooperation with developing countries by supporting them in learning fishing techniques and spreading the learned techniques
- * Study of countermeasures to solve the problems related to the marine environment
- * Set-net fishing training program for vitalizing the local fishing industry

In 2000 we started to implement these projects.

In 2000 an executive committee was organized with the participation of representatives of the Toyama prefecture government, fishery organizations and international exchange organizations, and learned and experience people. An international project for hands-on training for set-net fishing was drawn up and implemented late in August. The Costa Rica and Chinese governments were contacted through the IOI network, and trainees were invited from the Republic of Costa Rica and Liaoning province in China under the sponsorship of the executive committee. They received hands-on training in set-net fishing, learned the set-net fishing techniques, and had opportunities to know the Japanese culture.

To ensure the sound and sustainable development of



Boat with fishermen doing set-net fishing are seen off the coast of Himi City. This aerial view clearly shows the complex shape of the set-net.

fishery and the stable supply of marine products as a source of valuable food for us, the "World and Future Linked by Sea 2000" symposium was held, featuring the protection of the marine environment. Lectures on fishery and the use of deep water were given by first-class researchers, and many citizens and people engaged in fishery attended these lectures.

Cooperative project conducted with Costa Rica

In 2001 the Himi set-net fishing exchange team organized by people engaged in fishery, those of the municipal government, and students in the fishery department of a prefecture high school in Himi City was dispatched to Costa Rica. The team brought a set-net reduced to about a hundredth the size of the actual net and showed it to people concerned in the fishery administration, researchers and fishermen. They also showed them how set-net fishing is practiced and provided them with technical training.

People and the mass media in Costa Rica, which leads the world in the field of environmental protection, gave various opinions to the team. Some of the opinions are as follows:

- * The environment-friendly set-net fishing will be able to save our country's fishing industry, which is now facing the problem of depletion of resources due to over catching.
- * We want to modify the set-net fishing method to suit it to the natural conditions of Costa Rica so that we will be able to develop a Costa Rican-type set-net fishing method.

We pledged that we would exchange information and deepen friendly relations through the project.

While technical training was given, the feasibility of a one-year fishery experiment using a model net was discussed. It was decided that research of the University of Costa Rica and the local fishery operators jointly collect data by performing set-net fishing using the model net and verify whether set-net fishing is suitable for Costa Rica or not. We will exchange information and provide advice about technical questions that they will send to us.

New-century set-net fishing forum in 2001

On November 10 and 11, a forum entitled "Environment and food as viewed from the set-net fishing" was given. People concerned in fishery, researchers, people of administrative offices, and many citizens from all parts of Japan (from Hokkaido to Okinawa) participated in the forum. In a keynote speech entitled "The 21st-century fishery to pursue the sustainable use of resources," it was proposed that people engaged in fishery should spontaneously control the aquatic resources to achieve the sustainable production of

marine products and that the set-net fishing method should be used as an effective fishing method for conserving aquatic resources and ensuring the sustainable production of marine products.

In the forum, a panel discussion was held about the subject "Fishery that allows us to conserve the sea, fish, environment and food." Features and benefits of the set-net fishing method were pointed out as follows:

- * Unlike other fishing methods designed to make a wholesale arrest of aquatic resources, the set-net fishing method is a passive-type fishing method, that is, we do not run after fish, we wait for fish to come into the net. Using the set-net fishing method, we can gain a decent amount of catch without exploiting aquatic resources, so that we can realize a sustainable fishing industry.
- * The fishing ground is near the coast. This makes it possible to supply fresh fish and shellfish.
- * People engaged in fishery can commute from home to the fishing ground every day.

It was confirmed in this panel discussion that set-net fishing is environment-friendly, contributes to the preservation of aquatic resources, and therefore should be used as a main fishing method for the 21st century.

World Set-net Summit in Himi in 2002

We plan to hold the "World Set-net Summit in Himi" (tentative name) to build a global partnership for the protection of the global marine environment using the set-net fishing and to propose the set-net fishing for the new age. To this summit, we will invite administration officials of nations that lead the world in the field of the set-netting fishery, those of developing countries that are working seriously to protect fishery resources and to improve the life of fishermen, people of international cooperation organizations, representatives of administrative organizations in Japan, and so forth.

Set-net fishing is not limited to the production of marine products. We should note that it has many other functions. Everything of the relations between man and the sea is condensed in the set-net fishing method. It has a long history, a unique culture, and provides a clue to the solution of the environment and food shortage problems facing mankind today. I want to continue to study set-net fishing, which is handed down to us today in an unbroken line, from various different angles, to reconfirm the significance of spreading this fishing method, to propose the most appropriate set-net fishing method suitable for the coming age, to spread information on the set-net fishing home and abroad, to increase the power of our community, and to make Himi City the pride of our citizens.

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Shipbuilding – Where to Now?

Keith Wilson

International Marine Engineer Consultant

By the mid-1950s Japan took the lead in the world shipbuilding league for 35 years. However, at present there is more intense competition among the burgeoning shipbuilding countries that use cheap labour as leverage. Everyone should think more carefully about the effects for the ship operator from the cost down process during construction. In the future, Japan should take the lead in the world again on the basis of better quality and high reliability.

To look ahead is always a daunting task and, where shipbuilding is concerned it can be very difficult sometimes. Forecasts of future market requirements for new ships have been known to be disastrously wrong at times.

However, anyone trying to look ahead, in the world of shipbuilding, before the terrible events of September 11th, last year, might have seen a particular picture beginning to form. It could be seen that demand for some ship types, such as bulk carriers and VLCCs, had flattened out somewhat, as the "bulge" of the replacement programmes for those ships was over. The flow of orders for such new-buildings had slowed to a more healthy and sustainable rate.

On the other hand, there was a considerable demand for large container ships which many thought was getting out of hand. Nevertheless, there was active talk, and some discussions going on, about even larger container ships with capacities of up to 10,000, or even 12,000TEU.

Perhaps a similar situation had been reached in the more specialised but lucrative, market sector of large passenger cruise liner newbuildings.

Difficult though it may be to accept, perhaps the drastic events in September, last, did the shipbuilding market favour, in that over tonnage was stopped in its tracks or, at least stopped before it got out of control. Of course, everyone asks – but what now?

To answer that question is difficult to say the least but, as the world adjusts to new circumstances, which are perhaps not yet settled, world trade will pick up again and, hopefully new shipbuilding orders will follow since world trade levels are the biggest controller on shipping and the requirement for new ships. If we are lucky, we may just see some market sectors begin to rise as soon as the spring of 2002 or just after that. However, it will be a slow rise and it may take some time for other market sectors to pick up.

However, before looking ahead too far, we would do well to see what has been happening in recent years. It is after all, on lessons learned from history that we can build a better future but only if we are strong enough to learn and take on board those lessons, and accept their meanings.

Competition between shipbuilding countries has always

been there, since the industrial revolution and the coming of steel-hulled ships. The European countries led the way in the beginning and today it is hard to believe that the UK once built 80 per cent of the world's new merchant ship tonnage. By the mid 1950's Japan, through the strenuous efforts of its shipbuilders and their dedicated work forces, took the lead in the world shipbuilding league and remained the leader for some 35 years. Then came Korea, with huge new shipyards, cheaper, and it seemed unlimited labour, to challenge the Japanese position. Today we can see China beginning to go down that same road as a challenge to Korea, as that huge country's industrialisation begins to gather pace.

In all of this, perhaps the biggest change of all has been the collapse in prices of newbuildings over the last decade, or so. As an example, if we look at a new VLCC building in the early 1990's, an owner would have to pay around \$95 million for such a ship but, in 2001, the same ship could be purchased for a little over \$70 million. Surely, there can be few industries in the world which have seen such dramatic price reductions for large capital projects.

Those reductions have come about, partially by intense competition, with it seems, Korea leading the way and China having an underlying effect. At the same time, currency exchange rates have had a considerable effect. After the Asian crisis in 1997, the Korean Won devalued hugely and so the Korean yards were able to take in more domestic revenue from say, a newbuilding VLCC, costing around \$70 million, than they had previously received from the same type of ship order with a price tag as high as \$85 million. In the same time period, Japan's exchange rate did not move in such a dramatic way and so price pressures built up.

Present order books, in major shipbuilding countries, are full enough to keep the yards busy throughout 2002 and into the early part of 2003 but, what then? Hopefully, before the end of this year, we will see world trade pick up, at least slowly and, with that, an increase in the trickle of orders presently going to the yards. However, there will be intense competition for new orders and we could expect to see prices go down further, with subsequent losses to the

shipyards, engine builders, and equipment suppliers.

Before we look further into that scenario, we should look a little more closely at what has been happening, from the ship operators' point of view. Such gentlemen are, after all, the end users of the products coming from the shipyards and machinery works.

From the author's own 10-year experience of sailing on board ships as an engineer, in fast cargo liners operating between Europe and the East Asian area, it is clear that all ships spend some 80 to 85% of their time at sea, working in a rolling or pitching (or a combination of both motions). In such conditions, stresses are placed on the ship's hull, and equally importantly on the machinery and especially the main engine. Such stresses on main engines cannot be simulated ashore or even in the design stage of the engine, unlike the hull which can be modeled and tank tested in various sea conditions to confirm design calculations.

Those model tests are more concerned with hull performance in rough sea conditions. They are not so concerned with the endurance of the hull in long periods of rough weather. Of course basic hull strength, and hence design and construction rules, are laid down by appropriate Government bodies as well as the Classification Societies and, the ship designers must follow those rules.

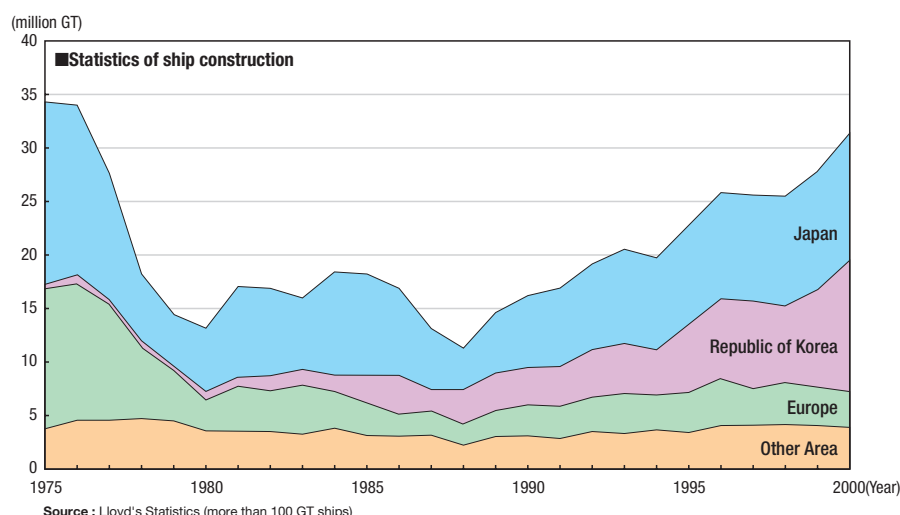
Where the main machinery is concerned, engines are so large that it is not possible to test them under simulated rough sea conditions and there is no computer program which can do the simulation mathematically, either. The result is that the engine designer or builder does not know the total forces being placed on his engine when it is operating in a ship in rough weather.

In recent years, ship operators have seen hull designs become minimised but of course still within the rules, as the commercial forces of stiffer competition lead to the so-called "cost down" effect. The result for the ship operators is that little or no reserve is left in the ship design for the extra wear and tear which comes with rough weather operations. That equally applies, if not more so in some detail areas, with the main machinery.

While mentioning the weather effects, it should be born in mind what the human race is doing to the earth's environment in creating the "greenhouse effect". Signs of this are already with us, and the effects will become greater, including changes in weather patterns, where greater and more ferocious storms can be expected. Thus, more and greater stresses will be placed on ships' hulls and machinery.

To the seafarer, the sea is a great friend who he lives with for many weeks of the year but, it can be his terrible enemy, also, so any weakness in hull or machinery will put the seafarer's life in unnecessary danger at times, as well as bringing the cargo carried into a poor condition sometimes.

When "cost down" methods are used in design and construction of the ship they also affect the machinery and from the operator's point of view, that brings the main engine into strong focus. Engine designers try to produce a design which will ensure an efficient and reliable engine but the majority of large 2-stroke engines today are built by licensees located far away from the designer's base. Thus, the actual engine builders, under pressure from their ship-builder customers, for lower prices, make what might be seen as minor modifications to the original design to suit their own cost structures. Such modifications in one part of an engine can make differences in other parts of the engine,



which are not investigated. So, reliability is reduced. Add to that, the use of cheaper, and hence sometimes lower quality parts, and reliability is reduced further.

It is quite clear today that such practices lead to engine failure, which is a costly business at the best of times, with losses on charter rates on top of what should be unnecessary repair bills for the operator. In some cases, within the past 5 years, the use of cheaper parts of dubious quality or, the lack of good quality control, has led to engine failures which have involved engine room staff being seriously injured. It is quietly feared among operators that if the "cost down" process is continued, that the death of an engineer working in the engine room, cannot be far away.

Who then will be the guilty party? The engine builder will blame the shipbuilder for pushing him further into the "cost down" process but the shipbuilder will blame the shipowner for pressing him down on price.

Who is the shipowner today can be quite a question. The number of real shipowners today can probably counted on one hand, as many ships are initially owned, on behalf of original shipowners, by banks, finance houses, perhaps trading houses, or even the shipbuilders themselves in some cases. Such organisations are not so interested in the technical aspects of the ship. Their business is money and how to make more of it. So it is natural that they want the cheapest possible price for the maximum cargo carrying possibilities and, hence the fastest return on their investment in the ship.

Any ship operator today (very often a previous shipowner) can appreciate that fact but, he has the responsibility of operating the ship, sometimes on a slender budget awarded by the "owner". The ship operator is looking for reliability and safety above all else but, he sees that those qualities may have been sacrificed to some degree in the "cost down" process during design and building. Thus, the repair and down-time costs go up and the long term investment begins to look poor.

Today, many ship operators feel strongly that the time has come to stop this pressure on the shipbuilders and engine builders, before there is a fatal accident. They feel that it would be much better if so-called "owners" were to look at the long term returns on the considerable investment a ship represents, rather than a short term quick profit view. However, long term benefits of lower repair and down time bills only come through higher quality, which in



Double hull ship under construction.

turn, means an initial higher price. It also means that the shipowner gets a better and safer ship with less risk to him, his ship operator, and to the ship's crew.

So, the ship operators – the users of the end product, the ship – ask that everyone think more carefully about ship prices and costs in the future and, where might we be going with the "cost down" process. If an increase in quality means a higher price, so be it. Many major ship operators today would be prepared to pay another 10 per cent on the cost price if it assured them that they were getting better quality and hence increased reliability and safety.

However, market competitiveness is important so we might ask where is Japan's place in all of this and particularly in the future?

Japan has a good reputation for high productivity and, on-time delivery from its shipbuilders. Their productivity levels have been the envy of the world's shipbuilders. Quality was also a feature but, in the face of intense competition, especially from Korea, and to some degree to China breaking into the market, it has regrettably diminished. So which way should Japan's shipbuilders take now?

From the ship operator's view point, the way forward would be an increase in quality, even it means an increase in ship prices. Orders might well be lost for a while to the major competitors of Korea and even China. But, Japan could lead the way back to better quality and higher reliability in ships. Others then must follow or, lose market share in the new quality ship league.

Some idea of what can be done can be seen in the European area yards. They gave up trying to compete against

the East Asian yards for many ship types, quite some years ago, to concentrate on the higher quality styles of ships and the more specialised types of ships. The results can be seen today in the number of passenger cruise ships built in the European yards, for example – more than 90 per cent of the world's requirements. Likewise, the bulk of the many specialised vessels which are required for the offshore oil and gas business today come from European yards. All of those ships require and get good quality built into them.

There is a wealth of talent in Japan and, while ship quality is increased, it should be possible to refine efficiency and hence take productivity to even higher levels in the yards. Grouping up of some of the various shipbuilding divisions of the major industrial groups has been promoted but, so far has made little progress for a number of very different reasons. Perhaps a different look at the possibilities regrouping should be made. The idea of much larger shipbuilding affiliations through various combinations should provide some savings on costs but it is hoped not at the sacrifice of flexibility of operations.

If Japan were to go for higher quality ships, it could of course mean some reduction in shipbuilding capacity and consequent loss of employment for some people. The author is well aware of what that means to the individual person, having been through the same process himself. If that were the case, the Government would have to look at alternative employment schemes but also should be able to encourage out of work operatives to use their hard won skills to their own benefits through self-employment schemes.

If we could set aside the events of September 11th, last, just for a moment, and consider where the world's shipbuilding industry might have been if those events had never occurred. We can see, as previously mentioned, that the demand for bulk carriers and VLCC's had flattened out while the demand for container ships, especially of the larger sizes, was almost rampant. However, a diet of large container ships with small side dishes of some bulk carriers and tankers is not good for the appetite of shipbuilders as it can lead to some indigestion in the form of over tonnage in the container trades. Therefore, a reduction in the world capacity for newbuildings is inevitable at least in the medium term. Thus, some shipbuilding berths will have to closed down and used for other purposes.

If we now bring the effects of the September 2001 terrorism back into the equation, we can immediately see that in the container ship sector of the shipbuilding market, the possibility of owner/operators ordering new ships in the

10,000 to 12,000 TEU size range are very remote. If such huge ships were to come back into vogue, perhaps only 30 to 40 of them would ever be built, for the trans Pacific and, the Europe/East Asia routes only. Basic design work for such ships has been completed by a number of shipyards, in anticipation of what might have been required. However, the main propulsion ideas for these ships have never been fully settled and the huge costs associated with the full development of engine powerful enough to for single screw 12,000 TEU vessels will never be repaid by the relatively few orders which would be available to any single engine designer.

Looking right across the world's new ship requirements under the present circumstances, it is not possible to see any clear picture but it is certain that that there will be no great surge of orders once the market restarts. At best it can be hoped that a slow but steady increase in market requirements will occur, and we can be sure that some cut throat, and loss making, pricing tactics will be used by certain shipbuilders. There is, however, a limit to how much loss any sensible company can take, and prices will inevitably rise but that could take some time to accomplish.

If such price competition will inevitably lead to more "cost down" process, it will be the ship operator who will suffer at the end of that line once again. Better quality with less sophistication on board should be the way forward. It is sometimes thought that there is too much in the way of so-called clever design in some ship types today when crews don't fully understand all the devices and electronic systems on board. A more sturdy and simpler design is the order of the day particularly where the simple bulk carrier is concerned, for example. Better quality with less "frills" is what is really required in such ships and a good shipbuilder will recognize that.

It will not be easy to produce, and sell, better quality ships at a higher price against the general flow of cheaper prices on "cost down" vessels but, that is what is wanted by the ship operators. Those who finance newbuildings would be wise to not look for short term gains but to think longer term. After all, a ship has a 20-year lifetime on average. That is not a short life for a major investment. Few aircraft, for example, reach that age and motor cars rarely do but, the relative investment initially, is high for a company or an individual, respectively, in those cases. Why shouldn't a ship with a lifetime of 20 years deserve a greater investment initially? If the shipbuilders are to go for better quality at slightly higher prices it might serve them well to remember an English motto – "he who dares, wins".

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