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INDUSTRIAL
TECHNOLOGY
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1977

*Marine Industrial
Technology*



UNITED NATIONS
INDUSTRIAL DEVELOPMENT
ORGANIZATION

**EMERGING TECHNOLOGY SERIES:
MARINE INDUSTRIAL TECHNOLOGY
No. 1/1997**

CONTENTS

SPECIAL ARTICLE:

Deep Sea Manganese Nodule Mining

by *Dr. Toshio Sakasegawa, Metal Mining Agency of Japan*

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INTERNATIONAL NEWS

SOFTWARE

CALENDAR

PUBLICATIONS & WEB RESOURCES

UNIDO's *Emerging Technology Series: Marine Industrial Technology*, is established as a mechanism of current awareness to monitor developments in the marine industrial technology sector and to inform governments, industry and academia, primarily in developing countries.

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Dear Reader

The United Nations Industrial Development Organization (UNIDO) has undertaken a programme of activities on the implications of marine technologies in developing countries since the early 1980s.

In 1981, David Ross, a UNIDO consultant, prepared an extensive report on *Technologies for investigation and exploitation of seabed resources: the potential for developing countries*. This was followed in 1982 by another authoritative report on *Ocean mining and developing countries: an approach to technological disaggregation*, by Elizabeth Mann-Borghese.

The subject of marine technologies for the development of non-living resources continues to be of great interest. In 1992, a status report on *Deep seabed minerals, mining and related technology* was prepared by a team of experts. This report provided a detailed insight into the state-of-the-art of deep seabed mining programmes and related technologies. It covered: a) survey and exploration; b) deep seabed mining; c) environmental impacts; d) metallurgy and processing; and e) the interface of industry with various R&D institutions working in these fields.

Following the status report, a UNIDO *Workshop on Marine Industrial Technology for the Development of Marine Non-living Resources* was held in Madras, India. The Workshop noted that the provisions relating to Exclusive Economic Zones (EEZs) contained in the UN Convention on the Law of the Sea (UNCLOS), provides an international framework for the management and development of marine resources. It stressed the importance of marine resources, considering that the oceans and its resources will represent an important source of food, minerals, energy and coastal and sea space. It also identified the lack of information on marine non-living resources available as a major constraint for the proper functioning of the market mechanism, which is recognized as the driving force for resource development.

This issue of the Marine ETS continues our examination of technological developments for the exploitation of non-living marine resources.

Anthony Bromley
Technical Editor

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(iv), b4 p.
diagrams
illus.
maps

**EMERGING
TECHNOLOGY
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1/1997

***Marine Industrial
Technology***



**UNITED NATIONS
INDUSTRIAL DEVELOPMENT
ORGANIZATION**

Vienna, 1998

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A. SPECIAL ARTICLE

Deep Sea Manganese Nodule Mining

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Metal Mining Agency of Japan*

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1. Introduction

According to United Nations statistics, the current world population is approximately 5.8 billion and it is predicted to reach about 9.8 billion by the year 2050. More specifically, the population will, on average, increase by 75 million people per year over the next 50 years.

The current annual global consumption of resources consists of approximately 3.5 billion tons of coal, 3.0 billion tons of petroleum, 650 million tons of iron and steel, 20 million tons of aluminium, 12 million tons of copper, 900 thousand tons of nickel and about 25 thousand tons of cobalt. Thanks to the consumption of these resources, many of us live conveniently and comfortably. It is generally considered that the world population will continue to increase and, for many of us, living standards will also continue to improve. This is to say that we are going to be faced with an even greater consumption of resources than ever before. As the Club of Rome pointed out in 1972 in "The Limits to Growth", there is a limit to the resources that the Earth can provide. Consequently, we must make an increased effort to recycle and conserve products. These resources exist not only on land but also on the deep seabed, for example, manganese nodules, cobalt-rich manganese crusts, hydrothermal polymetallic sulphide deposits, phosphate nodules and so forth. We must recognize these resources on the land and on the deep seabed as Earth's resources. For the time being, we will probably be able to depend on on-land resources. However, since the consumption of resources continues to increase, we believe that, in the near future, we will need to exploit resources from the deep seabed in order to maintain the standard of living to which we have become accustomed.

Human beings receive great benefits from marine resources. Major marine resources include biological, energy, mineral and material resources. Yet, we must not only enjoy the benefits of these resources now, but also take responsibility for maintaining these natural resources for generations to come. The United Nations Convention on the Law of the Sea (UNCLOS) Part XI declares that the deep sea and its resources are the common heritage of mankind. With this in mind, it is necessary and vital to collect scientific data and information on present sea conditions, as well as on biological, energy and mineral resources for their sustainable development.

These days, environmental issues, such as global warming, desertification and so on, have become the centre

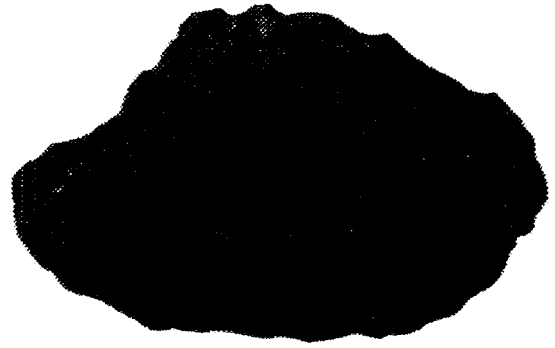
of public debate, and these issues will become more important year by year; therefore we can say that the twenty-first century will be the environmental century. If the consumption of resources increases, as a consequence, the global environment will be affected. Thus, worldwide cooperation to secure a comfortable living standard while sustaining the global environment is necessary. For that purpose, it is necessary to create a new socio-economic order for the recycling of resources. Research results concerning this theme were published in "Beyond the Limits" in 1992 by the same group who published "The Limits to Growth". In any case, "Sustainable Development" will be one of the most important issues of the 21st century. This paper therefore focuses on manganese nodules of the deep seabed as a future resource and very briefly introduces exploration, mining system, smelting, total system of deep sea mining and environmental research on manganese nodules.

2. Distribution of manganese nodules

Manganese nodules from the seabed were first collected by the ship *Challenger of England* at a depth of about 300 km south-west of the Canary Islands in the Atlantic Ocean. This occurred during the period 1872 to 1876. Subsequent surveys and research have proven that manganese nodules are distributed in almost all deep seabeds around the world. However, it was not until the late twentieth century that the distribution areas of economically feasible manganese nodules became clear. Once it became clear that the total grade of nickel, copper and cobalt of the manganese nodules, distributed in the seabed of the so called C-C zone (the Clarion-Clipperton fracture zone) south-east of Hawaii in the Pacific Ocean, is about 2.5 per cent, large enterprises from the United States, Germany and other countries actively searched for nodules from the 1960s to the early 1970s. As the surveys, and the research and development of manganese nodules required highly advanced technology, as well as a huge amount of funds, large enterprises from the USA, Germany, Japan and others, organized an international consortium around 1975 to conduct joint surveys, and research and development. As a result, INCO, US Steel, KENCOTT and others conducted mining experiments to exploit manganese nodules on the deep seabed and succeeded in recovering manganese nodules at a depth of 5,000 metres.

Deep Sea Mineral Resources

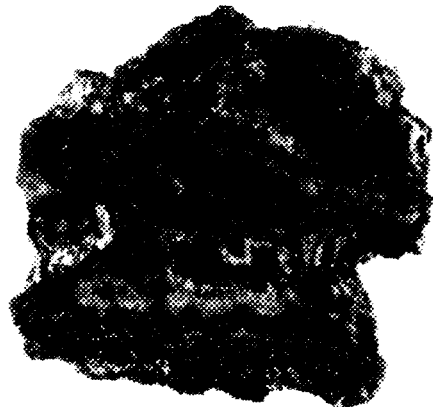
Composed of ferro-manganese oxides, including nickel, copper and cobalt, in a spherical or elliptical form with nodular diameters ranging from 1 to 15 cm. Abundant in the Clarion-Clipperton zone, south-east of Hawaii. Cover the relatively flat surface of deep sea bottom, 4,000-6,000 m depth.



Composed of ferro-manganese oxides similar to manganese nodules, including extremely high content of cobalt (named accordingly). Cover the bed-rock, top and slope of sea-mounts in the form of crust (approximately 5 to 15 cm thick). Abundant on sea-mounts 800 to 2,400 m depth in the Central and West Pacific areas.



Metallic components of hot water circulating through hot rock body spout from vents are precipitated on the sea floor. Found on the central ridge of the East Pacific Ocean, in the centre of the Atlantic Ocean and the Red Sea, approximately 1,500 to 3,500 m depth.



MARINE RESOURCES

Tourist Attractions

- Marine Sports
- Fishing
- Resort



Biological Resources

- Fish
- Shellfish
- Seaweed

Energy Resources

- Oil
- Natural Gas
- Methane Hydrate
- Tide & Wave

Material Resources

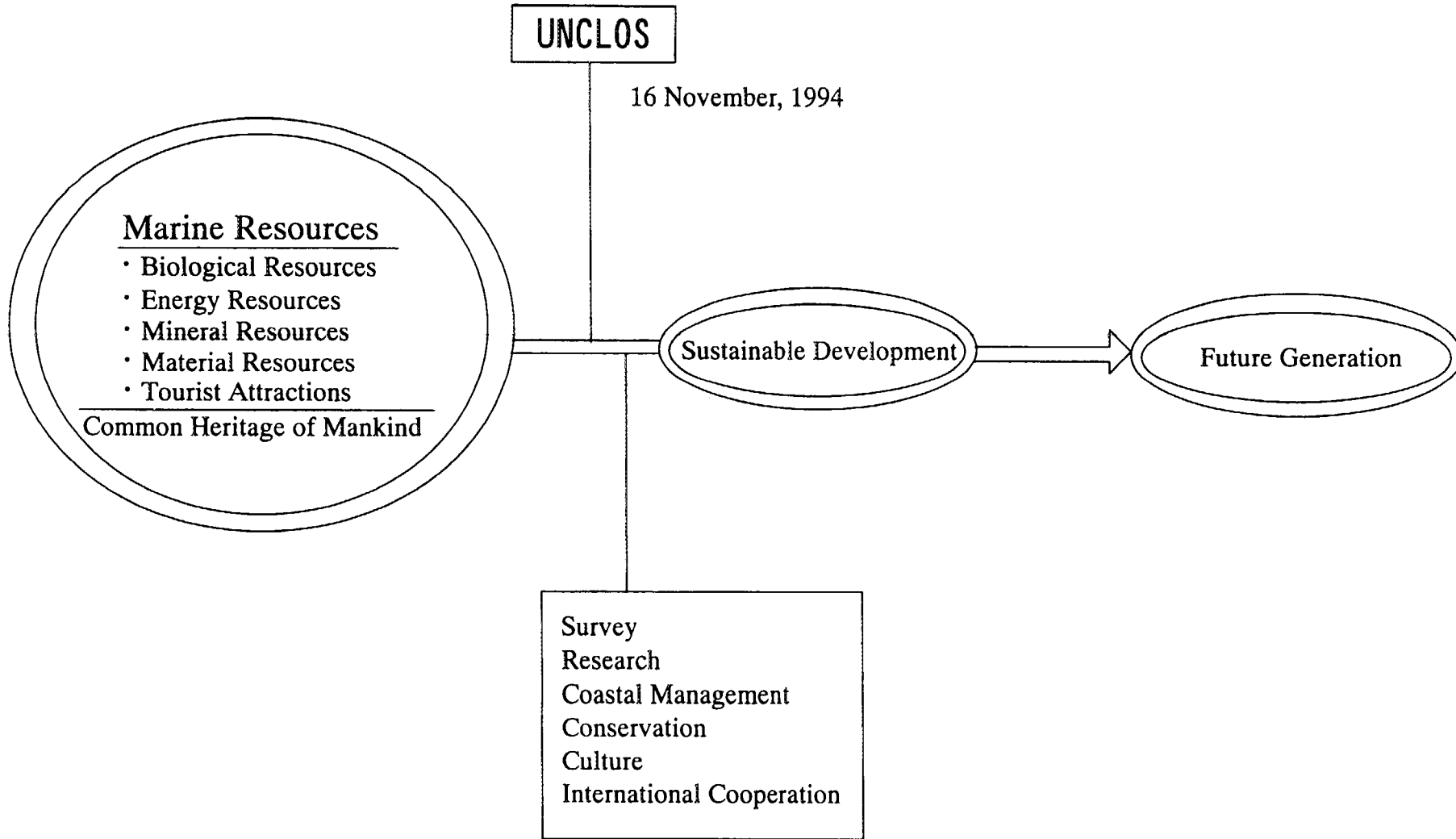
- Silica
- Carbonate

Mineral Resources

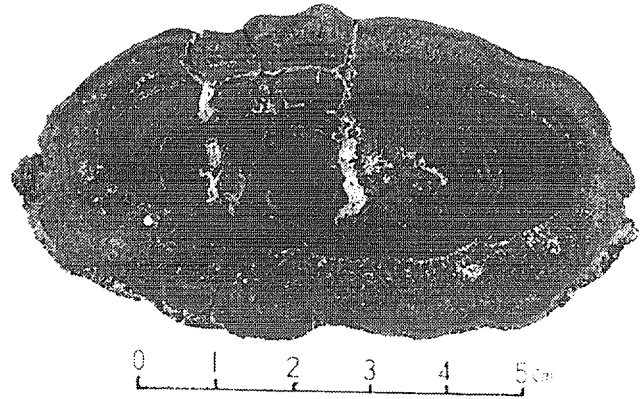
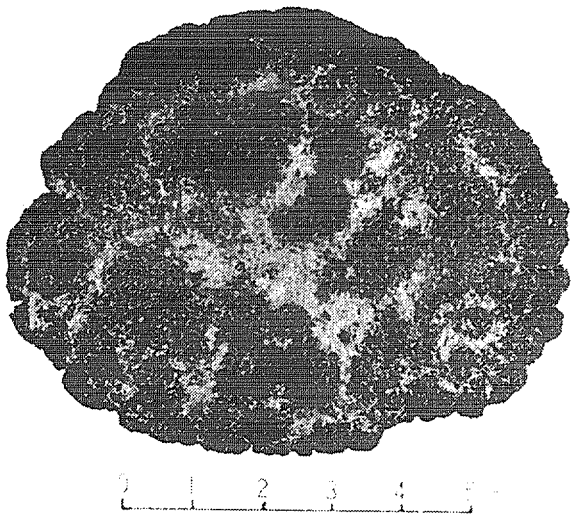
- Mn-Nodules
- Cobalt Rich Crust
- Hydrothermal Polymetals

UNCLOS : November 16, 1994

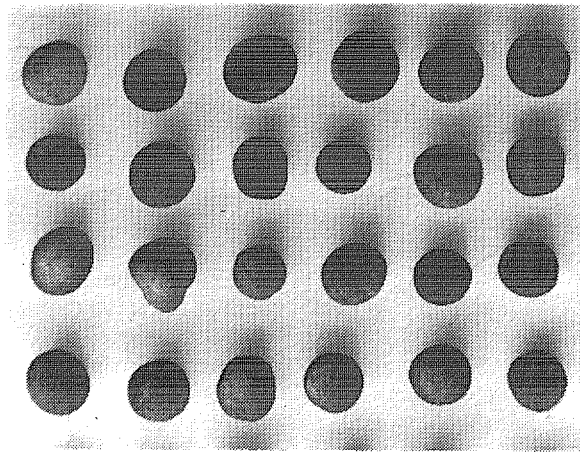
- EEZ (Part V)
- Continental Shelf (Part VI)
- High Seas (Part VII)
- The Area (Part XI) "Common Heritage of Mankind"
- Protection and Preservation of the Marine Environment (Part XII)



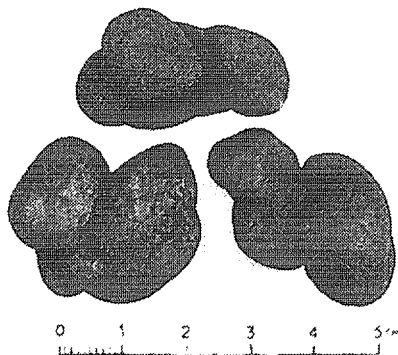
Shapes of Manganese Nodules



Hamburger Steak Shape



Ball Shape



Knot Shape

Manganese nodules occur in various shapes: hamburger steak, ball and knot shape; 1 to 15 centimetres in diameter and dark brown to black in colour. They contain iron and manganese hydroxides as the main components and metals such as copper, nickel, cobalt, molybdenum and titanium. Generally, a dark brown manganese nodule is richer in iron. A friable manganese nodule shaped like a knot with a smooth surface often contains lower grade nickel and copper. A black manganese nodule, like a hamburger steak with a rough surface, generally contains higher grade nickel and copper. The manganese nodules discovered at about 5,500 metres depth in the EEZ of the Cook Islands look like tennis balls and contain relatively high grades of cobalt compared with those of the C-C zone.

Most of the manganese nodules in the C-C zone are distributed on the seabed at a depth of 4,000 to 6,000 metres and contain relatively high grades of nickel and copper. At a depth of 1,000 to 2,500 metres, on both sea-mounts and sea areas near the land, manganese nodules are also found. Manganese nodules distributed on sea mounts, compared with those on the seabed at 4,000 to 6,000 metres in depth, often contain higher grades of cobalt. The metal grade of manganese nodules distributed at a relatively shallow depth and near land is generally low. Moreover, ultra small manganese particles, which are called micro-nodules, are distributed in sea water and/or on the seabed.

Many manganese nodules form in a concentric circle around a nucleus of a rock chip, a dead organism or a shark's tooth. The manganese nodules are distributed on pelagic sediment; some are concentrated and some are scattered, while others are covered with sediment. At depths where manganese nodules are distributed, mega benthic fauna such as Ophiuroidea, shrimp, Comatulina, fish and other organisms live; in addition, in the sediment of the seabed, meio benthos, which are too small to be photographed by a deep-sea camera, live. There are other mysterious benthic communities, however we have not yet enough knowledge, data and information on them. In recent years, the biocenose of the seabed have received attention. It is now necessary to start collecting basic data and information about the biocenose so that the effects will be minimal when commercial mining of manganese nodules begins. For such purposes, the USA, Japan, Germany, India, Poland, Korea, China and others have been conducting marine environmental surveys, sampling and research. Their research results were demonstrated at the "International Symposium on Environmental Studies for Deep-Sea Mining", held in Tokyo from 20-21 November 1997. The symposium was organized by the Metal Mining Agency of Japan and supported by the International Seabed Authority and the Advanced Marine Science and Technology Society. The symposium was very informative and fruitful in understanding the present activities of marine environmental research of each country.

3. Mining claims for manganese nodules

After 1987, on the basis of The United Nations Convention on the Law of the Sea, France, Russia, India, Japan, Interoceanmetal, People's Republic of China and the Republic of Korea applied to the United Nations and acquired their own mining claims. India acquired a claim in the Indian Ocean, while the other nations acquired their claims in the C-C zone in the Pacific Ocean. On 16 November 1994, the United Nations Convention on the Law of the Sea came into

effect and at the same time, the "International Seabed Authority" was started in Jamaica to supervise the deep sea and its resources. The Authority is now preparing mining codes and guidelines for marine environmental surveys which has become an important issue. In any case, commercial mining may only be carried out after careful consideration of the effects on the environment and with international cooperation.

4. Exploration of manganese nodules

The objective for the exploration of deep sea mineral resources is to confirm the amount, grade and abundance of such nodules. A high precision bathymetric chart must be prepared to search and fix the location of manganese nodules on a bathymetric chart. It is the most important part of the exploration. Therefore, a research vessel is installed with high precision positioning system and echo sounders. Systems such as Sea Beam of the United States and Hydrosweep of Germany are aboard such vessels.

Water pressure on the deep seabed is very high. For example, at 5,000 metres water depth, the pressure may be as high as 50 atmospheres, with a water temperature as low as 1 to 2° C. It is an extreme environment. Since almost no light, nor electric waves, can be used, equipment which can be operated by ultrasonic waves is most effective. Therefore, research vessels are installed with ultra wave systems for research activities.

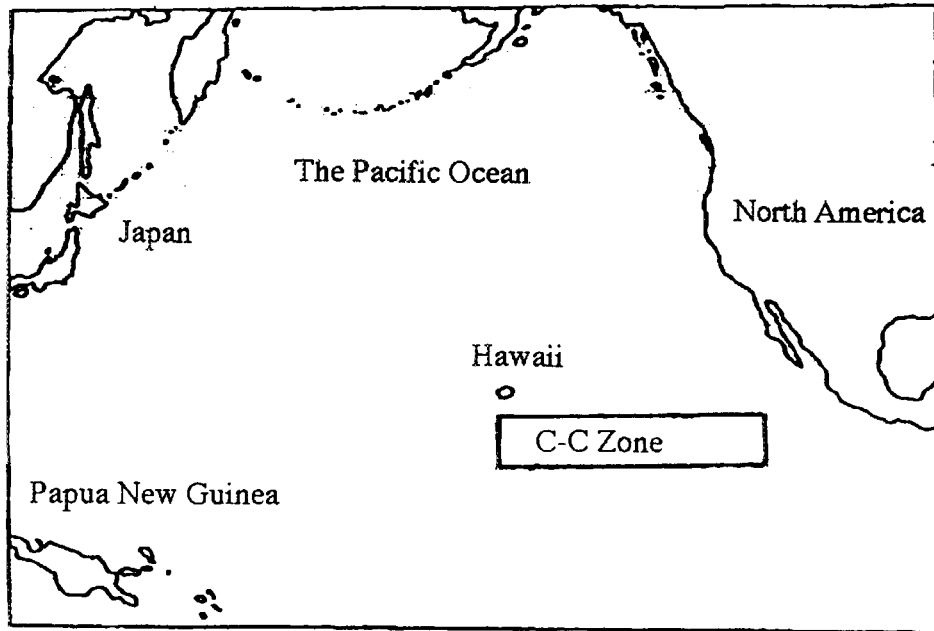
In order to conduct exploration, highly precise data and information on the horizontal and vertical variation of grade and distribution of manganese nodules must be effectively obtained. Of course, exploration must be carried out using different methods and equipment depending upon the characteristics of the target ore types. In order to determine the origin of resources, much data and information are needed. For this purpose, it is important to collect basic data through keeping a gravity meter and a proton gravity meter in operation all the time during the navigation and exploration.

To explain the exploration methods of manganese nodules, the survey system of the Metal Mining Agency of Japan is introduced here as an example. The Agency has been exploring for manganese nodules for more than 20 years in the Clarion-Clippertone Zone south-east of Hawaii.

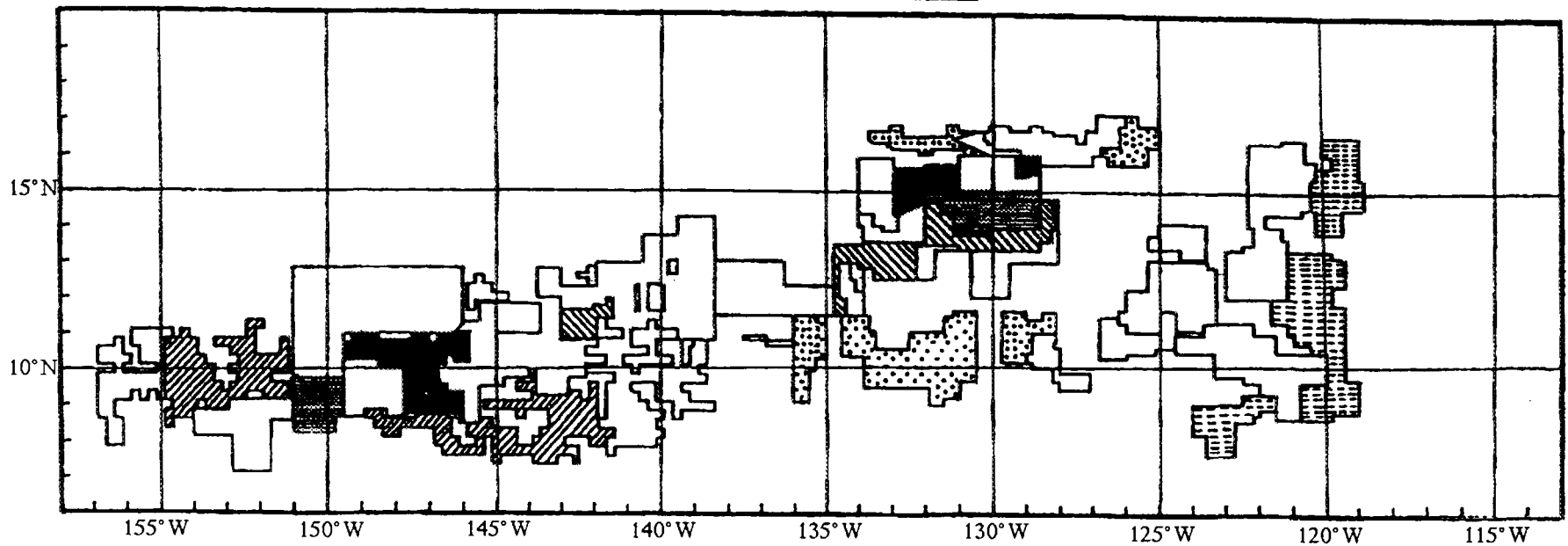
In order to draw bathymetric charts of vast sea areas effectively, they have installed the Hydrosweep (multibeam echo sounder) made by Kruppe Atlas Co., Germany. Using this system, while sailing at 8 to 10 knots, they can acquire geographical information of the seabed, which is twice as wide as the depth of the water and can simultaneously draw bathymetric charts by computer on board the vessel.

For automatic measurement of the abundance and diameters of manganese nodules, ultrasonic waves from a narrow beam echo sounder (30 kHz), a precision depth recorder (12 kHz) and a narrow beam sub-bottom profiler (3.5 kHz) are simultaneously transmitted and the reflection of these three sound waves are analysed by computer to estimate the abundance and the size of manganese nodules (Multi-Frequency Exploration System).

To investigate the grade and continuity, manganese nodules and mud are sampled from the seabed with a free-fall grab attached to a one-shot camera, a spade corer or a piston corer, and are then chemically analysed. To understand the characteristics of the manganese nodules, observations of the seabed with a deep-sea TV and/or a steel camera are very important.

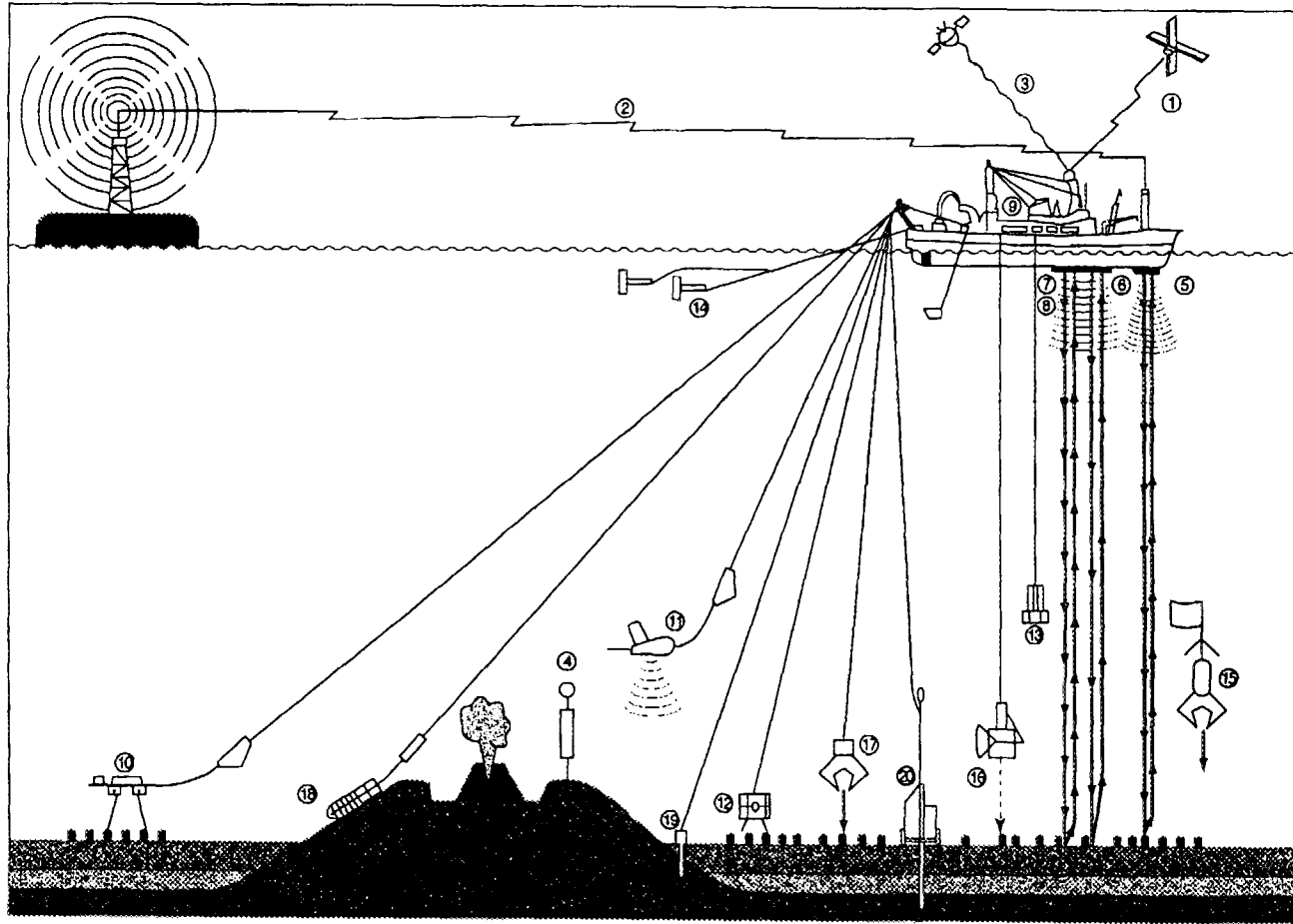


-  Japan (Registered in December 1987)
-  France (Registered in December 1987)
-  The former Soviet Union (Registered in December 1987)
-  China (Registered in March 1991)
-  Interoceanmetal (Registered in August 1991)
-  Korea (Registered in August 1994)
-  International Seabed Authority



Distribution Map of Mining Claims at "C-C Zone"

Exploration Equipment of R/V Hakurei-maru No. 2



Navigation System

- 1. Satellite Navigation System
- 2. Differential Global Navigation System
- 3. Global Navigation System
- 4. Transponder System

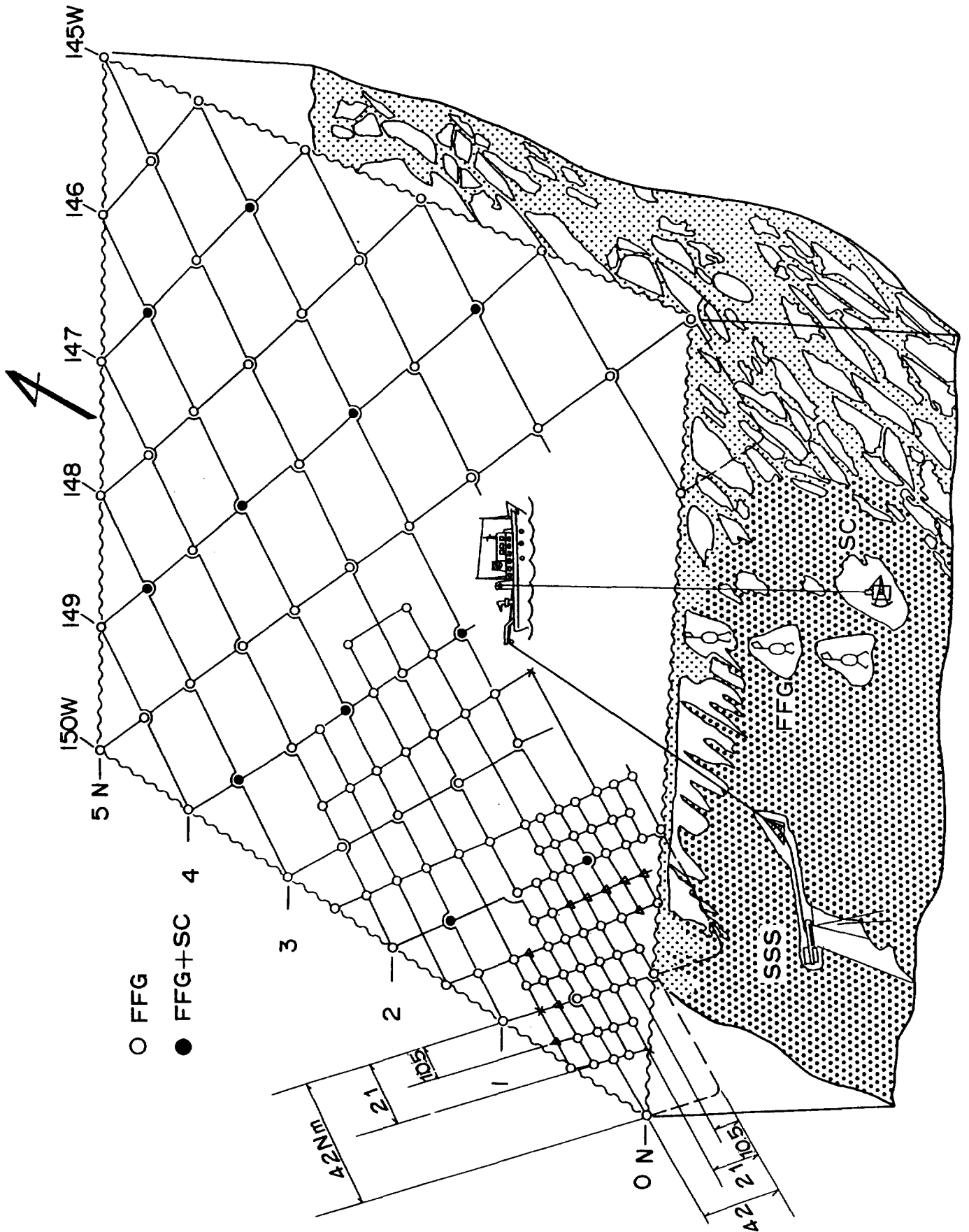
Exploration Equipment

- 5. Narrow Beam Sounder
- 6. Sub-bottom Profiler
- 7. Precision Depth Recorder
- 8. Multi Beam Echo Sounder
- 9. Multi Frequency Exploration System
- 10. Finder installed Deep-sea Camera
- 11. Side Scan Sonar
- 12. Continuous Deep-sea Camera
- 13. Conductivity-Temperature-Depth System
- 14. Proton Radio Meter

Sampling Equipment

- 15. Free Fall Grab
- 16. Spade Corer
- 17. Finder installed Power Grab
- 18. Drage Bucket
- 19. Piston Corer
- 20. Boring Machine System

Concept of Exploration of Grid Space



During a comprehensive analysis of these research results, promising distribution areas are then selected for further exploration. In the selected areas, further research will be intensively carried out. In other words, sampling would be carried out at a narrower pitch to study more precisely the continuity and grade of manganese nodules. This brief outline is the basic flow of activities for manganese nodule exploration.

5. Manganese nodule mining system

The mining system for manganese nodules has been developed by a consortium of primarily US enterprises which first succeeded in a mining experiment in 1975. Following this success, France, Japan, India and other countries began research and development into mining. Methods for mining are broadly divided into three categories:

- A suction system using a transport pipe;
- A line-bucket system using many buckets on a rope;
- A modular mining system by an unmanned submarine.

Up to now, the systems which have been successful in mining are the suction system and the line-bucket system. There are two different types of suction systems: a pump-lift system using several large underwater pumps and an air-lift system using compressed air.

Japan has been developing the suction system. In particular, the air-lift system seems to be promising because the pump-lift system has several mechanical underwater pumps, which require an electricity supply into the water. If trouble is encountered with the system, it must be lifted up on board for repairs. Conversely, since the air-lift system has a compressor aboard to generate compressed air, its maintenance is much easier.

The suction system consists of four main sub-systems:

- A collector system for manganese nodules;
- A lifting system to transport manganese nodules collected by the collector to a mining vessel;
- A handling system to transport, connect, descend and suspend the underwater equipment such as a collector, underwater pumps, etc. suspended by lifting pipes; and
- A measurement and control system to monitor operating conditions of each equipment to carry out safe and effective operation.

6. Smelting technology for manganese nodules

A manganese nodule is a polymetallic oxide, of which major components are manganese and iron hydroxides. Nickel, copper and cobalt also occur in a complex manner among manganese and iron phases. Compared with mineral deposits on land, the water content is relatively high, with manganese nodules containing as much as 30 per cent, its porous structure creates quite a large surface area. Therefore, in comparison to the conventional method of dry treatment for ores on land, smelting of manganese nodules has the disadvantage of being very costly in terms of energy.

The following five methods have been considered to be possibilities for the smelting of manganese nodules up to now:

- Reduction and ammoniacal leaching;
- Cuprion ammoniacal leaching;
- Reduction and hydrochloric acid leaching;
- High temperature and high pressure sulphuric acid leaching;
- Smelting and sulphuric acid leaching.

Since manganese nodules are not entirely suited to smelting, it is necessary to develop a more economical and effective method which combines both dry and wet systems.

The Metal Mining Agency of Japan made a comparison test of the above five methods on the same manganese nodule sample and developed a modified "smelting and sulphuric acid leaching" method. Ordinary smelting and sulphuric acid leaching has the disadvantage that sulphuric acid cannot be reused as sulphuretted because an autoclave at a high temperature and high pressure is used in the sulphuric acid leaching process. To solve these disadvantages, a new and upgraded method was created to leach refined mat with chlorine gas. This new improved method has realized a high leaching rate of metals that can be easily recovered. Furthermore, the reuse of sulphur is possible. Yet, not all problems are solved. For example, since chlorine gas is used, corrosion proof materials must be used for leaching devices. It is very costly. In addition, the chlorine anion adversely affects electrolysis of copper.

7. Total system for deep-sea mining

With commercial mining of manganese nodules occurring in the future, it is necessary to operate the mining system efficiently. For that purpose, it is an ideal method to manipulate a collector along the isobath. Therefore, a detailed survey of the seabed topography and manganese distribution is required. According to annual plans for mining, to delineate the exploitation area, more precise surveys should be carried out. During this stage, more precise topographical and manganese nodule distribution maps would be essential in order to exploit the nodules more efficiently. According to present knowledge, a step less than 50 centimetres would be required for the safe and efficient operation of the collector.

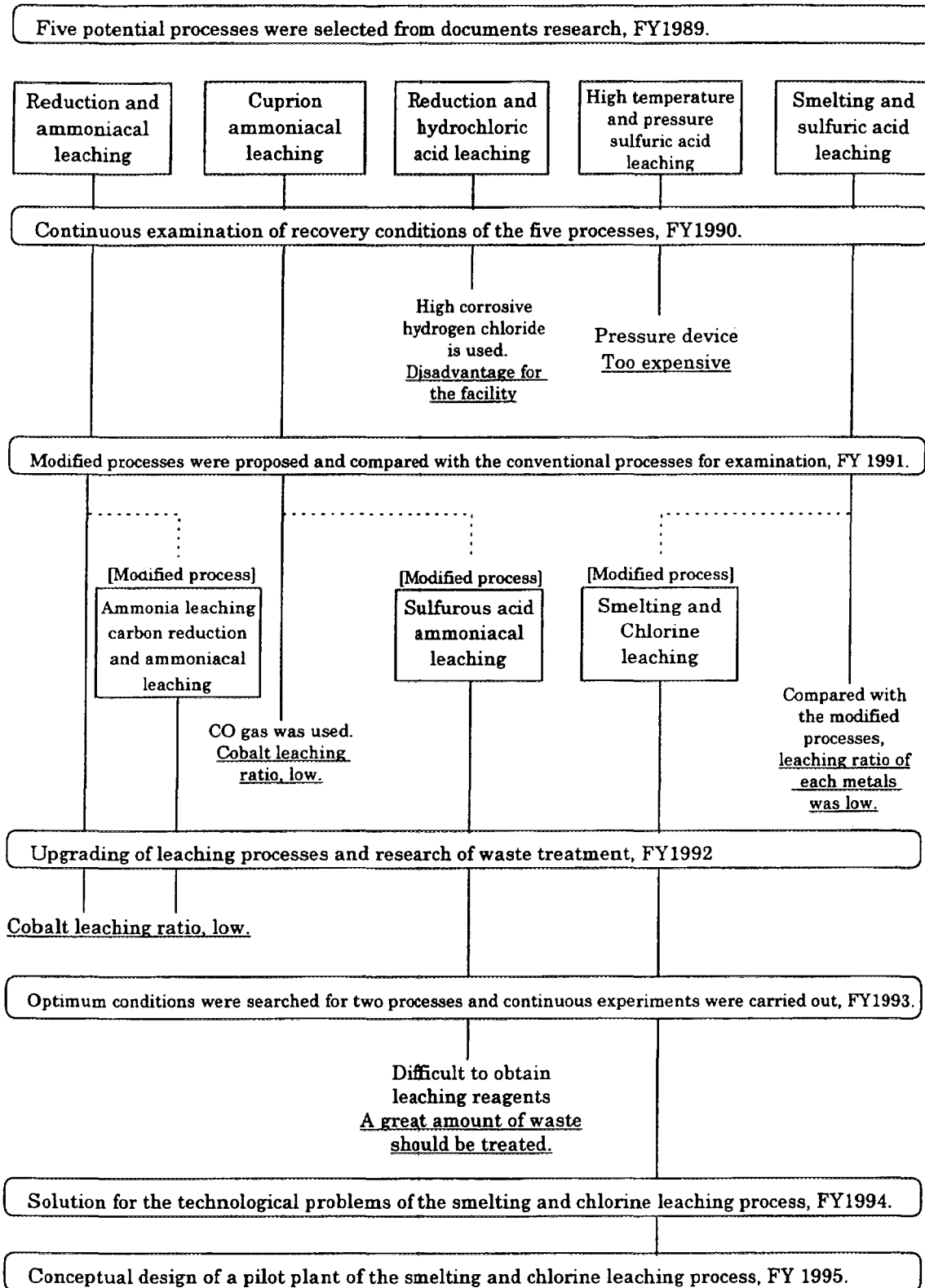
To keep the mining cost low and make a profit, a targeted volume of manganese nodules must be lifted within a scheduled operation period. In order to do so, the efficiency and reliability of the lifting system must be high. At present, the system with the most potential is the suction system. However, we need more detailed data and information on the scale, efficiency and number of mining vessels for the feasibility studies.

The scale and location of a smelting plant must also be carefully examined. Once the annual volume is decided, the scale of a smelting plant can be settled by the type of smelting method. However, as for the location, the most suitable place must be selected after careful consideration of the distance from mining claim areas, scale of transport, electricity supply, transportation of products, environmental preservation and other factors.

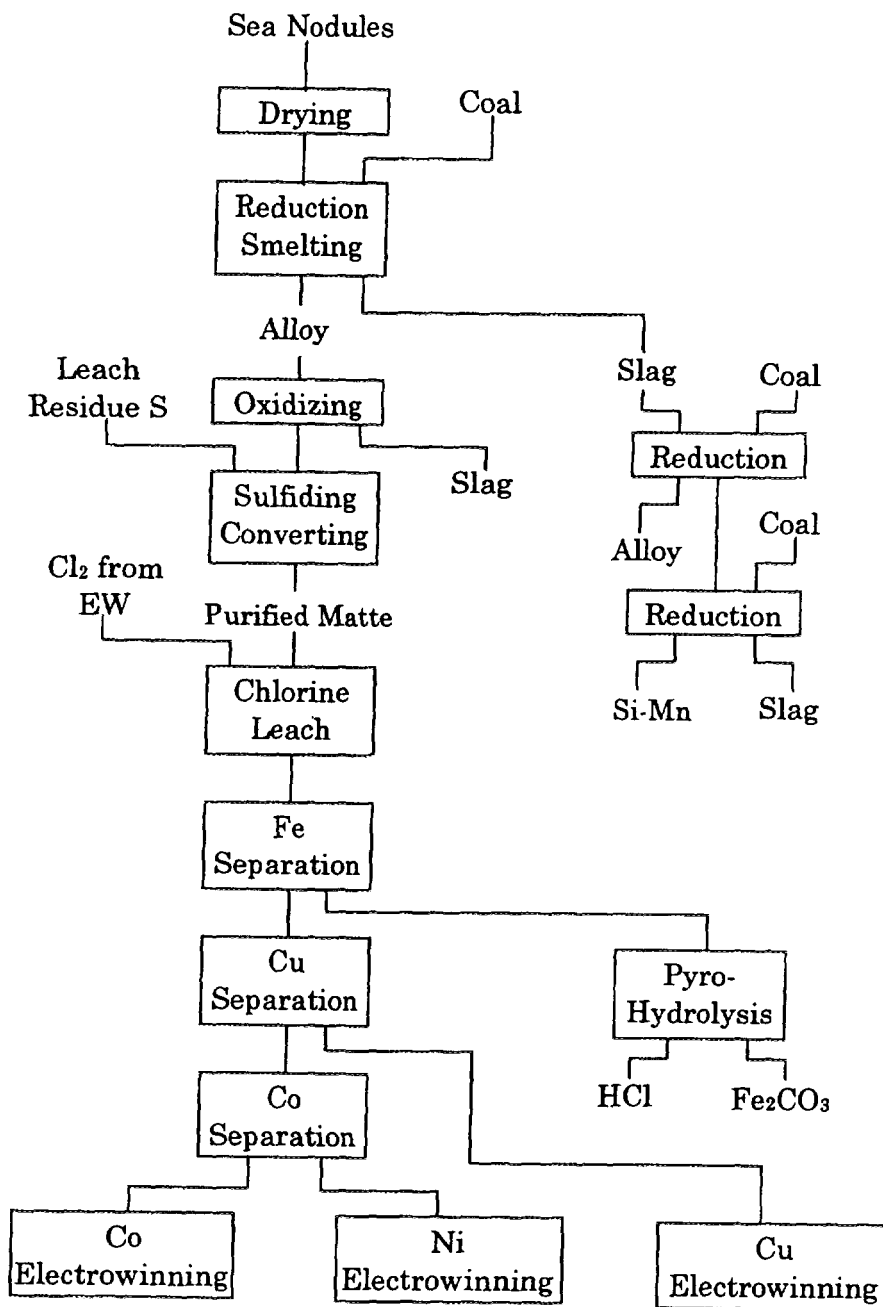
8. Research on environmental effects by deep-sea mining

Deep sea mineral resources have attracted a great deal of attention as a promising resource in the future and many developed countries have enthusiastically conducted exploration activities. The research and development of manganese nodule mining and mining tests at sea were completed in the late 1970s as mentioned before. On the other hand, due to increasing concerns from all over the world about the preservation of the environment and depreciation of base metals such as copper, lead and zinc, as well as rare metals such as nickel, cobalt and others, the development of manganese nodule research was forcibly postponed. At the same time, since developed countries were requested to solve the problems of the destruction of the ocean environment and thus the deep sea mineral resources; they have been conducting marine environment surveys, collecting valuable data and information on the marine environment, including physical-chemical and biological conditions and the ecosystem.

History of Research and Development of Processing Technology of Manganese Nodules



Flow Sheet of Smelting and Chlorine Leaching Process



To understand the marine environment, data and information concerning the surface layer, underwater and the seabed must be collected. At the surface layer of the ocean, physical phenomena such as waves, ocean currents and others affect wide areas. Underwater, particularly near the surface layer, a great number of living things such as fish, plankton and others exist. Since their living conditions depend on the concentration of oxygen, nutrient salts and other elements dissolved in the sea water, it is necessary to measure the dissolved and suspended substances to understand the chemical phenomena. It is also necessary to study the ecology of zooplankton, phytoplankton, fish and large animals such as whales. On the seabed, it is necessary to conduct research in order to truly understand the ecology of benthos, including bacteria and protozoan and others.

To understand the relationship between resedimentation and biological reaction, artificial impact experiments are being conducted by the USA and Germany. The former, named BIE (Benthic Impact Experiment), began in 1991 and is being performed by the NOAA (National Oceanic and Atmospheric Administration of the United States of America) in the North Equatorial Pacific Ocean. The latter, named DISCOL (Disturbance and Recolonization Experiment in the Deep South Pacific Ocean), was started in 1989 and is being conducted in the South Equatorial Pacific Ocean by a scientific group from Hamburg University. The Metal Mining Agency of Japan (MMAJ) carried out environmental studies. These studies, commenced in 1989, were conducted in association with NOAA and include an experiment named the Japan Deep Sea Impact Experiment (JET).

JET included two cruises in the summer of 1994, both of which were conducted in association with CGGE (Central Marine Geological and Geophysical Expedition of the Russian Federation) aboard CGGE's vessel the R/V Yuzhmorgeologiya. JET was designed to evaluate the impact of resedimentation on the deep sea benthic community, and consists of three phases. Phase 1 is a baseline study to confirm the pre-disturbed condition of the benthic community (density, fauna, composition, environmental factors). Phase 2 is to create an artificial resedimentation condition using a mechanical benthic disturber. Phase 3 is to observe and analyse the biological reaction associated with the resedimentation and to understand the recovery process. Based on these phases the biological impact of sedimentation will be assessed both spatially and temporarily.

There was an epoch-making research programme on the marine environment, which was known as Deep Ocean Mining Environmental Study (DOMES). It began in 1975, to evaluate potential at-sea environmental effects from deep ocean mining. The DOMES programme focused on studies relating to short-term (one week), near-field (5-10 km from the point of operation), physical-chemical and biological effects of deep ocean mining. DOMES consisted of two phases: DOMES I characterized the baseline conditions within the 13 million square kilometres of the ocean area where industry has indicated initial mining would occur; DOMES II monitored the effects from industrial pilot-scale mining tests within the same area. The programme also broadly characterized the region of potential mining, since so little is known of the deep sea ecosystem where mining is expected to occur. This was indeed a leading and epochal programme and provided much important data and information to the world.

9. Japan's marine environmental research

The Metal Mining Agency of Japan, in cooperation with the NOAA of the United States, has been studying the

environmental effects of manganese nodule mining in the Japanese mining claim area south-east of Hawaii, since 1989.

In commercial mining of manganese nodules, although it depends on the type of mining system, a great amount of mud and cold deep sea water is discharged at the ocean surface. At this time, water temperature, salt content, nutrient salts and other factors at the water surface layer is changed. Thus, extinction or abnormal breeding of plankton by eutrophic salts may occur. An increase of suspended substances of mud in the sea reduces the transparency of sea water by preventing penetration of sunlight. If such conditions last for a long time, sea life such as plankton will be badly affected; the food chain will be disturbed and the whole ocean will lose its balance. Consequently, in order to learn about the seasonal changes and time deterioration of the natural environment of the sea, long-term research should be carried out to collect the necessary data and information needed to understand what factors will influence the ecology of the ocean.

(1) Baseline research

A baseline, running north-south, was set in Japan's mining claim. At survey points on the baseline between 0 and 200 metres depth, data and information were collected for water and weather conditions (the direction of the wind, wind velocity, the height of the waves and swells), chemical composition of sea water (water temperature, concentration of salt, dissolved oxygen, concentration of hydrogen ion, nutrient salts, trace elements, suspended substances and others) and the amount of living things in the sea water (zooplankton and phytoplankton). In addition, mud from the seabed was collected by a multiple-corer and observations of macro benthos, micro benthos and meio benthos, which are living in the seabed, were carried out.

(2) Environmental impact experiments

When commercial mining of manganese nodules takes place, it is anticipated that along with the manganese nodules, cold deep water, together with mud, will be discharged, affecting the ecology of the surface layer. Therefore, for this reason, culture tests of plankton were carried out with a mixture of surface water and the deep water containing eutrophic salts, indicating the possibility that phytoplankton can multiply.

(3) Disturbance experiments

It has been assumed that meio benthos in the seabed would be damaged by the disturbance of the seabed caused by mining of manganese nodules. Therefore, artificial disturbance conditions were created by pulling a disturber and its influence on living things on the seabed and aged deterioration were studied. It was confirmed that the ecology would almost recover after one year. However, it is necessary to observe the ecosystem on the sea floor for a long time.

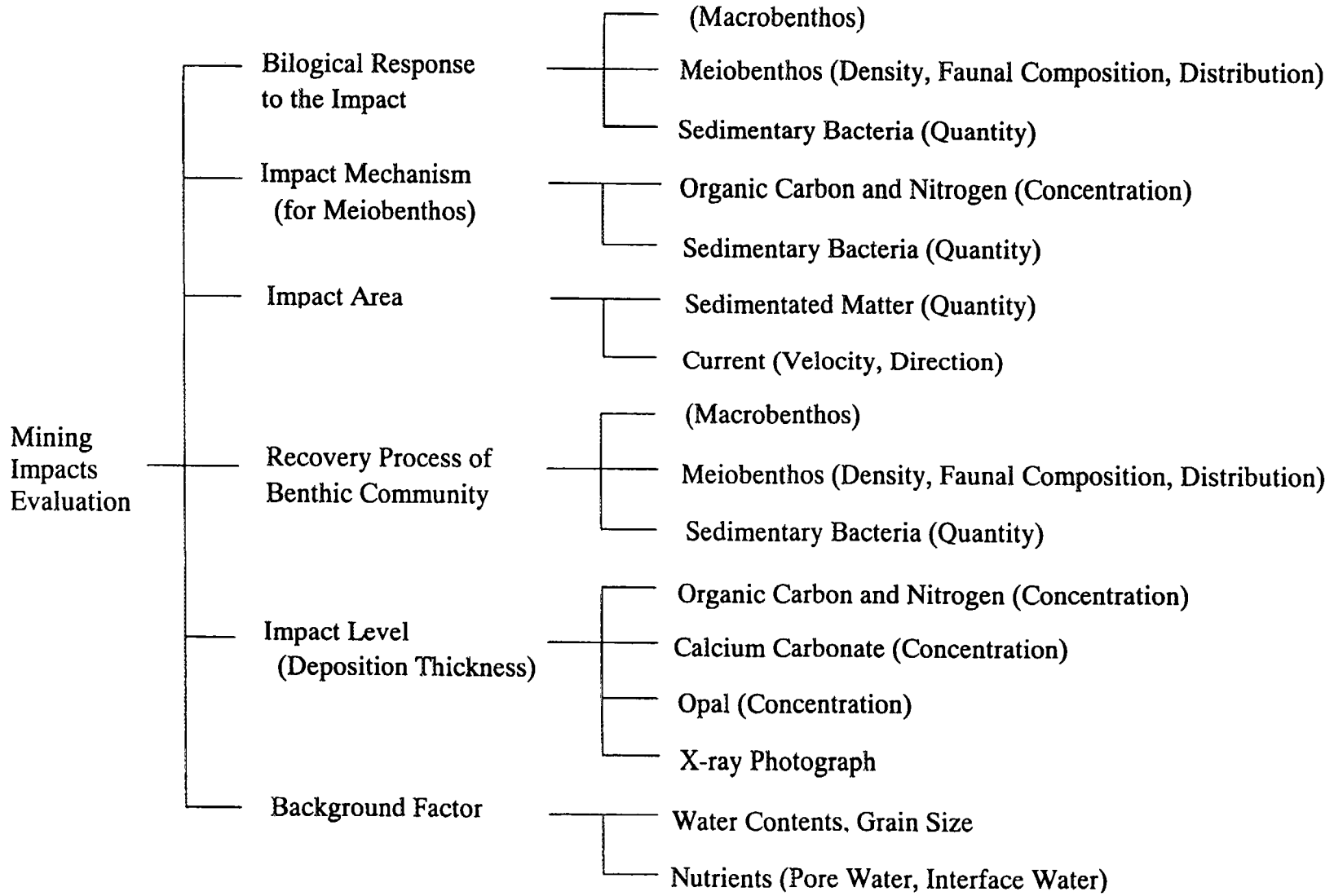
(4) Development of an environmental impact estimation model

On the basis of the data and information obtained by the baseline research and the submarine disturbance tests, a simulation model to assume ecological changes on the surface layer and a simulation model of mud diffusion during mining were developed.

10. Conclusions

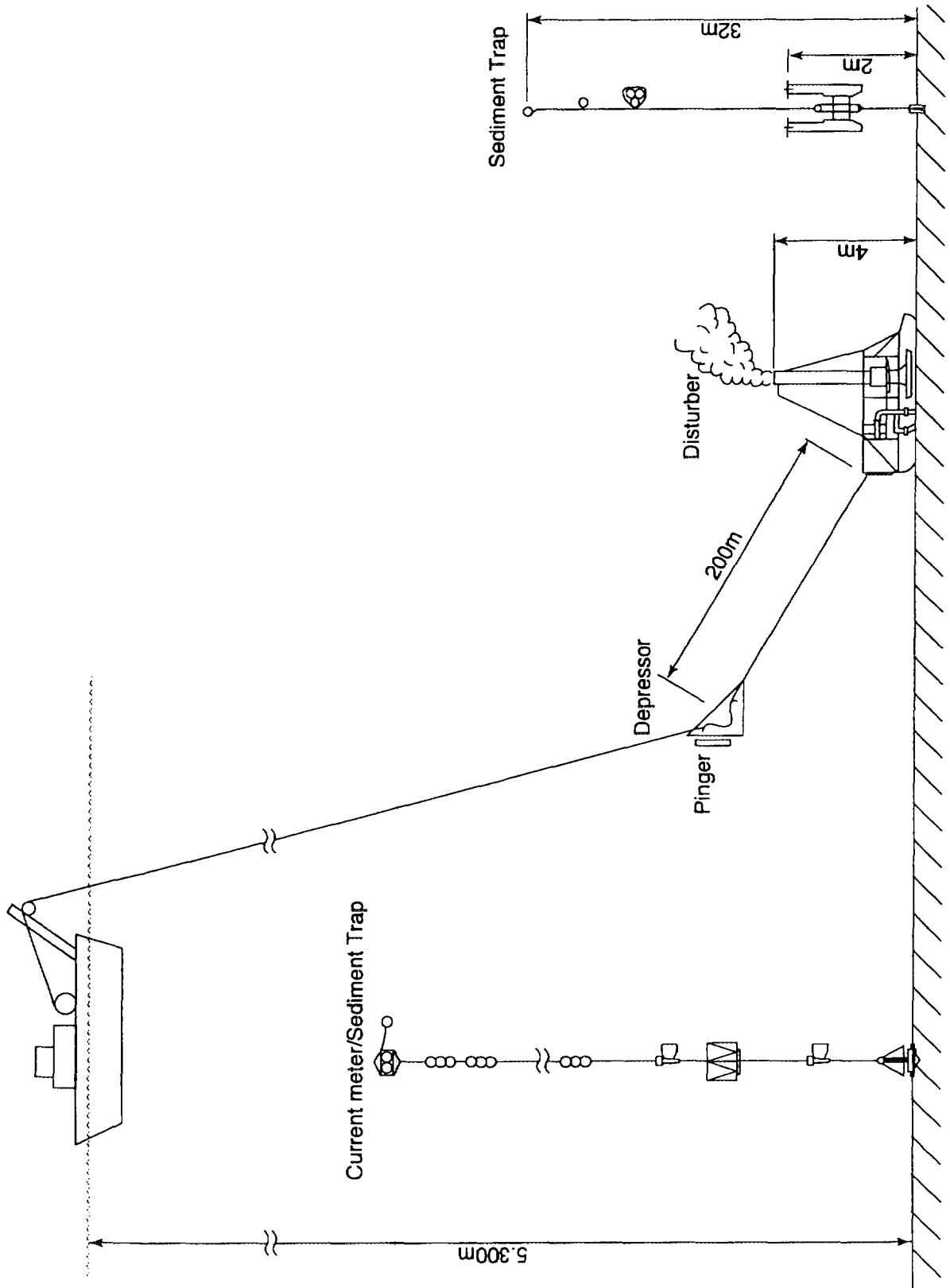
According to Dr. Skinner (1976), there are two patterns in the amount of resources and grade of resources on Earth:

- Those which exist abundantly in the continental Earth's crust are 12 elements, including iron, aluminium,



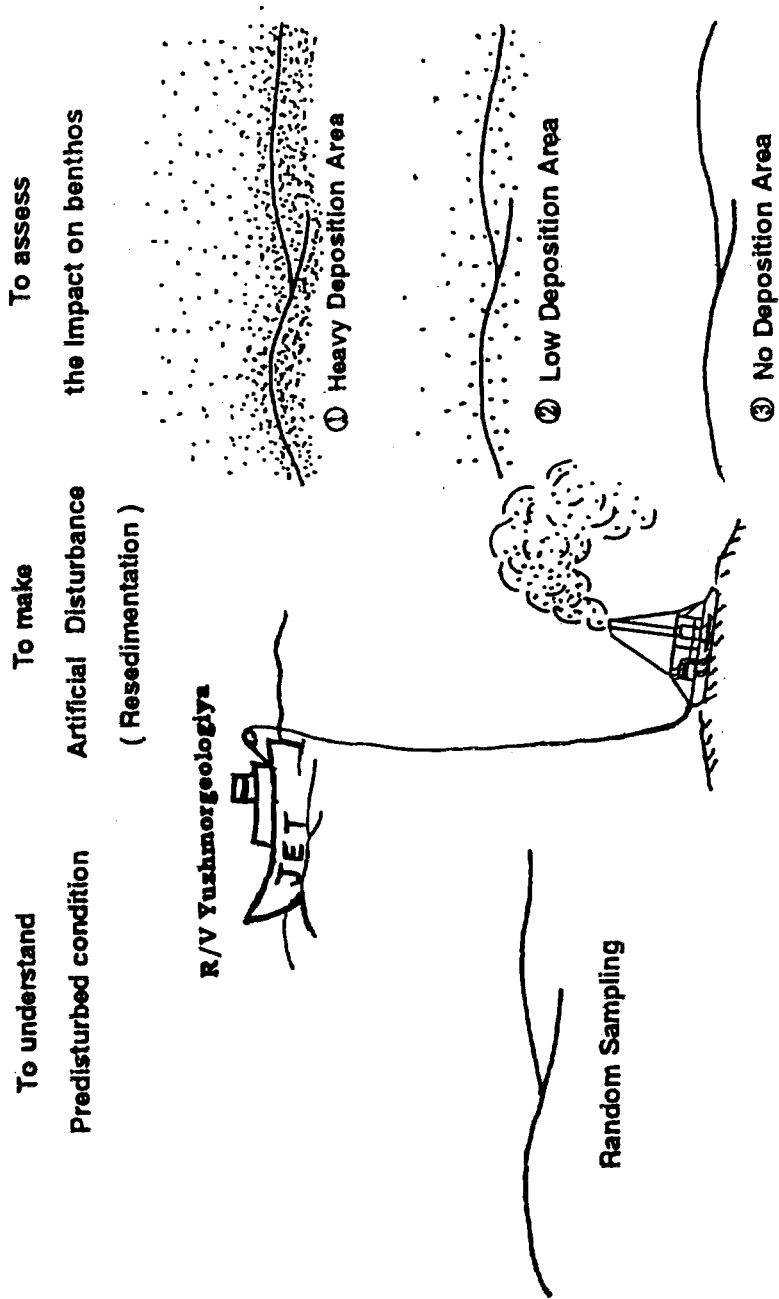
Study Subjects

Schematic Arrangement for Disturber towing



Original Sampling Plan

Sediment sampling was conducted to evaluate the effect of resedimentation on the benthic community by comparing pre-disturbance samples with those collected after the disturber towing



magnesium, manganese and titanium. Small concentrations of these elements are also contained in rocks. Therefore, if they are concentrated a little more than the average of the Earth's crust, they will be useful resources.

- Although resources in high grade are small in amount, if their grades are lowered, the amount of resources will increase. There are 76 elements, including chromium, strontium, vanadium, nickel and copper, of which the amount of resources will increase rapidly if their grades are extremely lowered.

For these two types of resources, lower grade ores are extracted thanks to improvements in processing and smelting technologies. If processing and smelting technologies are highly developed and unlimited amounts of energy were allowed to be used, resources utilized by society would not be exhausted. However, such behaviour will never be permitted.

Compared with the development of resources on land, development of deep-sea resources is costly, as large amounts of investment are required for new facilities, such as mining equipment, transport vessels, smelting plants and so forth. On the other hand, since the grade of ore on land has shown a tendency to decrease, it is inevitable that a greater amount of energy will be required for the acquisition of these metals. Taking these circumstances into consideration, we can say that the time will come when the cost of mining deep-sea manganese nodules will be equivalent to the cost of mining resources on land.

We are currently able to maintain our prosperous and advanced civilization because our precursors discovered and secured abundant resources for us. If our descendants wish to maintain the same or better living standards than presently achieved, they will need various resources in greater amounts than at current levels. Therefore, it is important for us to develop resource recycling and new exploration technologies for unknown ore deposits, and at the same time to explore new resources and deep sea resources such as manganese nodules, to secure new resources for the future.

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B. INDUSTRY NEWS

Waterproof LCD radar

A new *T-150* micro-sized LCD radar from Si-Tex Manne Electronics Inc., USA is small enough to fit on most sizes of powerboats. It has a high definition 7" screen with back-lighting for crystal-clear clarity, day or night. With a 1.5 kW transmit power it has 12 programmable ranges, up to 16 nautical miles.

To monitor local fishing hotspots, the Position-Pick-Off (PPO) control can display position of on-screen targets. (Source: *INFOFISH International*, April 1996)

New ammonia test kit

The new Ammonia Pocket colorimeter Analysis System from Hach Co., USA is a convenient, economical test kit that simplifies ammonia monitoring in water. The kit's 0-0.5 mg/l range can be easily extended to 0-12.5 mg/l using sample dilution. Ammonia nitrogen ($\text{NH}_3\text{-N}$) is displayed in direct concentration units, and conversion factors are given for expressing results as mg/l ammonia (NH_3) or mg/l ammonium (NH_4^+).

The Hach system uses prepared, unit-dose reagents, based on salicylate chemistry, to simplify sample colour development. Each PermaChem Powder Pillow contains the precise amount of reagent required for a single test. Pillows for 100 measurements are provided. The kit is supplied with instrument, power pillow reagent set, graduated mixing cylinder, sample cells, dilution water with field containers, and a detailed instrument and procedure manual, and is packaged in a sturdy carrying case. (Source: *INFOFISH International*, April 1996)

Fish vaccination system

The *Marivax* pneumatic fish vaccinating system supplied by Diamond Engineering Co., UK is a cost-effective way to vaccinate farmed fish quickly, accurately and safely. The system allows the operator to administer the exact dosage automatically to fish ranging from 20 to over 200 g.

The *Marivax* can process 2,000-3,000 fish per hour with minimum stress to the fish. The system is simple to operate and the danger of self-vaccination is reduced as the syringe will not operate unless the fish has been placed against the sensitive guarded button. (Source: *INFOFISH International*, April 1996)

Spectrophotometer carousel accessory

Hach Co. USA has announced the availability of a new accessory for the popular DR/4000 UV-VIS Scanning Spectrophotometer, the COD/Test 'N Tube Carousel. The five-position samples cell adaptor is designed to provide a way to group, record and quickly perform several sample measurements at a time.

Configured to accept vials containing chemical oxygen demand and Test 'N Tube (nitrate, nitrite, ammonia, phosphorus) premeasured reagents, the carousel speeds testing with minimal human intervention. Depending on the set-up menu selected, the DR/4000 automatically rotates the sample cells and reads the concentrations in a programmed sequence. (Source: *INFOFISH International*, April 1996)

Shell's Mars platform installed in Gulf

Shell Oil's Mars tension-leg platform (TLP) is being installed in record water depths in the Gulf of Mexico. The \$1.2 billion Mars project will produce oil and gas from the largest US Gulf discovery in 25 years.

The TLP was towed in May from its integration site near Corpus Christi to its permanent location in 2,940-foot waters, which will set a water depth record for a production facility in the gulf. Mars will surpass Shell's Auger TLP at a previous record-breaking depth of 2,860 feet. When completely assembled, Mars will be 3,250 feet high from the seafloor to the top of the drilling rig and will weigh about 36,500 tons. (Source: *Sea Technology*, July 1996)

New tool reduces time taken to carry out bolt-tensioning

A tool developed for divers working on subsea-engineering projects could reduce the time taken to carry out bolt-tensioning operations by up to a half, according to a spokesman for the British Trade Office of the British Consulate-General (New York).

Aqua Jack is manufactured by Hedley Purvis Ltd. (Morpeh, Northumberland, UK) and features a patented quick-fastening reaction nut, according to the spokesman. He said the compact tool allows easy access in restricted applications. Its cylinder, piston and seal design eliminates the problem of piston seizure, while low-friction seals allow easy piston retraction. The coloured antislip surface improves operator grip and visibility, while the integral manifold design simplifies hose connection and does not require complicated tee-block arrangements. (Source: *Sea Technology*, July 1996)

More British equipment ordered by French hydrographic service

Following the success of earlier units in providing hydrographic data for a mid-Atlantic ocean survey, more British equipment has been ordered by the French hydrographic service based in Brest.

The Service Hydrographique et Oceanographique de la Marine (SHOM) originally bought eight 6,000-meter-depth-rated, low-frequency deep oceanographic release transponders (DORTs) from Sonardyne Ltd., in Fleet, UK for the Atlantic survey.

These were installed in pairs for a two-year deployment in more than 4,000-meter-deep waters. Above the DORTs were sensor packages moored at intervals through 3,000 metres of water column. Two years of data gathering followed. The cost of recovery depended on the release mechanisms of the equipment working—which they did for the first time.

Now SHOM has ordered 14 more Sonardyne DORTs plus three lightweight command units. The DORTs are the latest positive-drive type and have a new release action for use in both light and heavy buoyancy loads and particularly where there is heavy marine growth. The mooring link is pushed out by the release mechanism rather than relying on gravity and the buoyancy load alone to open the release hook. (Source: *Sea Technology*, July 1996)

Eurosense orders TSS dynamic motion sensor for hovercraft

A TSS (UK) Ltd. (Weston-on-the-Green, Oxon, UK) motion sensor has been ordered by Eurosense to provide accurate vessel-motion compensation on board the company's Beasac[®] IV marine survey hovercraft. The DMS-10 motion sensor will be interfaced to a single-beam echosounder during a survey to be carried out in the Belgian coast area on behalf of the Coastal Hydrographic Survey Department of the Flemish Government.

The Beasac (belftop Eurosense acoustic sounding air cushion) platform is a new system developed by modifying a hovercraft to build a specific marine survey system. The vehicle is both highly manoeuvrable and very stable according to a spokesman from TSS. It allows surveys to be made with speed and accuracy from sea to beach even in shallow areas that are inaccessible to traditional survey vessels.

The motion sensor will be placed close to the transducer on a hoisting platform in the moonpool. This interesting application—involving a very fast-moving platform subject to harsh horizontal and vertical acceleration in speeds in excess of 25 knots as well as significant vibration—requires the highest quality of motion compensation equipment available, according to the spokesman.

The DMS-10 uses an emerging generation of processing techniques optimized for the high-dynamic marine environment and provides the ability to combine GPS data with new low-cost inertial sensors to achieve $\pm 0.10^\circ$ accuracy according to the company. (Source: *Sea Technology*, July 1996)

Patent issued for seawater purification process

A US patent (5,512,178) was issued to Fumio Dempo (Saitama, Japan) for a high-purification step for a water treatment system useful for treating seawater that has been processed by reverse osmosis (RO). The treatment step consists of an RO filter and an ion-exchange vessel added to a system with ozone, filtering units and UV treatment. The UV kills bacteria and breaks down organics; the ozone kills microbes and the filters remove organic and inorganic material. (Source: *Semiconductor International*, September 1996)

Oil Spill Response Ltd. (OSRL)

OSRL has become the first company in the UK to be awarded accreditation by the Nautical Institute to provide the highly specialized training required to deal with oil pollution. The company's operational base is at Southampton. The requirement for countries to set up and approve training programmes to deal with oil spills and pollution was agreed by the Oil Pollution Preparedness and Cooperation Convention in 1990. The UK Coastguard Agency is the competent authority responsible for putting the UK's programme in place through its Marine Pollution Control Unit (MPCU).

The UK is the first signatory to the Convention to have identified a rigorous set of training standards to which companies wishing to achieve accreditation must adhere. The validation panel set up to identify these standards included representatives from UK port and harbour authorities, the shipping industry, oil exploration and production companies, local authorities, the British Oil Spill Clean-up Association, the International Tanker Owners Pollution Federation and the Nautical Institute. (Source: *The Dock & Harbour Authority*, September 1996)

Fish cage security system

CageGuard from Ferranti-Thomson Sonar Systems, UK, provides fish cages with protection against approaching vessels. It supports features such as full system audit trails and sound recording of a vessel's engines, all based on a centralized shore station, with individual cage groups under radio-telemetry control. Natural predator protection can be provided when the system is integrated with an integral scrammer such as the Ferranti-Thomson Seal Scrammer.

At the sound of an approaching boat, *CageGuard* reacts by sending a radio message back to the shore, together with the underwater sounds for recording, and activates a relay which can be used to turn on lights or a siren. From the sounds of the boat, *CageGuard* can discriminate between passing boats—which it ignores—and boats coming alongside. The system classifies these as a threat and sends an alarm message to the shore base where *CageGuard* prints out a record of these events, sounds an alarm and, if fitted with an optional dialler, alerts you by telephone.

The *CageGuard* system checks itself automatically every hour and displays status information. (Source: *INFOFISH International*, May 1996)

Automatic feeders

Sterner Fish Tech., Sweden, has developed a new series of automatic feeders with a new, extremely accurate feeding mechanism. The feed is distributed by a revolving coil. The mechanism is self-cleaning and requires a minimum of maintenance. The adaptor *Presis* is specially designed to fit the *Evos 730/760* feeders and all *Aquatess* or *Sterner* feeders, but can be adjusted to fit almost any other feeder on the market.

The installation is done by removing the existing motor/gear box and the feeding disc. The adaptor slips right into the bottom of the hopper and requires no particular fastening. The adaptor distributes dry particles up to a size of 5 mm. All feeders in the *Presis* range are well suited for operation with computerized control units or time logging units. The 12-volt DC version has an adjustable speed or feed amount. (Source: *INFOFISH International*, May 1996)

New container tracking system from UK firm

Reading numbered containers and drums to try to track and monitor goods has posed huge logistical and manpower problems, but a new system from recognition specialists, Cambridge Neurodynamics, is set to transform the transport, storage and processing industries.

The new system—the Container Tracking and Identification System (CTIS)—is claimed to be the most accurate and reliable yet developed and sets a new industry standard for character recognition in situations where characters are partially obscured or printed on irregular surfaces.

CTIS enables highly automated stock control, tighter billing procedures, improved security, and does not require the large amount of paperwork and manpower involved in conventional tracking and monitoring.

Based on neural network technology and running on standard PC equipment or other common platforms, CTIS technology is both powerful and cost-effective. It has high levels of accuracy and reliability because, instead of being programmed, the intelligent system is trained on a large number of sample characters and thereby learns to cope with poorly defined characters in the video image. The system can

therefore operate efficiently in the dark and in all sorts of weather conditions and, as it is portable, can be located at a variety of convenient points. (Source: *The Dock & Harbour Authority*, September 1996)

Morris container cranes delivered to China

Morris Mechanical Handling Ltd. of Leicestershire, UK recently delivered two ship-to-shore container cranes to the Port of Tianjin, China's second largest port.

The order was won against intense world-wide competition and broke a previous monopoly by Chinese and Japanese suppliers to the port. The cranes have a capacity of 40.5 tons and an outreach of 44 m, suitable for standard 40 ft ISO containers stored 16 across the vessel beam.

The contract was funded by the World Bank which insisted that all serious bidders had both the resources, experience and financial stability to provide the required quality package.

Operating round the clock, the units are fitted with an electronic anti-sway device which helps operators counter the dynamic effects of a fully laden ISO container. The cranes are the largest container handling cranes in Tianjin and operate at speeds 50 per cent faster than the port's other installations.

To enable the operators to maximize productivity of both units, Morris fitted a diagnostic management package which monitors key functions to give early warning and logging of any faults which need repair or attention. The system also provides vital management information including container handling log and shift reports. (Source: *The Dock & Harbour Authority*, September 1996)

The world's largest swing bridge over Suez Canal

This is being built near El-Ferdan by an international consortium headed by Krupp Stahlbau Hannover GmbH and comprising the Lübeck works of Krupp Fördertechnik, the Brussels-based company Besix and Cairo-based Orascom.

Plans to widen the Suez Canal to 320 m have made it necessary to build a new link between the African mainland and the Asian Sinai Peninsula. The new 600 m long structure replaces the present bridge which was built by Krupp in 1964.

The lattice girder bridge will consist of two 300 m long swing sections and has been designed to alternate between single-track rail traffic and two-lane road transport, thus providing road and rail access to the Sinai Peninsula. The construction period has been set at 30 months and the bridge is due to be completed in early 1999. (Source: *The Dock & Harbour Authority*, September 1996)

Continuous control of oil spillages

A system for the continuous monitoring and control of oil spillages or run-offs from petrochemical complexes, industrial sites close to waterways and shipping activities within harbours has been developed by Ionics (UK) Ltd.

Whenever there is an unacceptable oil discharge the Ionics oil-on-water control system, based around its Slickwatch detector, can monitor spillages unattended. Should the levels exceed pre-determined limits the system issues control signals for corrective action such as the lowering of booms or closing of sluice gates.

Several options allow the user to programme the system to the detection sensitivity required. These include a film thickness discriminator to allow the detector to discriminate between thin and thick hydrocarbon films on the water, actuating controls only when thicker films have been detected.

The detector works continuously, projecting a light beam on to the water and sensing any difference in reflectance

characteristics. It can measure thicknesses as low as 0.1 micron, long before they become visible to the naked eye.

Users can bolt the detector to any convenient structure spanning or overhanging the water surface, such as a bridge, catwalk or beam. In some cases it can be mounted at heights up to 10 m. (Source: *The Dock & Harbour Authority*, September 1996)

New tidal sensor from Ormston Technology

A new two-part combined tidal and wave monitoring system with a resolution of 4 mm and an accuracy of ± 50 mm has been introduced by Ormston Technology, Hull, UK.

The system comprises an underwater sensor and a top-end processing unit using a vented sensor, so that no atmospheric compensation measurement is required. Incorporating a facility for measuring water temperature, the underwater sensor can be configured to measure both tide levels and wave activity. It can be located up to 5 km from its top-end unit or up to 20 km using a low-power telemetry link.

Transfer of data via a standard connection cable is interference-free, while multiple sensors can be connected for relay of information to a single top-end unit.

Top-end options include an RD100-TG waterproof LCD for configuration and measurement display purposes, while an interrogator can also be fitted with serial data output in the user's own format; also available are telemetry versions with remote receivers for ship and shore use as well as an automatic microprocessor-controlled data logger with up to 16 MB of memory. (Source: *The Dock & Harbour Authority*, September 1996)

EGS completes underwater noise projects

Electronic & Geophysical Services Ltd. (EGS) has completed a series of acoustic measurement studies for the Hong Kong Government and public utility clients in response to concern that underwater noises generated by major construction projects in the colony are having an adverse effect on marine mammal life, particularly rare Chinese white dolphins.

For the studies, EGS developed a complete calibrated noise measuring system with a sampling rate of 1 million samples per second. Experiments carried out in a controlled environment showed that a well-designed bubble curtain could effectively reduce underwater noise sources and levels occasioned by construction activities such as dredging, piling and cable ploughing operations.

Based on design parameters selected from experiments, a bubble curtain was installed around a large percussion piling project in Hong Kong waters. Subsequent measurements acquired and analysed on site by EGS confirmed that the curtain significantly reduced levels of noise heard by underwater marine life, thus contributing to better understanding and control of local marine ecology. (Source: *The Dock & Harbour Authority*, September 1996)

UK consultants to design Pakistan's new port

A joint venture of consulting engineers Posford Duvivier of Peterborough and Gifford & Partners of Southampton has won the design contract for the US\$ 800 million development of a new deep-water port. This is to be built at Gwadar on the Makran coast of Baluchistan, some 250 miles west of Karachi. The new port, promoted by the Federal Government of Pakistan, is intended to provide a strategic alternative to the Port of Karachi which currently is the main gateway for Pakistan's international trade. It will also form part of a new trade route for the emerging economies of the Central Asian republics.

Stage I will be developed directly by the Government to provide the basic port infrastructure including 600 m of new quay and the 5 km of deep-water approach channel.

It is aimed to begin construction of this first stage, valued at US\$ 120 million, later this year. Stage II for the extended port, oil terminals and refinery along with an industrial free zone is to be developed by private sector finance. (Source: *The Dock & Harbour Authority*, September 1996)

Greeks place large order for stress monitoring

Piraeus-based Kristen Navigation Inc. has placed what is believed to be the largest order to date for hull stress monitoring systems with BMT SeaTech of Southampton.

Nine systems will be fitted to four Aframax tankers and a Cape-size bulk carrier currently being built for Kristen and Anangel Shipping by Daewoo and Hyundai shipyards in Korea. A further four systems are to be retrofitted to Cape-size already in services with the Anangel fleet.

The software BMT is supplying with the systems includes a data viewer and a plotting and printing routine which can be used simultaneously with the real-time stress monitoring. It also incorporates a fully interactive two-way data link to a Saab/Kockumation supplied loading computer. This provides the master or officer in charge of cargo operations with both measured and predicted values simultaneously on both computers. (Source: *The Dock & Harbour Authority*, September 1996)

Marine coatings

The global nature of the marine coatings industry, which means coatings manufacturers have to have a worldwide stocking and distribution capability, makes it difficult to obtain and evaluate sales statistics. To give some idea of the proportional value of the marine market, sales in the UK are around £27 million (\$40.5 million), out of a total UK paint market of £1.2 billion.

According to a spokesman from the British Coatings Federation, the regulatory pressures are proving to be a large and growing burden. Taking the UK as an example, marine coatings have been subject to several data call-ins issued by the Health & Safety Executive. These require certain data to be submitted and, where not already held, to be generated, for the active ingredients which allow antifouling coatings to live up to their name. There are currently data call-ins for antifoulings containing TBT-copolymers and copper compounds, as well as four organic biocides. The generation of such data is being driven by the Biocidal Products Directive, the draft of which achieved common position in the summer of 1996. This will set up, as an annex, a positive list of active ingredients to be used in biocidal products. The products themselves, including antifoulings, will also have to be approved before they are given free movement in the European market. Active ingredients will have to be subjected to an extensive data review by the EC before being placed on the list and these data will have to be generated by the industry.

The unfortunate toxic side-effects of TBT-based antifoulings on the marine environment in yacht marinas led to a ban on their application on yachts under 25 m in the 1980s in most of Europe and the US. Such coatings may still be used on larger craft, tankers and cargo vessels, mooring in deeper waters. Non-toxic antifoulings have been around for several decades, but have an inferior performance, being effective over a much shorter period.

The apparently conflicting demands for environmental compliance and high performance, combined with ease of application, seemed an impossible combination to achieve.

Now, after five years of research, marine market leader Courtaulds International seems to have hit the jackpot, with *Micron Optima*, an antifouling coating which is water-based, rather than solvent-based, thus reducing toxic emissions into the environment.

Micron Optima is said to be unique among antifoulings in being a two-pack product; the base pack contains traditional components such as copper antifouling agent, binder and various extenders which control the application and film characteristics. The second can contains the activator, which degrades when released into the water. Drying times vary according to ambient temperature, but it is not suitable for application between tides, or at temperatures below 5°C. Nor should it be applied in wet or humid conditions, to a wet surface or on aluminium and aluminium alloys.

Clearly, marine paint manufacturers flourish in adversity and are themselves rising to meet the "global challenge" as well as their customers. (Source: *European Chemical News*, 14-20 October 1996)

High-performance portable navigation system

Matsushita Electric Works, Ltd. has started marketing a high-performance, palm-size portable navigation system, Handy Map Navigation System.

The system is compact and lightweight (collapsible size of 15.7 x 9.0 x 3.5 cm, approx. 280 g), waterproof, operates from a lithium battery, and incorporates for the first time a function that specifies the present position on a map.

Inputting information such as the starting-out position and map size enables the subsequent positions to be indicated on a liquid crystal display. The latitude, longitude, elevation, shift direction, speed and time of day at the present position are displayed.

The position is measured very accurately since the signals from a maximum of eight satellites are received simultaneously from the 24 orbital GPS satellites, and a signal combination providing the greatest measurement accuracy is selected automatically from the eight satellites. Also, an opening is provided in the window to enable notes to be scribbled on the map.

For convenience when using the navigation system on the seas, the system is incorporated with a function for switching to the desirable speed unit and a function for indicating time differential. For more information, contact Matsushita Electric Works Ltd., 1048, Monma, Monma City, Osaka 571 Japan. (Source: *JETRO*, October 1996)

New energy-saving propeller developed by shipbuilders

Five Japanese shipbuilders have jointly developed a new energy-saving contra-rotating propeller (CRP) system. The new CRP system has two propellers rotating in opposite directions that increases thrust force and, when used for tankers, decreases energy consumption by up to 15 per cent. The advanced hydrostatic tapered (AHT) shaft-bearing system has also been developed to increase durability and reliability.

The five companies involved in the joint operation are Hitachi Zosen Corp., Kawasaki Heavy Industries Ltd., Mitsui Engineering & Shipbuilding Co. Ltd., NKK Corp., and Sumitomo Heavy Industries Ltd.

The companies started the projection 1992 to develop the optimal propeller with contra-rotating bearing and double shaft structure. The accuracy of the CRP design was simulated for verification using a power measurement facility at the Kawasaki Akashi Research Institute applicable to a 10-metre-long and 7-metre-diameter propeller. Tests using a

10-metre-long scale model ship with a 30 centimetre propeller showed great savings in energy consumption.

The contra-rotating shaft bearing is an important component for the whole system, so the AHT shaft was developed with the system. This bearing can maintain a sufficient thickness of lube oil film at any rotations per minute ratio. The oil film can also be maintained when oil pressure falls. The AHT bearing has been tested using a prototype shafting applicable for long periods.

The patents for this new system are pending and the five companies plan to market the CRP system independently. (Source: *Sea Technology*, October 1996)

New underwater swivel technology introduced

All Oceans Engineering Ltd. (Aberdeen, Scotland) has introduced what is being called the first of its kind in underwater swivel technology. The 200-ton underwater swivel has been delivered to McDermott Subsea Constructors Ltd. (Aberdeen) and deployed for use in connection with work on the BP Foinaven project.

Handling heavy loads from the surface to the seabed is typically done on a single wire, but a multi-fall system regularly twists up on itself before reaching the desired depth.

The search began for an underwater swivel that could be expected to undergo repeated use in depths up to 600 metres. Fitting the new swivel allows the rope to twist with little effect on the load. It also makes the load much easier to turn when it is required to do so. The simple design with integral pressure compensation and clean lines avoids vulnerable appendages to rigging attachments. This design also provides the benefit of using different end fittings for use with a wide range of different sizes and types of rigging attachments. (Source: *Sea Technology*, October 1996)

Watermaker

Nautilus watermaker, the latest Australian evaporative technology from Naiad International Pty. Ltd., makes pure drinking water from oceans, rivers, polluted water and even untreated sewage, at practically no cost. The *Nautilus* watermaker uses the principle of distillation to make water, like nature makes rain. Using waste heat from the radiator or cooling system of a petrol or diesel engine or boiler, the *Nautilus* evaporates dirty or polluted water, condensing it into absolutely pure water, leaving salts and all other impurities behind. Water produced by the *Nautilus* watermaker satisfies the International Bottled Water Association's standard for potable water. (Source: *INFOFISH International*, June 1996)

Fibre optic system to be installed on Thailand coast

Harmstorf Submarine Systems Pty. Ltd. (Singapore) has been awarded a contract by Jasmine Submarine Telecommunications Co. Ltd. to install a 620-kilometre submarine fibre-optic cable system on the west coast of Thailand.

Harmstorf will utilize its self-propelled, dynamically positioned barge Chin Ann 3 to perform the installation. Using its vertical injector cable burial system, the crew will install the cable to burial depths ranging between 1.2 and 4 metres beneath the seabed throughout the system.

The festoon network will span the entire west coast of Thailand from the Burmese border to the northern Malaysian city of Kuala Perlis, landing in six locations on the coast. The cross-border Malaysian landing will connect the Jasmine network directly with the peninsular Malaysian festoon system operated by Time Telekom Sdn. Bhd. of Malaysia. The 24-fibre cable has been supplied by Alcatel Submarine Networks. It will operate with synchronous digital hierarchy (SDH) technology and allow transfer of information at the

speed of 2.5 gigabytes per second. (Source: *Sea Technology*, October 1996)

Data program off Malaysia verifies design criteria

Fugro Geoscience Snd. Bhd., in collaboration with Global Environmental & Ocean Services (GEOS) (Swindon, Wilts., UK), completed a year-long data acquisition program to verify pipeline design criteria for Esso Production Malaysia Inc. (EPMI), according to a spokesperson.

GEOS conducted the oceanographic and meteorological program off the Terengganu coast of Malaysia. Ocean currents, tides, and other essential data were recorded at four different sites. Continuous ocean current measurements were made close to the Semangkok-A platform some 130 kilometres offshore. Three other measurements were made in the north-east and south-west monsoon. These measurements were made from sub-surface moorings, each of which was made up of an anchor weight on the seabed and a float just beneath the surface which maintained the tension cable. This cable had environmental monitoring instruments mounted at various depths throughout the water column.

The instruments recorded data on currents, temperature, salinity, and other parameters for up to three months at a time. Wind and air temperature measurements were made on the Semangkok-A platform. The data will be used by EPMI to determine the design and installation parameters for seabed-mounted pipelines. The data gathering program was coordinated by the GEOS office in Singapore. (Source: *Sea Technology*, November 1996)

World's oldest and largest tidal power plant celebrates

The La Rance tidal power plant in Brittany, a western region of France, has recently celebrated its thirtieth birthday and embarked on a 10-year, \$78 million program to renovate all its turbine engines. Considered a living laboratory on operation and reliability, the plant has generated 16 billion kilowatt-hours in a total of 160,000 hours of operation. La Rance has welcomed 400,000 visitors and is France's most popular industrial site.

Electricity is generated by taking advantage of the difference in water levels between high and low tides. As the tide comes in, sea water is channeled through 24 turbines, creating electric power. When the tide is in, the turbine channels are closed, awaiting low tide. Once the tide is completely out, the water being held behind the barrier is then let out through the same turbines, creating more energy. The plant supplies 90 per cent of the electricity used in the region and is Brittany's only large-scale electrical generation facility. (Source: *Sea Technology*, November 1996)

Racal finishes installation, readies mapping system

Racal Survey Ltd. (New Malden, Surrey, UK) has completed installation of a vessel tracking system, completed a major Bangladesh survey, and is ready to launch a seafloor mapping system with a new standard of data quality, according to a spokesman.

First, Racal completed the installation of its high-precision Tracs 2000 vessel tracking system in a major contract for the Brunei Shell Petroleum Co. Sdn. Bhd. (BSP). The Tracs 2000 system is a major contribution to the management of vessels offshore and can also be used for effective use of vehicles in complex operations on land.

Second, Racal completed the first phase of a major contract for Cairn Energy in block 16 of the Bay of Bengal, despite difficult working conditions. The project was undertaken by the M/V *Eastern Explorer* which was equipped

with a 1,280 cubic inch seismic source that is expected to permit reservoir mapping to a degree of accuracy not possible before. The complete project will investigate pipeline routes, drilling rigs, and production platform sites. It will include a 2-D infill seismic survey, analogue and digital geophysical surveys, geotechnical and oceanographic data acquisition, and data processing and analysis.

Finally, the company is set to launch a seafloor mapping system that will introduce new standards of data quality for cable route surveys and other sub-sea tasks. The Racal SeaMARC[®] system became available in the first quarter of 1997 and is being commissioned to take advantage of the latest in sonar techniques and advances in software. The new system will provide precision seafloor mapping with true-range, high-resolution backscatter imagery, perfectly registered with precision swath bathymetry. It is intended to overcome the current problems experienced during cable surveys failing to accurately map difficult seabed conditions. (Source: *Sea Technology*, November 1996)

STN Atlas Elektronik introduces new sounder

STN Atlas Elektronik (Hamburg, Germany) has introduced a new navigation echosounder, the Atlas Echograph 9205, which can be operated with one or two transducers for various frequencies over ranges down to 2,000 metres with IMO-based ISO 9875 specifications.

The system can be used with either Atlas transducers between 30 and 200 kHz or retrofit with other models made for operation between 28 and 210 kHz. It provides simultaneous bottom track recording and indication on a split LCD-type high-resolution screen. The depth displays are selectable at metres, fathoms, or feet.

In addition to the integral depth alarm facility for whenever actual depth falls below present limits, other main features include 24-hour memory for bottom track recording, printer options, and NMEA 0183 interfaces for input of position, date, and time as well as output of depth data. The system can also be easily integrated into any bridge design. An ancillary digital depth LED display unit, the 9205T, can be connected, providing both audible and visual alarms as well as an automatic decimal point for depths below 50 metres. (Source: *Sea Technology*, November 1996)

Prototype sonar imaging hulls in turbid waters

Engineers at the Applied Physics Laboratory at the University of Washington (Seattle, WA, USA) have built a prototype sonar that detects fouling, damage, and foreign objects on the hulls of ships moored in turbid-water conditions—when optical systems fail. Funded by the Naval Explosive Ordnance Technology Division and the Naval Surface Warfare Center, Caderock Division, the sonar can image individual barnacles, water intakes, anodes, and even peeling paint in water with zero visibility.

The university's acoustic barnacle imaging system provides a method of efficient and accurate inspection even in turbid water. Mounted on the front of a remotely operated vehicle (ROV), the system images a surface of 7 feet from the soundhead and is capable of imaging a section of hull 2 feet by 5 feet in 0.5 seconds with a resolution better than 0.4 inch. The developers believe the system can also be used on commercial ships. (Source: *Sea Technology*, November 1996)

Joint venture offshore Angola

Shell and Amoco have formed a 50:50 joint venture in Angola and entered into a production-sharing contract with the State oil company, Angola Es, to explore for and develop

potential petroleum deposits in Block 18, offshore Angola. Amoco will be the operator.

Covering about 5,000 square kilometres, Block 18 is located approximately 7,400 kilometres north-west of Luanda in water depths of up to 2,400 metres. The companies have already acquired extensive 3-D seismic data over the block and plan to begin drilling in late 1997 or early 1998. (Source: *Shell World*, December 1996)

Offshore move in Côte d'Ivoire

Shell Exploration Africa and United Meridian Corporation (UMC) have signed a production-sharing contract (PSC) with the Government of Côte d'Ivoire for the country's first deepwater offshore block. Shell has a 55 per cent working interest in the block, while UMC holds 35 per cent and the national oil company, PETROCI, 10 per cent. UMC will be the operator in the exploration phase, while Shell will operate in the development and production phase if a commercial discovery is made.

The PSC covers the 512-acre Block CI-105, known as Entente, which lies in water depths ranging from 500 metres to 2,000 metres. Several prospects and geological leads have been identified on the block based on existing 2-D seismic data, but that will be updated by the results of further 3-D seismic surveying. (Source: *Shell World*, December 1996)

South China Sea exploration bid

Shell and the China National Offshore Oil Corporation (CNOOC) are to launch an oil and gas exploration, development and production campaign in the South China Sea.

The area of interest, Contract 15/23, is adjacent to the Xijiang oil fields, in which Shell companies have an average working interest of 39 per cent. The current average production level of 100,000 barrels a day from the fields makes Shell the largest individual foreign oil producer in China. Shell Exploration (China) Ltd. (SECL) will be the operator in the new joint venture.

SECL will complete the prospecting, evaluation and related drilling work for the project, as well as running all the business risks of the associated investment. Should the commerciality of a discovery be confirmed, CNOOC and SECL will invest in further development and share the resulting production.

This is the second contract signed by Shell with Chinese oil companies this year. Following the signing of a petroleum contract in the onshore Bohai Basin in August, Shell now has both onshore and offshore exploration and production projects in China. (Source: *Shell World*, December 1996)

Software sort-out for seismic in US

Shell Oil, long a leading exponent of 3-D seismic, is to develop a new software application which will make it more efficient to store and access the massive quantities of seismic data captured for oil and gas exploration and production. Its affiliate, Shell E&P Technology, has teamed up with the Houston Advanced Research Center (HARC) for the project.

Shell is in the process of installing the revolutionary HARC-C data compression technology for use in its internal seismic applications, and over the next few months Shell will license and market its application of the technology to other companies in the oil and gas industries.

HARC introduced its data compression software in 1995, making it possible to store enormous quantities of data quickly, efficiently and accurately, using a desk-top workstation. Its primary value in the oil and gas industries is its capability to quickly store data, then retrieve it in a convenient format.

HARC-C technology is built on a set of mathematical principles called "wavelet" theory. Image attributes are described mathematically in terms of frequency, energy and timing blocks, managing the task in real time. HARC's compression technology, which requires no special hardware, solves the problem of file size by coding an image in a form which is easily stored and shipped. (Source: *Shell World*, December 1996)

MTD's research history

The Marine Technology Directorate Ltd. (London, UK) celebrated 20 years of administering research in the offshore and marine areas. Officials presented some highlights at its annual general meeting in November 1996. The presentations showed that initiatives in structural design, hydrodynamics and petroleum engineering each had the potential to save the industry millions of pounds.

Professor Grant Hearn of the University of Newcastle upon Tyne showed how the apparently unexciting techniques of complicated mathematical analysis can help design more cost-effective structures. In one example, a comprehensive analysis program for a large container ship led to a hull design that could hold an extra 50 containers and was also able to maintain speed in more severe wave conditions. Although the analysis was more expensive than the standard industry procedure, it was justified by the improved operating cost profile.

Professor Mike Cowling, centre coordinator of Glasgow Marine Technology Centre, also looked towards the future and remembered the past. Most of the eight marine technology centres at UK universities were established soon after MTD itself. A recent change is the formation of a Centre Coordinators Committee to help interpret the requirements of EPSRC and the Marine Foresight Panel when it reports early this year. Cowling emphasized that this structure for offshore and marine research was able to deliver the seed corn for the supply and operating sectors, set industry standards and guidelines, provide data for safety cases, and encourage innovation and training, all of which contribute to wealth creation. (Source: *Sea Technology*, January 1997)

Oceaneering notes successful sea trials; pair of purchases

Oceaneering International Inc. (Houston, TX, USA) officials announced successful sea trials of a new heave compensated landing system (HCLS) project supported by five major oil companies.

The company's new HCLS project led by BP Exploration and Shell Offshore proved the ability to soft land, in a controlled manner, payload packages of 6,000 pounds in 3,000 feet of seawater. The trials were conducted from Oceaneering's 200-foot, dynamically positioned vessel *Ocean Service*, which was outfitted with a new 25-ton hydraulic A-frame. The test was supported by a 75-horse-power Hydra Quantum remotely operated vehicle (ROV) system rated to a depth of 7,000 feet. (Source: *Sea Technology*, January 1997)

Oceaneering Board approves fourth expansion of ROV fleet

Oceaneering International Inc. (Houston, TX) announced that its board of directors has authorized further expansion of the company's remotely operated vehicles (ROV) fleet with three new Hydra* Magnum work class vehicles. The units, manufactured in Morgan City, Louisiana, are being built to meet increased market demand around the world for ROVs capable of working in depths greater than 1,000 feet of

seawater and in severe weather conditions, such as those encountered in the North Sea.

The Magnum ROVs are high-thrust, cage-deployed vehicles designed to accommodate a variety of sensor and work packages for performing a wide range of underwater intervention tasks that support oil and gas drilling, construction and production activities. The new vehicles are 75-horsepower units capable of operating in 6,600 feet of seawater or more and are being manufactured using the latest technology in advanced control systems for high performance, optimum adaptability and maximum reliability. (Source: *Sea Technology*, February 1997)

New high tech ICCP system launched by Subspec-tion Ltd.

An impressed current cathodic protection (ICCP) system with the latest state-of-the-art technology has been introduced for use on board merchant ships by Subspec-tion Ltd. (Aldersford, Hampshire, UK). The system's power unit features full microprocessor control, providing greater reliability and maximum flexibility in combination with simplified operator controls for greater efficiency.

The ICCP control unit basically comprises three sections. The upper section is a "systems status" panel and is provided with indicator lights for each anode, the alarm, operating lights, and an LCD display. The centre section comprises the "diagnostic and maintenance" unit, while the lower section houses the high power electrical equipment.

Another advantage of the technology is that data can be automatically recorded on a daily basis, thereby eliminating the need for daily, manual recording. The period for storing data can be varied to suit the requirements of the shipowner. Any changes to the system's operating parameters are also logged. The recorded data are used in the evaluation of the system performance. These data can also be used by the ship's engineers, by linking the power unit directly into the onboard computers. (Source: *Sea Technology*, February 1997)

Deep sea tankers

Last year was the most frenetic in over a decade for chemical tanker building. Within 12 months 700,000 deadweight ton (dwt) of new chemical tanker capacity was delivered from the world's shipyards.

As only a relatively small number of older chemical ships were sold for scrap, the total chemical tanker fleet grew by 550,000 dwt to reach 18.8 million dwt.

And brisk as they were, deliveries were easily outpaced by contracts for new ships. During 1996 orders were placed for a further 1.6 million dwt of chemical tanker tonnage, with delivery dates spread over the next three years.

But recently, shipowners' conservative attitude to new ships has come under pressure from two sides. Firstly, demand for tonnage has begun to exceed supply, prompting an improvement in freight rates, and secondly, ageing sectors of the fleet need to be replaced.

Demand for chemical transport is driven by the global nature of the chemical industry and the regional imbalances in the supply and demand of the raw materials and products.

Chemical tankers carry some 90 million tons of bulk liquid products on short sea and deep sea routes each year, this volume being made up of organics (43 per cent), inorganics (16 per cent), vegetable and animal oils (22 per cent) and miscellaneous products, including lubricating oil additives, (19 per cent). The organic chemicals sector is forecast to achieve the fastest growth.

From the chemical tanker operator's view, there are two categories of organic chemicals: commodities and specialty

products. Trade in commodity chemicals—primarily methanol, styrene, ethylene glycol, benzene, MTBE, paraxylene and ethylene dichloride—is forecast to grow at 5 per cent per year to the year 2000.

Movements of specialty chemicals, the intermediate and finished organic products which require high standards of care in shipboard handling, are forecast to grow more rapidly, at 6 per cent per year.

In contrast to these growth patterns, trade in inorganic chemicals, such as acids and caustic soda, is forecast to remain at current levels. The chemical tanker fleet is controlled by a small group of dedicated, independent owners and operators and the price of admission into this select club is rising daily. Newbuild prices, typically \$70 million for a 35,000 dwt parcel tanker, represent the first hurdle.

Secondly, ships are run on scheduled services with regular sailing patterns according to the just-in-time concept. Operators enjoy close relationships with charterers, some of which have been elevated to the level of alliances. Great attention is paid to the quality of service as the cost of a stalled factory due to a contaminated or delayed cargo can be substantial. To compete on a global scale ship operators now need a minimum of 20 ships in their fleets.

Another factor impacting participation is the strict regulatory regime governing ship design and operation. In an effort to deal with the human element, which has been identified as the cause of two thirds of all maritime accidents, the International Maritime Organization (IMO) has developed a series of initiatives aimed at improving the operation of ships.

The two key planks of this regulatory platform are the revised Standards of Training, Certification and Watch-keeping (STCW) convention, which came into force on 1 February 1997, and the International Safety Management (ISM) code, which is due to be implemented for chemical tankers on 1 July 1998.

The regulatory enforcement gap, too, is closing. In Europe, for example, under the port state control directive which entered into force on 1 July 1996, inspectors are checking operational procedures, such as crew competence, as well as design and equipment features. Also, inspections are being targeted, on the basis of a flag registry's ship detention performance record and the age of particular vessel types.

Evidence that the industry is prepared to leave the operation of ships to the specialists is given by the fact that five companies—Stolt-Nielsen, Storli (Odfjell Tankers), Jo Tankers, Seachem and Tokyo Marine—between them hold 70 per cent of the market share of chemical tankers over 10,000 dwt.

The axis of the global chemical industry is moving inexorably eastwards. The demand for chemicals in Asia is doubling every six years, as opposed to every 36 years in Europe. It is estimated that a further 5 million tons of new chemical plant capacity will be added in South-East Asia and 2.3 million tons in North Asia in the next four years. Despite this new capacity the region's deep sea import and export quantities should be maintained at current levels as reductions in movements of commodity products are compensated by increased shipments of the specialty chemicals characteristic of a maturing, more diversified local industry.

While deep sea volumes may remain static, Asian intra-regional balancing movements of chemicals are expected to increase steadily in the years ahead. Of particular interest are the longer haul movements between South-East Asia, North Asia and Australia/New Zealand.

A number of chemical tanker operators are active in the region and, if intensifying levels of Far East shipbuilding

activity are anything to go by, most are planning for steady growth in the years ahead.

The significant distances between the main trading centres and the swelling volumes of more sophisticated products being moved are creating interest in ships which have more stainless steel tanks and, at 5,000 to 12,000 dwt, are slightly larger than those traditionally utilized on these routes. (Source: *European Chemical News*, 10-16 February 1997)

Conoco, Reading & Bates plan to build new drillship

Conoco (Bartlesville, Oklahoma) and Reading & Bates (Reading, PA) are establishing a venture to meet the challenge of exploring ultra-deep waters of the Gulf of Mexico and ensure long-term access to a suitable rig available to meet Conoco's deep water drilling requirements according to a spokesman. The partners set up a 50/50 venture to undertake an aggressive \$400 million, five-year drilling programme and disclosed plans to build a \$200 million, new generation dynamically positioned drillship able to drill in water depths up to 10,000 feet.

The 721-foot long, double-hulled drillship to be constructed at Samsung Heavy Industries of South Korea, will carry the most stringent American Bureau of Shipping requirements for dynamic positioning systems, DPS-3. The drillship will afford Conoco the ability to extend its exploratory efforts beyond the traditional offshore shelf areas so that deeper fields can be developed economically. Conoco's marine department will assist in the rig's design and help oversee construction, while Reading & Bates will provide drilling services to the new venture. Delivery is expected in 1998.

The rig will have the flexibility to perform extended well tests and includes crude oil storage and offloading capacity, provision for simultaneous drilling and testing and eventual conversion to a floating production/storage and offloading (FPSO) vessel. The drillship will feature extremely large deck space and load carrying capability. The rig will be able to load onboard materials for two deep complete wells, eliminating the need for resupply during drilling. (Source: *Sea Technology*, February 1997)

Rockwell agrees to form venture with Chinese firms

Rockwell International Corp. (Cedar Rapids, IA, USA) has announced an agreement to form a company to design, develop and build commercial global positioning system (GPS) navigation receiver systems with Chinese partner companies in Shanghai. Initial activities of this joint venture are expected to begin once the business licence is approved.

The limited liability joint venture, known as Shanghai Rockwell Collins Navigation and Communications Equipment Co. Ltd., will be formed to provide locally developed and manufactured commercial GPS equipment to the Chinese market.

Applications for the products include handheld, maritime and commercial vehicle tracking and management. Rockwell's Collins Avionics & Communications Division will operate the joint venture with the Chinese partners Shanghai Avionics Corp. and Shanghai Broadcast Equipment Factory. Company offices and manufacturing facilities will be located in the greater Shanghai area. (Source: *Sea Technology*, February 1997)

Emerson & Cuming establishes buoyancy reconditioning stations

Emerson & Cuming Composite Materials Inc. (Canton, MA) reports it may have found a way to help its customers

extend buoyancy life and help preserve the environment at the same time. The company says many buoyancy modules could be economically restored to service rather than scrapped if expert and timely repairs could be made.

Therefore, Emerson & Cuming has announced the establishment of three reconditioning stations for restoration of damaged or worn syntactic buoyancy used by the offshore and ocean industry to support drilling and production risers, mooring lines, flowline tow-outs, ROVs, manned submersibles, and other oceanic instrumentation.

The stations are located in Houston, Rio de Janeiro, and Perth, Australia. Another station is being considered in Europe. These stations will be staffed with factory-trained technicians and stocked with company-certified materials to restore buoyancy to full performance as an alternative to replacement, thereby avoiding expense, lost time, and overloading of landfills. (Source: *Sea Technology*, February 1997)

Leica wins Australian beacon DGPS contract

Leica Inc. (Torrance, CA) has been awarded a contract from the Australian Maritime Safety Authority for a beacon differential GPS (DGPS) systems network. The network consists of beacon broadcasting stations, monitoring stations and a control station.

The beacon systems network will provide enhanced navigation accuracy in coastal waters along much of Australia's east coast by using marine radio beacons to broadcast DGPS error correction data. It will become part of what will eventually be a nationwide system covering the entire Australian coastline. The contract calls for DGPS beacon broadcasting sites to be established in Sydney, Cooktown, and Mackay with an additional station to be used for training and spares. One control station will be located at Victoria and three monitor stations will be located at Melbourne, Canberra and Brisbane. All the broadcast stations, monitor stations and the control station will be linked by a communication network.

The Australian installation will be based on Leica's recently introduced 12-channel MX 9400 series of DGPS receivers. The MX 9400 has extremely stable pseudo-range measurements and unsurpassed accuracy, according to a spokesman. When the MX 9400R reference station is teamed with the MX 9400N navigator, accuracy of better than 30 cm can be achieved.

The Australian system will comply with RTCM SC-104 and International Association of Lighthouse Authorities standards. (Source: *Sea Technology*, February 1997)

Staying shipshape

Chemical barging operators feel regulations and customer demands are forcing investment to uprate vessels, but freight rates are too low to allow them to claw back some of the money. And overcapacity remains a problem with "new" routes such as the Rhine-Main-Danube link not living up to expectations.

Low rates are unlikely to be a source of complaint for chemical producers who make use of barges. But shrinking profits are driving consolidation in the chemical barging industry. Unless things improve fast, the end result will be fewer operators and less choice for the user.

One important issue for chemical barge operators is the ADN regulations on transport of hazardous cargoes, now being phased in. Double-hulled vessels must be used for chlorine-containing compounds and from October the rules will apply to benzene.

Players foresee a rise in freight rates for benzene as a result. Regulations are also driving demand for stainless-steel tanks. To avoid more overcapacity, major operators are investing in refurbishments rather than new builds.

Chemical producers, on the other hand, accuse the barging industry of having operated for too long under protective rates and being too slow to change. BASF points to the system of fixed rates which existed in Germany until 1994, making imports and exports out of Rotterdam or Antwerp cheaper than shipments within Germany.

Overcapacity has long been the bane of the barging industry and is still riding at between 15-20 per cent in chemicals transport. A \$250 million European Commission-funded scrapping programme will take out 100,000 tons of capacity, but is not predicted to have much effect on chemical vessels.

The Maritime Economic Research Centre in the Netherlands points to two other factors driving the market against barge operators. Railway transport is taking on large-volume cargoes such as methanol, EDC, benzene and toluene. Especially in the Netherlands, railways are heavily subsidized. They can offer just-in-time delivery, wagons as temporary storage facilities, and access to sites away from waterways. Secondly, pipeline transport of gases and oils via the NATO military network, which is now open for commercial use, could mean more vessels moving into the "easy" chemicals market.

So how will barge operators react? Emphasizing an integrated service linked to tank storage is the path Van Ommeren has chosen. But others may opt for merger or get out of the business as shown by German firm Stinnes' decision to sell Bayerischer Lloyd and DDSG Cargo last year.

Both Stinnes subsidiaries operate on the Danube, and the sale could be seen as one example of industry's loss of faith in the Rhine-Main-Danube link, which was heralded as a vital connection between the North Sea ports and the Black Sea. But water-levels and its 60-plus locks have proved problematic. German environmentalists oppose enlarging it.

The general manager of the Basle-based Hamburger Lloyd says unpredictable water levels make the link a "gamble" for operators, since there are no facilities for liquid cargoes to be discharged to adjust the vessel's draught. The journey from Rotterdam to the linking canal takes eight to ten days time for weather conditions to affect water levels.

Long-term, a new route will open up when the Rhine-Rhône canal in France is widened, which could link Rotterdam and Antwerp to the Mediterranean chemical sites. The French Government is funding the project, but it will not be completed until the next century. (Source: *European Chemical News*, 10-16 February 1997)

Southern Oceanics delivers air dive system to Korea

Southern Oceanics (Pty) Ltd. (Cape Town, South Africa) recently delivered a custom-built six-metre ISO-containerized air dive system to Korea Ocean Engineering and Consultants Company Ltd. (Seoul, Korea).

The system will be used on a contract for the laying and protection of a submarine power cable and includes a recompression chamber, 120 m³ air storage bank with HP air management panel and HP air compressor, a three-diver air panel and all interconnect pipework.

The container was modified to provide structural underfloor reinforcing to secure the recompression chamber, fitted with a side access door and observation window, recessed alcoves for power and gas connections, a marine grade electrical system and fire-resistant rubber flooring. (Source: *Sea Technology*, February 1997)

C. TECHNOLOGY UPDATE

Innovative new emergency breathing system developed

One of the hazards faced by all divers is the risk of running out of air. To help increase diver safety, U.S. Divers Co. Inc. (Santa Ana, CA) has developed an innovative new redundant emergency breathing system. Micra Air System (MAS) is based on two of the company's successful products: Micra second stage and Conshelf first stage. These regulator components have been integrated with a 2.5-cubic-foot aluminium diving cylinder to provide enough air to handle most shallow water out-of-air situations.

MAS can be mounted in almost any position on the diver's tank or buoyancy compensator. Its compact size helps to reduce the possibility of entanglement when divers search sites that are littered with debris. Its low profile makes almost no change in a diver's ability to manoeuvre through small passages in a reef or cavern. (Source: *Sea Technology*, July 1996)

ABS launches products to advance ship safety

At a special presentation held at the Posidonia International Maritime Exposition in Greece, the American Bureau of Shipping (ABS) Chairman announced the introduction of two new products: SafeHull '96 and SafeNet™.

SafeNet '96 is an extension of ABS' revolutionary SafeHull™ system—a dynamic-based method for design and evaluation of ship structures. The SafeHull™ '96 initiative extends this technology from tankers and bulk carriers to container ships. It also introduces more flexible and user friendly features including Windows PC and workstation operating environments. Dedicated training and support teams have been added, as well, to better serve users.

SafeNet™ is a life-cycle ship management and information network designed to assist shipowners with the increasingly complex task of managing their vessels. The networks will give owners the capability to directly assess all classification-related technical and survey information for both the machinery and hull structure on their ABS vessels. ABS and the owner will be able to work together to continually assess the integrity of both the hull and machinery in order to develop a planned maintenance programme for executing surveys, maintenance and repair. (Source: *Ports and Harbors*, July-August 1996)

European consortium to develop IPSI

Norway's Kvaerner Ships Equipment is leading a Pan-European consortium which has been given the task of developing an improved port/ship interface (IPSI) for Europe to take the shipping industry well into the next century.

The project will result in lower cost port facilities and cargo handling equipment, as well as new ship types, cargo handling technology and management/information exchange systems.

The contract to carry out the IPSI project, awarded by the European Union in Brussels, is being undertaken to improve door-to-door logistic chains in Europe by increasing the use of waterborne transport, both short sea and inland waterways.

This consortium forms a unique combination of expertise related to the project and with little overlapping in

their respective areas of experience, all potential problem areas are accounted for.

The goals of the IPSI project are as follows:

- Develop new concepts for flexible port/ship interface in the context of added value, intermodal logistics (where applicable) in Europe, based on increased use of waterborne transport, including the utilization of inland waterways.
- Develop methods and equipment for effective transfer of cargo and information about cargo in the above-mentioned land/water interfaces, with focus on high efficiency and low investment.
- Demonstrate the new "port/ship and ship/ship interface concept" to verify the effectiveness of multimodal cargo exchange in a "door-to-door" context.

The challenges for the IPSI consortia are the following:

- In order to succeed in transferring much of the transportation of goods in Europe from land to sea, the complete logistic chain, using waterborne transport as a major component, must be competitive, both in terms of cost and reliability.
- Since cargo must be moved between ship/barge and land transport systems twice, the efficiency of the port/ship interface in the multimodal context of a door-to-door logistics chain is of vital importance.
- The challenge to the ports is that they must become more important interfaces in the transport chain as efficient and cost-effective logistics hubs where all available modes of transport can be effectively interconnected. This applies to sea, rail, road and to inland waterways as well.
- The interconnection of alternative modes of transport must be based on competition and flexibility, i.e. interchanges between the various modes of transport must be possible wherever necessary and applicable.

The IPSI project, which officially started on 11 April 1996, is scheduled to last 36 months, at the end of which the results and conclusions will be made public. (Source: *Ports and Harbors*, July-August 1996)

New underwater welding process gains approval

Lloyds Register of Shipping has approved a new process of underwater welding developed by UMC International Plc. (Eastleigh, Hampshire, UK) for permanent repairs to the shell plating of a ship. The new technique allows defective areas of shell plating to be cut out and replacement insert plates to be welded into place beneath the waterline while the ship is afloat.

The development is an option to underwater welding and the established alternative of creating a habitat for a diver to work in. Both methods are time-consuming, difficult to achieve, and can result in repairs of a doubtful quality.

This new technique creates an air-filled void space under water in the path of the defect. Welders working from inside the hull then cut out the defective plate and weld an insert into position.

Whereas in the past it has been necessary to weld from both inside and outside the hull to achieve an effective repair, UMC's process employs a combination of TIG (tungsten inert gas) and conventional welding using low hydrogen electrodes

to overcome the difficulty. The repair is then examined using ultrasonic and magnetic-particle examinations.

UMC originally developed this process in response to requirements of the Royal Navy and the method has been used extensively on ships in the Arabian Gulf. All of the repairs have been approved as permanent without a "Condition of Class" being imposed. (*Sea Technology*, July 1996)

To protect against salt water spray

The protective sealer DRY-TREAT 100N was recently applied to the Port of Brisbane Corporation Fisherman Island Coal Wharf. The wharf was constructed in 1982 and is capable of handling vessels of 80,000 tons dwt. In 1995 this wharf processed 3,500,000 tons of dry bulk goods.

The treatment is to protect the wharf from the attack of salt water spray, and so save in the cost of its life maintenance.

DRY-TREAT 100N is a pure silane that is designed to impregnate the concrete surfaces and permanently bond to the molecular structure of the concrete, so changing its absorption characteristics.

The work was carried out by the Port of Brisbane Corporation and included the sealing of the deck and the soffit of the wharf, a total of over 7,000 m². The treatment is guaranteed to penetrate 4 mm into the concrete, and reduce its chloride ion uptake by 95 per cent.

The main benefits of using the DRY-TREAT 100N are:

- Increases the resistance of the concrete to chloride ions by 100 times;
- Allows the concrete to dry out and so minimize corrosion of the reinforcing steel;
- Greater penetration to resist the effects of weathering;
- No deterioration of membrane;
- Safe to handle and safe to the environment;
- Treatment is guaranteed for 25 years; and
- Major world-wide contracts already completed.

For more details on this and other major projects, please fax Dry Treat (Australia) Pty. Ltd. Tel.: +61 2 9954 3162 or E-mail: siand@drytreat.com.au. (Source: *Ports and Harbors*, September 1996)

Fathoms completes salvage of Osprey

Fathoms Ltd., the Caithness and Somerset-based marine services company, awarded the contract to salvage *Osprey*, the world's first prototype wave-powered generator, has completed this major operation.

A team of 20 divers was employed to help recover around 1,500 tons of steel and concrete from the *Osprey* which sank off the north Scottish coast at Dounreay amid some of the most exposed waters in the UK.

Added complications arose from a particularly bad summer for weather conditions and also from minor spots of scrap contamination. *Osprey* was designed to provide reliable and sustainable energy from wave power.

Fathoms, which specializes in offshore and inshore construction and marine works from its offices in Wick, Scotland and in the west country, carried out all the initial and subsequent hydrographic and diving surveys of the structure from which it developed the necessary procedures.

Titan's jack-up rig *Karlissa B* and Briggs' barge *Forth Constructor* were the main barges used for recovery and transportation of the scrap. To improve productivity, explosive linear cutting cord was used extensively to break up larger sections of the structure under water. (Source: *The Dock & Harbour Authority*)

Royal Schelde given aluminium accolade

Royal Schelde has won the Aluminium Award 1996 for the electron beam welded aluminium propulsion gear assembly installed in the CAT 70HL catamaran *Captain George* that was delivered earlier this year to Catamaran Ferry Lines.

A company involved in shipbuilding or marine accessories is given the award every two years by the Aluminium Centre in The Netherlands.

The gear assembly was judged on the basis of its originality and functionality of the use of aluminium, the functionality of the product, its design, durability, recycling qualities, and its representation of and promotional value for aluminium.

By using an existing technique, electron beam welding, to weld the aluminium plates of the gear assembly, the company succeeded in realizing a light and very strong construction.

The lack of a large heat input during the process makes it possible to easily weld relatively thick plates together with very minimal distortion.

The use of plate material instead of aluminium casting made it possible to construct a stronger and lighter gear assembly, as well as giving a considerable time gain over hand welding. (Source: *Fast Ferry International*, September 1996)

Copper-free antifouling introduced for aluminium

Jotun has introduced a copper-free, self-polishing antifouling which, it says, has been specially formulated for use on aluminium hulls. According to the company, the new product, Alusea, is based on the same advanced organotin copolymer technology as Jotun's range of high-performance antifouling for steel vessels.

However, to bring to the aluminium hull section of the marine market the performance and economic advantages offered by self-polishing preparations, copper has been eliminated from the formulation.

Alusea will provide up to 36 months' protection against fouling, depending on the speed and sailing pattern of the vessel. For fast ferries, which have a short dry-docking period, optimum protection and maintenance costs can often be achieved with reduced coating thicknesses designed to give 12 to 24 months' protection.

As for preparation and coating requirements of aluminium hulls, the company stresses, because aluminium is fairly soft, it is important that any medium used for blast cleaning should be carefully chosen. Otherwise blast cleaning may result in a surface profile that is too rough.

Alusea is normally applied by airless spray, although brush or roller can be used for smaller areas. Typical dry film thicknesses range from 50 to 100 microns. At a temperature of 23° C, Alusea is dry to recoat in as little as four hours and is ready for launching in 8-12 hours, depending on the combined thickness of the antifouling and any primer. It can be applied over most organotin copolymer antifouling. (Source: *Fast Ferry International*, September 1996)

Specialized liners find place among alloys on surface, downhole

An entire technology is developing around the lining and cladding of wellheads, flowlines, injection lines and pipelines that transport production or solutions and gases injected into the reservoir. Traditionally, producers have simply resorted to solid alloy castings and forgings to deal with fluid and gas streams loaded with corrosive and erosive components. Even

injection lines had to be able to withstand halide solutions. Alloys are expensive, especially for entire fields with hydrogen sulfide, carbon dioxide, high temperatures, and other troubling conditions.

That scene is changing today. Alloys are still popular, but producers are increasingly looking at lining technology as a less expensive option, especially now that the process of holding the liners in position has improved dramatically. The mechanism of holding them in place is critical, since joint leaks can produce catastrophic conditions, or at the least, send the stripped-off cladding downstream to be sucked into turbine or pump blades. Refinery and process operators are sensitive to this condition and conduct many measurements to determine if cladding or lining materials are weakening. Offshore, such measurements are not as easily conducted, nor is the pipe or equipment so easy to replace; hence the preference for alloys, when economic.

Liners can be made of materials ranging from low and high density polyethylenes and polyurethanes up to tough inert metals. They are inserted, pressed, moulded, swaged or welded to the inside of production equipment and pipelines. Even trees with 6-8 different diameters, hangar surfaces, sensor probes and valve holes can be lined effectively.

Although cladding of production trees and equipment is done more often in Houston than elsewhere, much of the development of pipeline lining is taking place in the North Sea, where producers are facing difficult conditions on very commercial fields.

McDermott Marine has used new technology from British Gas and British Steel to install lined pipelines. The firm used swaging (called swagelining) by British Gas, which developed it to seal an inserted polyethylene liner within a carbon steel pipe for the Foinaven injection lines. The polyethylene liner is reduced in size temporarily, pulled through the carbon steel pipe, and then swaged (high-pressure heat pressing) to the inner diameter of the steel pipe. British Gas and many other companies today use the process to replace damaged and ageing distribution lines onshore. Offshore, the difference is the use of new compression fittings to ensure sealing during pipelaying and after many years of operation. (Source: *Offshore*, September 1996)

Load-bearing problem for SWATH vessels in well-head work

The advantages to single water plane twin hull (SWATH) vessels are their all-weather seakeeping abilities and speed in transit. A disadvantage is that the hull is weight sensitive with respect to seakeeping and cannot easily support or suspend a heavy load on the centreline. That disadvantage played a role in the model tank testing of Statoil's proposed SWATH vessel for well completion and intervention work in the North Sea.

In concept, the Statoil SWATH was an efficient vessel and could replace more expensive semi-submersible drilling units for completion and workover activities. In model testing, with full deckloads (drilling package) and suspended loads (production tubing), the design was insufficient. In testing of the Statoil vessel and others previously, it was found that seakeeping was lost in some cases and in others, the stresses on the deck crossmembers linking the twin hulls exceeded what would have been safe.

To remedy the stresses, designers would have needed a larger SWATH or to install cross-bracing close to the waterline and bulk up the crossmember density on the current model. With the later remedy, the SWATH cross-framing would come to resemble a box, which is exactly the design

strength of a semi-submersible, which uses both box deckframing and crossmembers below the waterline.

However, a larger or bulkier SWATH design would cancel some of the hull advantages and push vessel costs into the small semi-submersible range. Statoil is looking at either a monohull vessel, which can better support a drilling package, or a small semi-submersible. (Source: *Offshore*, September 1996)

Resistivity measurement used to evaluate composite strength

Composite materials are advantageous to use offshore because they are half the weight of steel and easy to mould, machine and fasten. Until now, however, there has been no reliable method of measuring bond strength in composite materials, and thus no way to predict loss of strength or structural integrity over time.

Enter resistivity measurement, that 80-year technology that has served many industries, including well logging, over the years. Researchers of the State University of New York at Buffalo have extended a process used to measure bond strength in steel and carbon fibre reinforcement in concrete to composite materials.

Previously, the ability to pull out wire fibres from concrete provided a measure of internal bond strength. However, the method has some drawbacks. Recently, the use of resistivity measurement between selected fibres, repeated from time to time, was found to provide an equally good measurement without damaging the component.

Researchers now attach wires to carbon fibres in composites and measure the amount of resistivity to current movement. The resistivity correlates accurately to bond strength and can sense the beginning of bonding loss. (Source: *Offshore*, September 1996)

Waves of power

Ireland has one of the best wave energy resources anywhere in the world. Along the coast from Malin Head to Carnsore Point, there is over 13 times more wave energy than in the ESB's total generating capacity. The big advantage of wave energy technology, even though it is presently the "Cinderella" of renewable energy resources, is that it has major relevance for Ireland. The other countries in Europe where it is particularly appropriate are the UK (on the west and north coasts of Scotland) and Portugal, with more limited applications in Denmark and Norway.

Ireland is probably one of the best placed locations in the world to develop this technology and put it into commercial application, a task that is eminently feasible over the next 20 to 30 years. Ireland also has a considerable research base, particularly at Queen's University in Belfast and in the Hydraulics and Maritime Research Centre at University College, Cork.

Other centres that are contributing to the great wave energy debate include the Irish Energy Centre location in Bandon, Co. Cork and the Marine Institute, Dublin. As far as the key natural resource—the waves themselves—are concerned, Ireland is an almost ideal location, because of the wave height along the west coast. The significant wave height along the west coast is about five metres; very few other locations anywhere in the world have such favourable wave heights, except for Scotland and Portugal.

A major problem with wave energy generation is the tremendous fluctuation in pressure and direction. There are only a few operational wave power plants in use in the world at present. All but one are of the oscillating water column

type and use a Wells turbine as the primary means of conversion. All these plants have one factor in common: they are all massive concrete structures. But at this prototype stage, the primary aim is to demonstrate that the technology works. However, costs have to be kept under control, in order to encourage replication.

Standardization is essential in the mechanical electrical plant. It is essential to standardize the manufacturing process for turbine blades and other components if the system is to be cost effective. The machines must be capable of being put together from standardized kits of parts to accommodate different wave collector bodies located in various wave climates.

The power wave research team at Queen's has been developing wave power technology since 1975, with State funding from UK sources, mainly what is now the Department of Trade and Industry.

That funding is due to end in 1997, because the UK Government is no longer funding energy research following the privatization of the energy supply companies there. Fortunately for Queen's, the funding has now been placed on a wider footing, with European funding under the Joule II programme.

Initially, the Queen's team concentrated on small-scale buoys which included a floating oscillating water column and a Wells turbine to produce electricity. More recently, the Queen's team moved into a full-scale demonstration and research project at Islay in the west of Scotland. This 75 kW plant is a shoreline wave power plant. Construction of this plant was completed in 1988. The mechanical electrical plant was installed and the plant was connected to the national grid in 1991. Many of the components for this test plant were made in Northern Ireland and shipped over to Scotland. The plant has shown in over 3,000 hours of operational time that it can produce electricity, with average power outputs of 17 kW over 20-minute scanning periods, and short peaks have been seen of 50 kW.

Although various factors have meant the plant's producing less power than originally planned, it has provided valuable information, vital to the design of larger devices.

As a follow-on from the initial Islay project, Queen's is now deeply involved in the Osprey project, a more advanced type of oscillating water column wave power device. This project is being developed by Queen's in association with a private company, Applied Research and Technology, based in Inverness. The first of these nearshore devices was sunk, literally by the force of the waves after it was "launched" off the north coast of Scotland early in 1996. Lack of ballast was the Achilles heel of Osprey I; this shortcoming has been designed out of Osprey II. This project is being funded under the EU Joule II programme.

The Joule II programme is also being used to fund the Azores project, which is a larger version of the first Islay test plant. Here too, Queen's has had an input. Multiple Wells turbines are being used in this 600 kW plant, due for completion the summer of 1996.

The oceans form one of the world's most abundant sources of renewable energy. Wave energy also avoids the main drawback of wind power, which can be visually, as well as aurally, intrusive. And wave energy can be used for other processes, too, besides generating electricity, for instance, desalination of sea water, hydrogen production, mineral extraction and oxygenation of sea water. (Extracted from *Technology Ireland*, October 1996)

3,000 ft-long floating runway concept returns

After being considered some years ago for commercial aircraft emergencies in mid-ocean locations, floating aircraft runways were put aside because of high cost. The concept has resurfaced, encouraged by the US Government.

Brown & Root has designed a floating 3,000 ft-long runway for the US Office of Naval Research that can be towed or deployed in international waters. The concept's 300-ft wide deck is supported on semi-submersible pontoons large enough to keep the deck 100 ft above the waterline, but sufficiently ballasted to keep the deck steady in rough weather. The deck runway could support the takeoff of all combat aircraft, a C-130 cargo jet, or commercial aircraft in emergencies.

One end of the runway or an accompanying string of similar vessels would support hangars and work spaces, with aircraft storage below. The configuration would be variable, depending on the tasks. Tugs and rescue craft would be in attendance. The entire structure would be aligned by tugs with wind direction to assist takeoffs and landings. The cost of the structure was estimated at \$2-4 billion. (Source: *Offshore*, November 1996)

Graphite-epoxy riser key to deep water for lighter rigs

Second and third generation rigs could begin drilling in 4,000 -5,000 ft water depths if riser weight can be cut in half. That riser weight reduction is the target of Westinghouse Marine's effort to produce a riser prototype made of graphite-epoxy instead of steel. At present, rigs with less than fourth generation deckloading can drill in a maximum of 3,000 ft depths.

The drilling riser diameter would be smaller, offering fewer problems for on-deck storage and mud volumes, but also reducing the hydrodynamic loads on the vessel when deployed. The manufactured riser joints for both drilling and production would be 75 ft in length. (Source: *Offshore*, November 1996)

Marine composites

The goals of the aerospace industry are not too far removed from those of marine transport. Speed, payload and fuel are all intimately linked in the operator's business plans. And one factor, weight, underpins all three. Lighter and stronger than aluminium, composite panels have been used for more than 20 years by commercial airlines.

They have also helped to shed heavy loads from structural floors, decks and fire-resistant interiors for the marine industry, considered by some to be even more demanding.

Composites allow major weight-savings, now known to be up to 50 per cent for structural, and even 75 per cent in other areas. These in turn lead to higher speeds, and more economical running costs. Weight-reductions aside, composites can also improve weight distributions and overall stability.

Most of the industry's focus has been on sandwich panels, which basically consist of a core between two skins. The core itself can be a plastic foam, a honeycomb, or even wood, while the skin panels can be either metallic or reinforced plastic.

As a building block, composite panels are versatile. They can be designed to a vessel's specific loading needs, while offering low weight and structural integrity.

Moreover, a well-designed structure will use the full properties of all the constituent materials. Finally, parts can be fabricated to almost any form, with minimal finishing.

Core type	Typical application
Aramid honeycomb	Bulkheads, flooring, partitions and superstructures, including hull top-sides and radomes.
Aluminium honeycomb	Similar to above.
Closed cell foams	Interior partitions, hulls and superstructure.
Balsa wood	Bulkheads, specific hull components.
Interior applications	Luggage bins, cabin linings, wall, ceilings, galleys.
Resin type	Key properties
Epoxy	Very good resistance to water, high toughness, chemical resistance.
Phenolics	Extremely fire-resistant, low smoke and toxicity, thermal stability.
Vinyl ester	Easy to process, good temperature performance, very resistant to acids and solvents.
Unsaturated Polyester	Low-cost, easy to process.

Any loads which are applied to a structural panel are resisted by the tensile and compressive strengths of the skin materials. The core material itself transfers shear between them. The result is that very thin face materials can support high loads. Structures of this type have been used on the areas between car decks, and forward bow on high-speed ferries.

To illustrate the weight-saving potential of these materials, it is worth looking at a typical load-bearing application. To support a 500 kg load, with an allowable deflection of 1 mm, a typical steel plate will need to weigh close to 100 kg. The aluminium version will weigh just under 50 kg, while a honeycomb sandwich panel will be under 10 kg. (Source: *Advanced Materials News*, November 1996)

Satellite phone antenna

A compact maritime satellite antenna developed by KVH Industries Inc., Middletown, RI, can transmit and receive signals through high-powered satellites such as those launched by the American Mobile Satellite Corp. The Tracphone ASAP 19's small size and low price provide an affordable tool for mariners who need satellite communication, but have limited space on board their vessels.

Tracphone's antenna has an 11½ in. diameter and its radome measures 19¼ in. across. The entire system weighs a mere 30 lb, compared to other satellite phone systems that can weigh as much as 80 lb. The rugged unit is made with composite carbon-fibre plastic.

Compensating for the vessel's movement at sea, Tracphone's three-axis digital gyro sensors precisely measure the pitch, roll and yaw of the antenna platform. A patented stabilization system converts these measurements into motor commands that move a robotic arm holding the antenna, keeping it pointed in the correct position to send and receive satellite signals.

In addition to the sensors, the system uses satellite step tracking to maximize signal strength. This combination ensures rapid reacquisition if satellite signals are temporarily blocked. (Source: *Machine Design*, 7 November 1996)

Plastic fuel tanks

One-piece plastic fuel tanks from Meese Orbitron Dunne Co. of Ashtabula, OH, shrug off salt water, fresh water, acids, solvents, and other chemicals that cause steel tanks to deteriorate in marine environments. Suitable for use in sailboats, yachts, speed boats, jet skis and other watercraft, the tanks are maintenance-free and outlast traditional steel tanks.

Rotomoulded into a single, uniform piece, the tanks eliminate the multiple fasteners, joints, seals, solders and welds that invite corrosion and weaken complex metal fuel-tank assemblies. The potential for hazardous leaks and spills is also eliminated.

The tanks feature dual moulded-in bosses that accommodate standard tubing for transporting fuel to the engine and for venting exhaust. A moulded-in insert attaches directly to the fuel gauge to aid fill-level accuracy. Moulding in these inserts during manufacturing eliminates several components and assembly stages, increases structural strength and improves seal integrity.

Made with cross-linked polyethylene, the tanks minimize fuel temperature fluctuations in a variety of severe outdoor conditions. Virtually stress-free, they distort in high temperatures without rupturing or catching fire, thereby reducing the risk of explosion. Tank integrity is ensured in temperatures ranging from -30° to 175° F. They can be moulded in capacities ranging from 12 to 118 gallons. (Source: *Machine Design*, 7 November 1996)

OTTER—the design and development of an intelligent underwater robot

Recent advances in sensing and intelligent control technologies open a whole new dimension in underwater autonomy. However, before truly capable, autonomous underwater robots can be created for subsea intervention and exploration, many research issues must be first investigated and developed experimentally on testbed platforms.

OTTER is an underwater robot designed to be used as a testbed for autonomous technologies. Both OTTER's

hardware and software systems are configured to support simultaneous development and testing of different concepts for underwater robotics by independent researchers. A general control-software framework enables common access to all subsystems and avoids the duplication of basic robotic functionality jointly required by all projects. Additionally, the new autonomous technologies enabled by the results of individual research are mutually compatible and can be easily integrated into a single robotic system. Examples of new technologies demonstrated on the OTTER underwater robot include control from a real-time vision-sensing system, coordinated arm/vehicle control, and control from 3-D graphical user interfaces.

More information can be obtained from Wang HH, Stanford University, Dept. Aeronaut. & Astronaut., Aerosp. Robot Laboratory, Stanford, CA 94305, USA. (Source: *Autonomous Robots* 3(2-3):297-320, 1996)

Collapse analysis

Norsk Hydro's Visund project is the latest on which Fire Safety Design (FSD) has been contracted to bring its expertise in fire protection to bear. The company is a leader in the development of computer analysis to optimize passive fire protection requirements, and has delivered cost savings to offshore installations in the North Sea and elsewhere.

For the Visund project FSD will use its Global Collapse Analysis program to optimize the passive fire protection applied to the drilling derrick, in order to ensure that in the event of fire, the structure will maintain its integrity for a minimum of 10 minutes; and that, if or when it does collapse, it falls in a pre-planned direction and not on top of, for example, the accommodation module.

FSD has already carried out the same analysis for Norsk Hydro's Njord platform. Typically the amount of insulation can be cut by up to two thirds compared with the amount calculated by methods conventionally used by the offshore industry such as the form factor method.

The company also helps to cut project costs by simulating fire tests, and thus reducing the number of tests that actually have to be carried out to a minimum. Moreover, the combination of simulation and actual tests itself enables the amount of insulation to be reduced by 25-30 per cent compared with using fire tests alone.

With its deep knowledge of fire safety, FSD has produced a design guide for passive fire protection which gives a ready indication of the amount of insulation needed. DNV accepts the guide for general use offshore in the North Sea, but Lloyd's Register wants the company to undergo the expensive process of having its software certified as a prerequisite for accepting the design guide.

Increased sensitivity to safety in the offshore industry following the Piper Alpha disaster in 1988 raised the demand for FSD's services and its profile. FSD performed optimization of passive fireproofing on the steel in well-bay areas, risers and the TLP columns, and on aluminium in the living quarters. Its work resulted in savings of 70 tons of insulation, worth \$2 million, in the well-bay area.

For more information contact Dr. Yngve Anderberg, Fire Safety Design. Fax: +46 46 14 00 30. (Source: *Offshore*, November 1996)

Composite-hull rescue boat

The Royal National Lifeboat Institution provides 24-hour sea rescue service on the coasts of Britain. To withstand this rigorous duty, the RNLI developed the Trent Class lifeboat, an engine-powered vessel with hull, deck and

superstructure made of tough fibre-reinforced composite material.

Completely watertight, the boat can right itself after a capsized. Its wheelhouse contains seats for six crew and space for a stretcher. A forward console in the wheelhouse holds all engine controls, hydraulic steering unit and wheel, tachometers, navigational equipment and other instruments crucial to operating the craft.

Measuring 14 meters from stem to stern, the Trent is one of several new RNLI designs replacing older wood, glass-reinforced plastic, and steel-hulled vessels. Extensive tank testing of scale models took place as part of the design process.

As a result of these trials, marine architects adopted a hard-chine hull form. Protection is provided by tunnels and deep bilge keels to minimize propeller damage if the craft should hit bottom when operating in shallow water.

The composite material used consists of a relatively low-density PVC core sandwiched between skins of epoxy resin matrix reinforced with glass and aramid fibres.

The Trent's hull is subdivided by five watertight bulkheads providing room for a cable locker, forward storage, survivor cabin and aft steering compartment, as well as fuel tank and machinery spaces. Its deck sheerline is dropped to reduce the freeboard, which helps when bringing rescued persons aboard.

Electronics onboard the Trent include an echo sounder, speed log, anemometer, satellite navigator, intercom system, and radio transmitter and receiver. A closed-circuit television lets crew members monitor the aft deck and engine room. (Source: *Machine Design*, 7 November 1996)

Seek and retrieve: closed loop systems by year 2000

The introduction of computers to the drill floor has gone a long way towards removing personnel from harm's way and increasing efficiency. But, sophisticated as an iron roughneck or computerized pipe handler may appear, it is by most reckoning just the beginning of how computers will change the way wells are drilled. In time, probably by the year 2000, computers will be working downhole just behind the bit to, among other things, manipulate adjustable stabilizers. Taking a cue from the early days of side-tracking and directional drilling, instructions sent from computers at the surface will alter the well path by retracting or extending adjustable stabilizer blades.

Taken a step further, the BHA would take its instructions not from a program entered at the surface and based on stabilizer changes to be initiated at a predetermined depth and departure, but from a closed system in which instructions to the stabilizer are generated from LWD measurements. And, as companies add sonic logs to their LWD arsenals and develop formation evaluation while drilling (as several have), these high-technology drilling solutions could conceivably be programmed to drill according to seismic correlations and thus become exploratory as well as very precise development drilling tools.

Besides further removing human frailty from the drilling process, once perfected this system would also allow many directional wells to be drilled without the heart of most current horizontal and extended reach drilling assemblies—the downhole motor.

The individual components for such advanced drilling systems exist and the concepts are being tested by a few operators and service companies. The remaining task is to package the technology as a cost-effective tool. (Source: *Offshore*, November 1996)

Motion-control board fine tunes propeller pitch

Controllable pitch propellers improve engine performance and fuel consumption by maintaining a relatively constant shaft rpm, adjusting propeller pitch, and hence load, instead of bogging down the engine. But typical analog controls, requiring as many as five custom PC boards, are expensive and difficult to change. A better solution, developed by engineers at Galil, Mountainview, CA, incorporates one off-the-shelf board combined with unlimited parameter access through a special interface. What is more, customizing is simply a matter of rewriting software.

Controlling the pitch starts with an amplifier card that accepts a 5-V analog signal and outputs a 24-V PWM signal that drives an electrohydraulic proportional valve. This valve controls a hydraulic servo which translates a piston's forward and aft movement to rotary motion, using a crosshead sliding block, crank-ring mechanism. The pitch varies according to trigonometric functions of the linear servo stroke.

By monitoring engine rpm and fuel consumption and comparing them to a pre-programmed curve, the servo tunes the pitch if fuel consumption is high for the given rpm. If the vessel has two or more engines per shaft, a governor controls the lead engine and subsequent engines are kept in sync by additional control axes. (Source: *Machine Design*, 7 November 1996)

Aerospace coating lands marine business

A new type of coating, originally intended for high-technology aerospace composites, is now being marketed as a protective lining for tank containers. The system is claimed to match high-performance fluoropolymers, such as PTFE, but at a much lower cost. It is also reported to be resistant to 98 per cent of all corrosive fluids, and forms a strong bond with steel, concrete and other industrial materials. The Siloxirane polymer is being marketed worldwide through GATT International, part of Advanced Polymer Sciences of Ohio, USA, which developed the metal oxide technology. (Source: *Advanced Materials News*, November 1996)

Real Time Kinematic positioning system

A major advance in its high-precision positioning technology is presented by Del Norte Technology.

The latest Real Time Kinematic (Series 2) positioning system, which requires only one frequency and offers "on-the-fly" capability, is now achieving real-time dynamic accuracy better than 30 cm under fully operational conditions.

First to benefit is the Geological Survey of The Netherlands, which has just acquired the RTK/OTF system and is putting it to good use aboard survey vessels around the coast of Holland. The technology is incorporated in a Del Norte twelve-channel mobile DGPS receiver.

One of the advantages of Del Norte's patented "high precision at low cost" system is that it is not dedicated solely to RTK/OTF. The new option is part of a fully-comprehensive positioning tool, extending its DGPS capability and retaining the non-RTK features for use as required.

All the company's GMU measuring units and 5012 DGPS receivers are now supplied "TRK hardware-ready". Users need only acquire the necessary Del Norte "secured" software to upgrade.

Customers also stand to benefit from the use of single instead of dual frequencies, made possible by a continuing and intensive research and development programme. Operating with two standard single-frequency GPS receivers, one as a mobile unit and the other as a reference station, it involves far lower capital outlay.

Del Norte sees "enormous potential" for its latest RTK technology in marine, land and air applications around the world. It lists land-based seismic surveys, pipeline projects and dredging operations as just three areas where the level of accuracy offers real gains. (Source: *The Dock & Harbour Authority*, November/December 1996)

SLICE testcraft launched by Pacific Marine

The first vessel to be built using SLICE swath technology was launched in November 1996 at the Pacific Marine yard in Honolulu, HI. Designed by Lockheed Martin, the testcraft is part of a cooperative agreement with the United States Navy's Office of Naval Research. Lockheed began design work in 1993, with vessel construction commencing in late 1994.

According to the company, SLICE technology gives the same exceptionally stable ride of a swath but it also gives the ability to go faster for the same horsepower. This combination of stable ride and high speed makes SLICE an attractive possibility for a Hawaii inter-island ferry boat. If the design proves successful, Lockheed would like to use local craftsmen to build SLICE ferry vessels for export around the world.

SLICE technology is intended for both military and civilian applications, Pacific Marine has negotiated exclusive commercial rights while Lockheed retains those for the military and government markets.

The company has already completed, what the company describes as a major feasibility study of an inter-island ferry system employing SLICE ships. The testcraft has been designed as a basic platform that will be capable of being configured for a variety of roles.

In a fast ferry role, the aluminium testcraft will be fitted with a twin deck passenger module. The present superstructure is equipped with a wheelhouse and accommodation areas for an operations crew of two plus four research personnel. Built to US Coast Guard Subchapter T requirements, the main structure is less than 100 gross tons.

A pair of MTU 16 V 396 TB94 diesels in the forward hull pods will each power a Lips 2.2 m diameter controllable pitch propeller via a Westech 6:1 reduction gearbox. A full load speed of 30 knots is anticipated.

The vessel is designed to continue in stable and unrestricted operation in up to sea state 5 conditions. The automatic motion and system control supplied by Navatek Ships, a subsidiary of Pacific Marine, utilizes integrated ballast and fins. (Source: *Fast Ferry International*, January-February 1997)

Water world

The marine industry is now brimming with new ideas as operators vie for faster, larger and more powerful vessels to compete for cargo and passenger business. The shipping masters have traditionally taken a conservative approach to new technology, but that picture is rapidly changing. Tankers and chemical carriers are becoming increasingly complex, while innovative designs are appearing in ferries and other niche areas.

The world's largest cruise ship, the 101,353 ton *Carnival Destiny*, for example, built by Fincantieri at its Monfalcone yard near Trieste under a \$400 million contract, entered service in November 1996 for the Carnival Cruise Line. That same month, the Royal Caribbean Cruise Line placed an order for two 130,000 ton cruise ships to be built by the Kvaerner Masa Yard in Finland, at a cost of just under \$550 million each.

Meanwhile the Japanese are intent on breaking the current speed barrier for container ships of about 20 knots. Their TechnoSuperliner (TSL) project began in the late 1980s to investigate ships that could carry 1,000 tons of containers at 50 knots over a 500 nautical mile range. The Japanese project has resulted in the construction of two large-scale models (one over 70 m long), a full test programme and a vast amount of trial data. However, there have been no orders yet for a full-size vessel.

Competition on the ferry front is also fast and furious. Finnyards of Rauma, Finland, delivered the two revolutionary HSS 1500 aluminium catamaran ferries to Swedish line Stena in 1996. Both operate on the Irish Sea. Though these are fairly large (92 m long) high-speed ships, most of the innovative fast ferries tend to remain small.

Much of the ferry industry has now adopted the catamaran concept, but the trimaran is seen to have potential in certain quarters. The trimaran can offer the speed of a catamaran combined with the sea-keeping of a monohull. Vosper Thornycroft has proposed a fast trimaran corvette powered by waterjets, while the Basin des Carnes and Finnish hydrodynamic research centre has produced concept designs for a 40-knot trimaran container ship.

Fast commercial transport at sea or in enclosed water is, however, subject to rapid technical change. Where it will go in the next decade is still far from clear. The catamaran is capable of further refinement, especially incorporating waterjet-propelled hull forms. Since simple buoyant hulls can now achieve speeds equal to those of hydrofoils and surface effect ships (SES), there is little future in foils or skirted vessels.

Elsewhere the small water plane area twin hull (SWATH) is slowly gaining favour, though America has been experimenting with these vessels for about 20 years. The SWATH is essentially a catamaran with very narrow struts near the waterline supporting deeply submerged bulbous (torpedo-shaped) hulls and a box, platform or cross-beamed structure above the surface. The SWATH has excellent sea-keeping response due to the very small water plane and commercial vessels can now generate up to 30 knots. The SWATH, however, is slower in calm waters compared to a catamaran carrying the same number of passengers and propelled by similar engines. But though the catamaran is quite efficient in calm waters, it rapidly loses speed and suffers uncomfortable motion in heavy seas.

So far Kvaerner has built the only large SWATH, the 12,000 ton cruise ship, *Radisson Diamond*. Evaluation of the SWATH concept is, however, being carried out by the Glasgow Marine Technology Centre supported by Vickers Shipbuilding and Engineering and the Centre for Marine and Petroleum Technology (formerly the Marine Technology Directorate).

An EU-funded R&D project, called SPAN (Safe Passage and Navigation) to develop the next generation of high-speed catamarans for use in shallow water exists. SPAN comes under the umbrella of the BRITE/EURAM fourth framework programme. The vessel will be capable of speeds up to 40 knots in water as shallow as two metres. The 39 month, 6.5 million Ecu (£5 million) project has run a year so far. The project manager is the British Maritime Group (BMT), with other partners including Transtejo, Cetena—the research arm of Fincantieri—and Lips Waterjets of The Netherlands.

Design consultancy Yard has been working with the University of Glasgow on advanced marine vehicle (AMV) technology, seeking to determine which of several hull

designs could offer the most potential for carrying cargo at a speed of 50-60 knots. They concluded that surface effect ships and possibly foil-assisted catamarans were the only realistic options for a 55-knot cargo ship. The SWATH lacked speed, while hydrofoils and hovercraft were limited by sea-states. AMVs have potential as passenger ships but are unlikely to be viable as cargo vessels.

Another area of attention is lighter structures for hulls, based on fibre-reinforced plastics (FRP) phenolics, a composite commonly used in the aircraft industry. In order to meet the fire regulations, superstructures are currently a mixture of aluminium construction and FRP. The aim over the next five years is to develop an entirely composite superstructure. So far, tooling costs for plastics for larger craft are considered to be prohibitive. Non-traditional materials, however, are more likely to appear in areas such as shaft units, propulsion, piping, minor bulkheads and linings.

Research work is also under way at various centres to reduce fatigue over the lifetime of a vessel. The Ship Hull Integrity Programme (SHIP), for example, is a \$3.3 million project funded by the European Commission and managed and led by BMT in partnership with British Steel Shipping and Kelvin Hughes in the UK and classification society Bureau Veritas in France. The project aims to develop a hull stress monitoring system that combines comprehensive sensor-based monitoring of sea state and a new generation of computer-aided data mining techniques (including structural modelling and expert systems), in order to recognize patterns of stress, fatigue, motion and sea state. British Steel has fitted eight bulk carriers with BMT SeaTech's Smart commercial stress-monitoring system.

Tanker design in particular is also the subject of much debate. Last year, Stolt Nielsen took delivery of the first two of a "new generation" of 10 parcel tankers built by Danyard in Denmark and ACH in Le Havre. The vessels, designed and developed at Stolt's Houston base, feature two longitudinal cofferdams which offer greater strength and cargo stowage flexibility, while double skinned outside fuel tanks safeguard against fuel pollution. Also they have the first diesel electric motors used for chemical tankers, built by Wartsila, Finland; they offer improved manoeuvrability and reduced diesel emissions.

Meanwhile Norwegian company Pick Up Cat A.S. is negotiating with several interested licensees for an unusual tanker design which looks like a massive catamaran and comprises a fixed power and steering unit and interchangeable cargo units. The "split" concept enables a small number of power units to manage a large number of cargo units. Once assembled, the units will appear as a normal vessel and retain the same strength and seaworthiness as a traditional hull. It will take under two hours to disconnect one cargo unit from another and will permit major savings in onshore storage facilities, as the cargo units can be utilized as floating production storage. A 7.5 m model was tested in 1996 at the Danish Marine Institute.

The most powerful driving force in the next decade will be environmental concerns, rather than new technological demands from operators or even safety legislation. Stricter emission rules are coming to the fore and experiments are under way with compressed natural gas or liquefied petroleum gas as the fuel for smaller craft. Though suitable technology is available, there are problems storing the fuel on board and the logistics of fuel supply. Fast ferries are seen as the natural target for this form of fuel, as they use considerable quantities of fuel every day and often emit their

pollutant in populated areas. Overall, in fact, the greatest changes in the marine area will very likely be made in propulsion machinery, due to new environmental measures, rather than in the introduction of outlandish hull profiles. (Source: *Engineering*, February 1997)

Utilization of fly ash concrete in fishing ground development

A new material with a high content of fly ash named "Ashcrete" has been developed. Using Ashcrete in marine structures, its strength characteristics, resistance to erosion by sea water, and safety in the marine environment. Since 1980, many types of large-scale artificial reefs constructed of Ashcrete have been installed in sea water. As a result of long-term studies and underwater observations, the Japanese Government has approved and environmental friendliness to marine life.

For this reason, it has been proposed that Ashcrete be used in constructing large-scale sea mounts called "Super Ridges" in deep water for the purposes of developing fishing grounds. And so, Marino-Forum 21 (an extra-departmental body that researches and develops fishery resources along Japan's coastal regions) commenced actual testing of a Super Ridge to obtain a grant from the Fishery Agency as of the fiscal year 1995. In the project, Ashcrete blocks were piled onto the seabed in the shape of a mound. This project is being carried out at a cost of approximately \$12 million spanning a period of six years.

By international agreement, 200-mile exclusive economic zones have been proclaimed worldwide and the focus of the fishing industry in Japan has shifted from simply catching fish, to developing a constant supply and harvesting this, so that a stable supply of marine resources from its home waters is assured. The Fishery Agency of the Japanese Government has inaugurated the Coastal Fishing Grounds Enhancement and Development Program (abbreviated to "Ensei" Program), the objective of which is to develop techniques for constructing fishing grounds which give a much higher level of productivity.

The use of high-volume fly ash concrete named "Ashcrete" to support large-scale fishing ground development projects under way in Japan has been proposed.

The material's strength, resistance to sea water, micro structure, and safety features have been demonstrated by leaching tests. As proven by more than 15 years of research and testing, Ashcrete meets the criteria set forth by the Government and has now become one of the officially qualified materials for major public construction projects such as fishing ground construction in Japan.

A project was launched in which Ashcrete blocks were piled onto the seabed to construct a mound-shaped structure. This project, termed "Development of a Mound-Shaped Fishing Ground Construction System", is being carried out off the coast of Ikitsuki Island in Nagasaki Prefecture. It has already been determined that the approximately 20,000 tons of fly ash to be used here will be supplied by the Electric Power Development Company's coal-fired power plant in Matsuura. The main research topics are a system for efficiently forming 1.6 m x 1.6 m x 1.6 m fly-ash blocks, and a marine transport and location system for accurately positioning those 5,000 blocks at the specified coordinates. Needless to say, extensive studies will also be conducted to evaluate the performance of these structures in terms of functioning as habitats for marine life.

Listed below are possible advantages being put forward for the operation of the proposed sea mounts: (1) possible increase of food production in significant quantity, particularly fish and shellfish protein; (2) creating a maintenance-free food production system which is unique and as yet undeveloped as compared with current terrestrial food production systems based upon agricultures; (3) environmental protection due to avoidance of reclamation of shallow coastal water by fly ash; (4) environmental protection in the sense of increased CO₂ uptake and O₂ production by stimulating productivity; and (5) finding a promising way for the production of electricity by coal power plant.

For more information, contact: Marine Engineering Division, Hazama Corporation, Japan. (Source: *Science & Technology in Japan* No. 61)

D. OCEAN RESEARCH

Anti-erosion reefs effective, according to study report

Several anti-erosion reefs developed by Breakwaters International Inc. (Flemington, NJ) are installed off the New Jersey shore. After two and a half years of monitoring, a research team at Stevens Institute of Technology (Hoboken, NJ) confirmed that these reefs are doing what they were intended to do: reduce wave energy and sand loss.

The "Beachsaver" reefs were installed at three different shore locations as part of the state-sponsored New Jersey project to study their effectiveness.

Stevens engineers found that under optimal conditions, the reef can reduce wave heights by more than 20 per cent. They found no evidence of negative effects on adjacent beaches. For example, the reef installed at Cape May Point led to gains of sand that averaged between 2.3 and 9 cubic yards per linear foot of beach behind the reef, while adjacent unprotected beaches continued eroding, according to a recently released study of the reef's feasibility. The 15-page study was authored by Dr. Michael Bruno, director of Stevens Institute's Davidson Laboratory; Thomas O. Herrington, Stevens research engineer; and research assistant Kelly L. Rankin.

In addition to shore protection, an ecological benefit was observed. At the three reef sites, the Stevens engineers noted "rapid and diverse colonization of the structures [by marine life]. The reefs are virtually covered with shellfish—including mussels and lobster—and are home to an array of fish, including eel, blackfish and flounder".

According to Breakwaters International, the effectiveness of the reef has been validated throughout the gamut of weather patterns and seasons. (Source: *Sea Technology*, July 1996)

Poseidon Project gathers European scientist team

Researchers at the Southampton Oceanography Centre in the United Kingdom are heading the new Poseidon Project, which brings together a multidisciplinary team of European scientists to explore submarine slide areas.

With the help of a grant from the European Community, the group plans to carry out a detailed survey of the sea floor in and around a well-known slide area, the Storrega Slide, off the north-west coast of Norway. They hope to develop a European capability for measuring, mapping and monitoring deep sea sediment stability. In order to do this they will have to develop new techniques for obtaining high-resolution images of the sea floor and gathering information on the type and organization of sediment present.

The first step in the project will be to design and build deep-water instruments for studying slope instability. The group is also developing a "scatterometer" to investigate the way in which the ocean floor around the Storrega Slide reflects sound. By sending out a sound signal and comparing the return echo with the original signal, it is possible to deduce what type of sediment the sound came from. In addition, the researchers will be carrying out laboratory-based experiments in large water tanks to mimic the behaviour of sediments in slope failure and to integrate the acoustic data with actual observations. (Source: *Sea Technology*, September 1996)

Sea floor observatory ready to plunge off New Jersey

Researchers will soon be able to extract information about a variety of processes taking place in real time in the coastal ocean—without going to the sea themselves. WHOI and Rutgers University researchers and engineers have just completed the final touches on LEO-15, the Long-Term Ecosystem Observatory. Hopes are that LEO-15 will be the first of many natural laboratories in the coastal ocean or even on the deep seabed.

LEO-15 was to be launched offshore New Jersey in 15 metres of water, linked back to Rutgers and WHOI laboratories by a buried fibre-optic cable. A vertical profiler would aid calibration of data from the ocean colour instruments aboard such satellites as the recently launched Japanese ADEOS satellite.

Other instruments will look at sediment transport and bottom boundary layer growth and decay. (Source: *Sea Technology*, October 1996)

Summer snows play role in marine ecosystems

A team of researchers from the Southampton Oceanography Centre (SOC) recently completed the first leg of a study investigating the effects of marine snow on sea floor communities off the Scottish coast.

Small organic particles in the surface waters of the ocean with negligible sinking rates are transformed into larger rapidly sinking aggregates reaching the sea floor in a few weeks. The larger particles, called marine snow, form a carpet of material up to a centimetre thick and become a food source for the sea floor communities. The complex currents off the coast may affect the availability and seasonality of the supply according to the researchers.

The team completed the first leg of the study by providing a detailed map of the sea floor west of the Shetland Islands, where complex currents are known to prevail and may be involved in the process. (Source: *Sea Technology*, October 1996)

Rising sea temperatures tied to melting glaciers

Warming tropical sea surface temperatures may be contributing to the melting of high-altitude tropical glaciers, according to researchers at NOAA's Climate and Diagnostics Center (CDC) and Scripps Institution of Oceanography.

Scientists believe that a general warming of the climate system in recent decades is related to a long-term increase of sea surface temperatures in the tropics and the resulting enhancement of the tropical hydrologic cycle. According to the researchers, higher sea surface temperatures and atmospheric humidity in recent decades are consistent with glacial records that indicate that temperatures in the tropics are warmer than at any time in the past 2,000-3,000 years.

The study compared temperature changes in the tropics, based on instrument records for the past three or four decades, to the results of a general circulation model.

Whether this recent increase is natural or caused by human activity remains to be seen. Regardless of the cause, physical evidence suggests that high-elevation environments may be particularly sensitive to long-term changes in tropical sea surface temperature and atmospheric humidity. These

factors are likely to impact the hydrologic and ecological balances of the high-altitude zones throughout the globe, but especially in the tropics. (Source: *Sea Technology*, October 1996)

Deep water survey completed off Irish coast by GLORIA

A deep water survey of Ireland's western continental shelf will reveal new sea floor features that will have an effect on fisheries management and future offshore activity, according to Southampton Oceanography Centre scientists.

The team will have covered an area over twice the size of mainland Ireland in 25 days using GLORIA, a sophisticated sea floor mapping device. Because of the region's size and resources potential, it has great significance for offshore operators, fisheries management and the marine science community.

The survey has revealed 15 submarine canyons, giant landslides and unexpectedly large areas of previously unknown rock outcrop.

Southampton scientists have been working in partnership with marine experts in Ireland in one of the largest marine research projects funded by the European Union. The Irish continental shelf/shelf edge is a vast region requiring a collaborative approach, while GLORIA has provided invaluable data about this little-known environment. They have produced a three-dimensional map of the seabed which will act as a strategic basis for work in many fields of marine research.

The data will be processed at the Centre. Further analysis will be carried out at the Dublin Institute for Advanced Studies and the University College Dublin. The information will be kept at the Irish Marine Institute's Marine Data Centre and will be available for use by other researchers. (Source: *Sea Technology*, November 1996)

Oil surveys by satellite could save millions

A quicker way to transmit and analyse large sets of data from offshore oil survey ships has the potential of saving the oil industry millions each year. A new system called the ATM Research and Industrial Enterprise Study or AIRES could be the solution. The AIRES network can save weeks or months between the seismic data acquired from one of the world's 60 survey ships and analysed by oil companies according to the American Petroleum Institute.

The satellite-linked system received its first real workout in a recent demonstration. It achieved the fastest data rate ever involving a moving commercial ship—2 megabits per second. The ship, the *GECO Diamond* seismic survey vessel, was in the Gulf of Mexico 130 miles south of Galveston, TX.

Using a small on-board antenna designed by NASA, the ship sent seismic data up 22,300 miles to an advanced communications technology satellite (ACTS). The satellite beamed the data to NASA's Jet Propulsion Laboratory in Pasadena, CA, which relayed the transmissions to Cray Research's Minnesota Supercomputer Center for processing. (Source: *Sea Technology*, November 1996)

Program aims to develop tools to monitor oil-eaters

A team of Washington Sea Grant Program researchers are developing tools to monitor bioremediation, a biological process that uses micro-organisms like oil-eating bacteria to decontaminate polluted areas. The ultimate goal is to develop a sensor that can reside unattended in a clean-up site for days or months, continuously measuring the presence of specific chemical compounds.

However, to run successful bioremediation clean-ups, scientists must make precise measurements of specific compounds. They need to know the contaminant concentrations in the area in order to know the type and amount of micro-organisms to use there. They must monitor microbial activity to provide the best conditions for micro-organisms to degrade complex, toxic molecules into simple, harmless ones. Finally, for bioremediation to work on a large scale, monitoring and measuring techniques must be inexpensive and easy to use.

The prototype sensors being developed incorporate advanced light technologies. One prototype, being developed by the University of Washington's Chemistry Department and the university's Division of Medical Genetics, uses fibre optics to sense chemiluminescence, the faint glow given off by some chemical reactions. (Source: *Sea Technology*, November 1996).

Expert panel gathers to address red tides

Sponsored by the National Oceanic and Atmospheric Administration's Coastal Ocean Program and the National Fish and Wildlife Foundation (NFWF), a panel of recognized scientific experts convened in Seattle, WA recently to address the human health issues related to the harmful algal blooms popularly known as "red tides" and outbreaks of domoic acid in the North-west.

Harmful algal blooms (HABs) hit the United States every year, resulting in the loss of millions of dollars from the closure or loss of commercial and recreational fisheries.

Blooms are caused by rapid proliferation of minute algal cells that occur in both fresh and salt water. In the case of red tides, the pigment in the organisms makes the water appear reddish. Other blooms appear as "brown tides" while some have no discernible colour. (Source: *Sea Technology*, December 1996)

Iron "fertilization" causes rapid plankton bloom

Despite being the fourth most abundant element in soil and rock (and most common on Earth as a whole), iron is in short supply in much of the sea. Scientists have long suspected iron deficiencies might affect about 20 per cent of the global ocean, yet the idea has not been tested until recently.

New results by the NSF-funded researchers, published in the science journal *Nature*, confirm experiments indicating strong biological responses to added iron. On a research cruise, "IronEx II", scientists "fertilized" a patch of ocean waters about 800 miles west of the Galapagos Islands. The experiment was tracked for 18 days. Iron-starved phytoplankton native to the region responded rapidly with the amount of plankton nearly doubling per day.

At the same time, the rapid growth of these plankton began to "draw down" carbon dioxide in surface waters. After 10 days, the concentration of carbon dioxide had dropped 20 per cent over the initial values, according to scientists from Moss Landing Marine Laboratories in California. Calculations for equatorial Pacific indicate that iron fertilization there would not significantly counteract projected future increase of atmospheric carbon dioxide. (Source: *Sea Technology*, December 1996)

Underwater surveying with SeaBat 9001 sonar

RESON Offshore Ltd. (Aberdeenshire, Scotland) was recently hired to conduct underwater surveys with its SeaBat 9001 around a deep water channel in the United Kingdom, according to a spokesman.

The Second Severn Crossing is 5.5 kilometers long, linking the areas just south of Sudbrook Point and the village of Severn Beach over the deep water channel called the "Shoots". Construction began in 1992 as a joint venture between John Laing Construction and GTM Europe, bringing together expert engineers and construction specialists to build approach viaducts and a central-stayed bridge.

To confirm the as-built construction under water, Laing/GTM hired Longdin and Browning (Swansea, West Glamorgan, UK), a surveying company, to conduct a high-resolution SeaBat survey of the underwater portion of five concrete caissons. The ground bearing caissons provide the foundations for the piers and pylons of the crossing.

SeaBat 9001 was deployed under difficult conditions with tidal variations of 14.5 metres, strong currents, and in waters 5-18 metres deep, yet it still provided what was needed, the RESON spokesperson said. (Source: *Sea Technology*, December 1996)

Scientists hunt 60 ft leviathan of seamen's legends

A team of scientists and adventurers are about to set sail in quest of the giant squid, a monster of mythological proportions and one of the last great ocean mysteries.

The international group will shortly leave Wellington on a six-week trip to waters over the deep trenches off New Zealand's South Island. The squid is a leviathan, believed to measure more than 60 ft in length, with eyes as big as dinner plates and a powerful, bird-like beak. It has tentacles as big as tree trunks and covered with suction cups. It is the largest aquatic invertebrate and is believed to weigh up to two tons.

Although the creature has been woven into seafarers' tales for centuries, the only giant squid with which scientists have had close encounters are dead ones. There has never been a recorded sighting of a live one. Seafarers' accounts have become the stuff of legend: the fabulous sea monster Kraken, which was said to have dragged down ships off Norway; the behemoth with which Jules Verne's Captain Nemo did battle in the submarine *Nautilus*; and the creatures encountered in Herman Melville's *Moby Dick*.

The two-boat expedition, sponsored by *National Geographic* magazine and television productions, will be using the latest equipment. Undersea digital video cameras with canisters of slow-release fish bait attached will be suspended from the boats. The cameras can be lowered 10,000 ft, although the expedition organizers are hoping to find squid at only 1,000 ft below the surface. A computer-directed submersible built by the Massachusetts Institute of Technology will also be used.

The waters off Kaikoura are a feeding ground for whales, among the few creatures prepared to do battle with the giant squid, on which they prey. In a controversial move, further cameras called Crittercams will be attached to some of the whales using tags and biodegradable straps. (Source: *Electronic Telegraph*, 30 January 1997)

One-man submarine poised for 37,000-ft dive

In a dress rehearsal for a plunge to the deepest part of the planet, the 37,000 ft Mariana Trench in the Pacific Ocean, marine engineer and explorer Graham Hawkes test "flew" his one-man submersible *Deep Flight I* in California's Monterey Bay. It is supposedly the first hydroacrobatic winged craft smaller, faster, and more manoeuvrable than conventional submarines. With an operational depth of 3,000 ft the submarine will test design ideas that Hawkes says will let the craft move with the freedom and grace of a dolphin. A second version will make the deep plunge.

The craft's name springs from the features not usually found on submersibles—wings and tails. In fact, it resembles an airplane more than a traditional submarine. Top speed is an estimated 12 knots with cruising in the 4-8-knot range. The pilot will be strapped in face-down to distribute loads in a compartment called a Bio Shell. One hand will be on the joystick, and forward vision will be out a clear acrylic nose cone. Equipped with a sophisticated camera system, the craft may bring new visibility to underwater spectacles not frequently seen by the public—for example, new species and shipwrecks that have lain untouched for years.

As a safety feature, the ship is given a fixed positive buoyancy and small amount of stability so it returns to the surface if problems develop. The main structure of the first version is made of fibreglass and epoxy. The second version will use more ceramics. (Source: *Machine Design*, 16 January 1997)

Scientists witness creation of hydrothermal vents

During a recent research expedition aboard the drillship *JOIDES Resolution*, two new hot springs were created on the sea floor while scientists "watched". The event reactivated an ancient hydrothermal system that produced mineral deposits on or just below the sea floor.

The group of 25 scientists from nine countries were part of an ocean drilling programme (ODP) research expedition to study active sea floor hydrothermal systems and the rich mineral deposits they often produce. The new vents occurred about 150 miles west of Vancouver Island, Canada.

The international research team will install instruments in the drill holes to monitor temperature and pressure changes during the next several years. The data will be stored in computers on the sea floor and will be recovered in the future when ROVs or research submersibles visit these sites. (Source: *Sea Technology*, January 1997)

European team getting deep into hot water

University of Southampton (UK) scientists are co-ordinating a huge deep-sea research project to explore the largest, most powerful hydrothermal vent site ever found in the Atlantic Ocean. The Rainbow vent field lies 2,300 metres below the ocean's surface along a segment of the Mid-Atlantic Ridge near the Azores where the tectonic plates that form the Earth's surface fracture and separate, allowing new sea floor to be created.

At hydrothermal vent sites, sea water percolates down through these fractures and, where it passes close to molten magma, it is heated to temperatures up to 400° C. The Southampton scientists believe the site could provide an "ideal laboratory" to study how biology adapts to cope with a harsh, hostile and inhospitable environment. Despite the high pressure, temperature and toxicity, the site supports an abundant and exotic ecosystem. Studying the site's biology will help understand how biology copes with extreme pollution and could prove invaluable in predicting the effects of man-made pollutants on marine environments.

The researchers will also be mapping the sea floor to find new sites and work out how far apart the sites are. Using this information, they will be able to test the hypothesis that some larval fauna carry enough food to survive the journey. (Source: *Sea Technology*, February 1997)

Fibre-optic sponges

The millions of long, thin, sharp silica spicules in *Rossella racovitzae* sponges, three-foot-high brown organisms that inhabit the Ross Sea in Antarctica, give the sponge

structure and shape, as well as ward off predators. Researchers of the University of Genoa in Italy have found that the spicules also pipe light into the sponge, much like fibre-optic wires. The transmitted light appears to support symbiotic photosynthetic green algae that produce sugars for the sponge. The researchers determined how well the four-inch-long structures transmit light by bending a spicule 90 degrees and shining a red laser into it. About 65 per cent of the light was transmitted one and a half inches from the top of the spicule; at approximately two and a half inches from the top (past the bend), 10 per cent of the laser light was still getting through. Silica spicules are an essential part of all sponges. (Source: *Discover*, March 1997)

Sponge with anti-cancer potential

The yellow coloured sponge *Lissodendoryx* contains an organic compound called *Halichondrin B* which is known to

kill certain types of cancer cells. According to the University of Canterbury, New Zealand, the compound is effective against human ovarian cancer cell lines, some colon cell lines and certain melanomas.

Scientists from New Zealand's Oceanographic Institute have been searching the seabed for samples of the sponge. A kilogram of the sponge, however, yields only a minute one mg of *Halichondrin B* which researchers estimate costs US\$1,000 in time and equipment to produce. The extracted compound is sent to the National Cancer Institute in Washington, USA for testing.

The cells of *Lissodendoryx* are known to be very robust and, when pressed through a sieve, they reconstitute themselves as new sponges. Manufacture of synthetic *Halichondrin B* requires expansion of sponge production, thus providing mariculturists with an opportunity for commercial exploitation. (Source: *INFOFISH International*, May 1996)

E. ENVIRONMENT

Seals on the pill

Many fishermen in the Northern Atlantic waters blame expanding seal populations for drops in fish stocks. Recently they were blamed for cod-stock collapse. The Canadian Government allowed fishermen to cull 250,000 harp seals in 1996. However, some scientists and anti-sealing activists dispute efforts to blame seals for the cod decline. The culled seals end up in processing plants; processors buy the pelts, meat and fat of the animals.

The British Government is considering a more humane option to culling—putting female grey seals on the contraceptive pill as an alternative. The technique was invented by Canadian scientists and has been used with a 90 per cent success rate. The pill is fired from an air gun into the body of the seal and slowly releases a compound which stops eggs from fertilizing for up to three years. Officials believe it is the first environmentally-friendly alternative to culling, which was stopped in Scotland in 1978 due to public protests. (Source: *INFOFISH International*, June 1996)

The coast is the key

The coastal zone and the marine environment are the keys to the economies of the West African coastal States. Over the last few decades, they and their resources have been of unsurpassed economic importance, especially for fishing, tourism, industry and the development of ports. They continue to be so.

The West African coastal zone and marine environment is made up of highly productive ecosystems of great biological diversity. The estuaries and mangrove swamps yield a high organic output; rich fishing zones lend themselves to fish farming; and their fish and other living resources make a major contribution to the health of the economies of the West African coastal States. The coasts and their waters also produce such useful materials as salts, shells, heavy minerals and peat, while the coastal areas themselves have great potential for tourism, fishing and leisure.

But in recent decades, these two major ecosystems have been subjected to growing stress from natural and human-induced changes which have many and varied causes. The development of infrastructure, improper use of their resources and extensive contamination by pollution have all exacerbated their degradation. The impact of global climate change has led to frequent flooding, salt-water intrusion or severe erosion in some coastal regions of our planet.

Other factors and major problems threatening the survival of the marine and coastal environments of West Africa include:

- The growing poverty of the communities living in coastal areas and the degradation of the coastal zone and marine environment, particularly through over-exploiting (or anarchically exploiting) mangrove wood, salts and other resources, through destroying nursery zones for fish and, in some instances, through dynamite fishing.
- The constantly increasing pressure from the high concentration of population, especially in the large coastal towns. This intensifies marine pollution both from the land—such as sewage and domestic waste

water, agricultural and industrial waste—and from sea-borne sources.

- The physical contamination and destruction of crucial habitats that are occurring virtually everywhere on the West African coast. This is a grave concern because restoring them will take several decades, and it should be taken into account in all strategies for tackling the effects of global changes and their possible impact on marine systems and on the sea level.
- Some natural forms of environmental changes such as the dramatic reduction of mangrove swamps, dying as a result of the hypersalination of some estuaries, and the decline in rainfall—and increase in the salinity of soils and large areas of surface and underground water—due to the increasing aridity of the climate, as in Senegal.
- The malfunctioning of some natural local ecosystems in delta regions, lagoons and estuaries as a result of inadequate water supply and control installations.
- The harmful use of certain fertilizers, pesticides and herbicides.
- The incipient invasion of freshwater surfaces by water weeds and other floating-leaved plants.
- The salination and acidification that has reduced the agricultural potential of some mangrove swamps converted into paddy fields.
- The very poor health and hygiene of the communities living in many coastal areas, including the high incidence of bilharzia that has appeared upstream of the dams built on many coastal rivers.

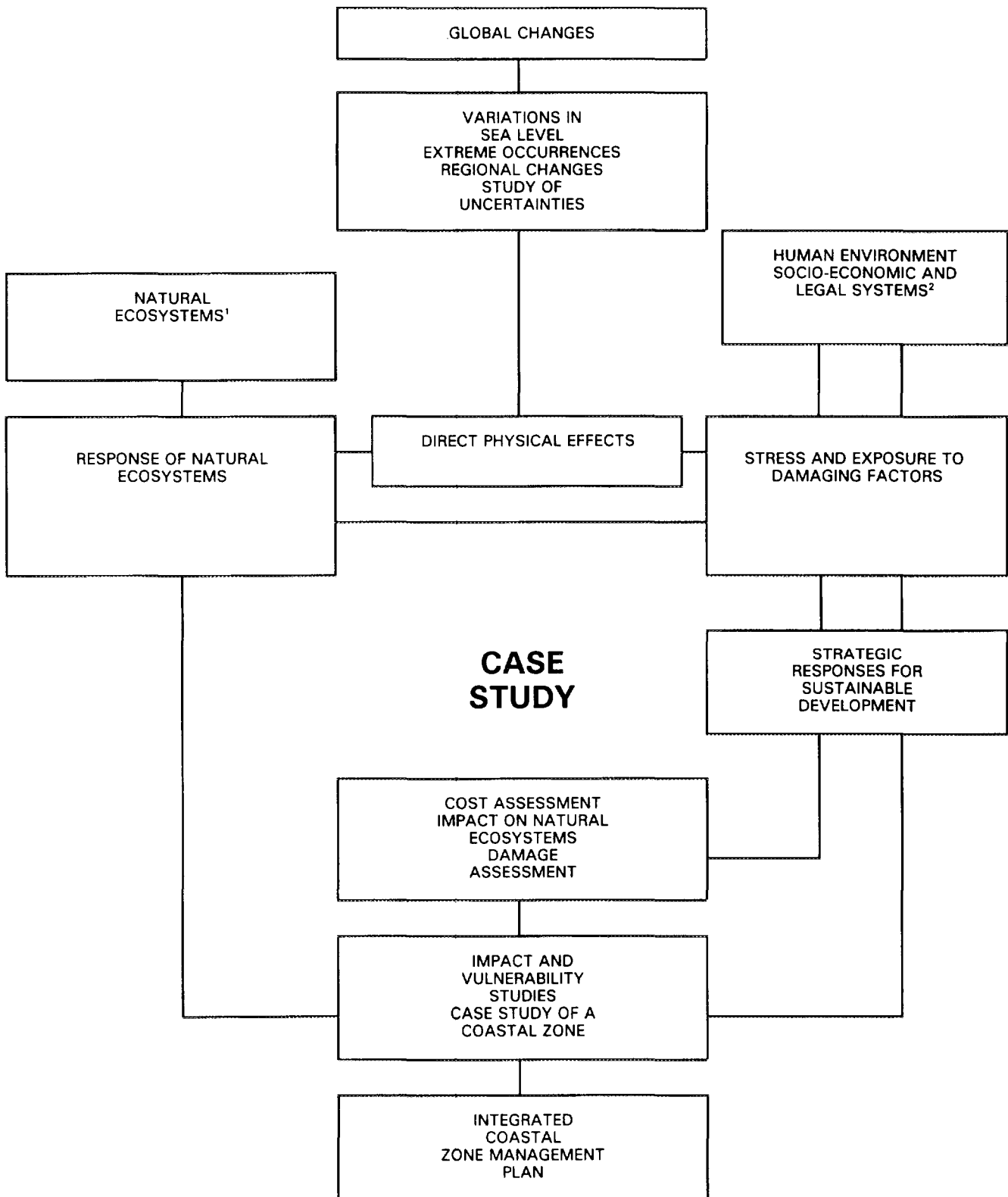
Integrated marine and coastal zone management programmes for West Africa must be established if sustainable development is to be achieved. Several governments have recognized this and embarked on initiatives, especially within the framework of the various National Environment Action Plans. Sectoral projects have not improved the situation much—far from it—and nor have the many existing laws and regulations designed to protect and safeguard the marine environment and coastal zone. The African coastal States must face these challenges in the coming years in their efforts to establish and implement integrated management programmes that are sufficiently coherent and effective to achieve sustainable development (see following table).

The programmes should place emphasis on:

- The integrated management, protection and sustainable development of the coastal and marine zones.
- The rational use and conservation of their biological resources.
- The study of the fundamental uncertainties concerning the management of the marine environment and climate change.

Criteria that need to be taken into account in establishing these programmes include:

- Identifying and assessing the problems and establishing priorities in consultation with local communities.
- Drawing up action plans which should both be simple and flexible, and as comprehensive as possible. These should set management targets for the priority problems and their ultimate objective must be to reverse the deterioration of the marine and coastal ecosystems.



INFORMATION REQUIRED:

¹ Biological: type and extent of ecosystems, primary products, diversity and abundance of species, breeding areas, evolution cycles.

Physical, physical-chemical and geological: geology, temperature, salinity, nutrients, tides, sea level and currents, typology and distribution of sediments, erosion/accretion, alluvial deposits, forms of pollution, etc.

² Socio-economic: population distribution and growth, density, migration, economic activities, land use, etc.

Legal and institutional: land tenure systems, fishing rights, legislation and regulations in force, institutions in charge, available financial and human resources. (Source: *Our Planet*, Vol. 8, No. 3)

- Developing strategies and measures, including integrated management, with the participation of the communities concerned, of representatives from local government and authorities and the relevant socio-economic sectors, including NGOs and women.
- Using science and technology to ensure efficient implementation of integrated management programmes.
- Defining criteria for assessing the effectiveness of the strategies selected.
- Conducting environmental impact studies to assess possible solutions.
- Taking steps to protect threatened marine species and fragile habitats in the coastal zones, with the participation of the communities concerned, with a view to sustainable development.
- Identifying and establishing a viable framework for partnership, and efficient cooperation and coordination mechanisms, at both national and regional level; this could help create data banks to provide better information on these vulnerable zones.
- Applying the precautionary principle in planning for more rational and efficient management of the coastal and marine ecosystems.
- And lastly, given the complementarity of the coastal and marine zones in West Africa, ensuring that their overall management is implemented on a regional basis. (Source: *Our Planet*, Vol. 8, No. 3)

Beware an ecological tsunami

Water defines our planet; the oceans dominate it. But because humans are terrestrial creatures and because until recently our impact has been relatively minor, we are largely ignorant of the essential roles of the oceans, the escalating changes in the marine realm and the possible consequences for all life on Earth. The explosive growth of the human population, our unsustainable use of resources and generation of wastes, and the increasing inequity within and among nations are resulting in profound changes to the oceans. A more enlightened understanding of these changes and their possible consequences is needed.

It is time to move beyond the outdated assumptions that the oceans have unlimited potential to provide food and assimilate wastes, beyond the myopic focus on short-term economic gains, beyond the primary preoccupation with the goods obtained from marine ecosystems, and beyond the indifferent acceptance of ignorance about oceanic patterns and processes. It is time to think more holistically about ocean ecosystems, and to consider more responsible ways in which humans can minimize their impact on the very systems that provide for our well-being. It is time to take better stock of our treasures before they are swept away in an ecological tsunami of unprecedented proportions.

People have relied for millennia on the useful goods produced by marine ecosystems. Food, fibre, shells, medicines, chemicals—and now genes—are extracted, used, bartered and sold around the world. These “ecosystem goods” have been the prime focus of the economic value and “usefulness” of marine ecosystems. But the oceans also produce a suite of essential “ecosystem services” so far less appreciated, but no less essential.

These services range from producing oxygen and influencing climate, through both carbon and sulphur cycles, to creating the habitat that other species need to survive. Kelp forests, mangroves and coral reefs provide homes for rich assemblages of coastal organisms and protect shores from erosion by waves. Oysters in bays filter water; mangroves and salt marshes detoxify pollutants and collect sediment which

could otherwise smother animals and plants downstream. These services are the product of the functioning of the ecosystem, the result of the characteristics of species, interactions among them and interactions between the organisms and the physical and chemical environment.

Together with ecosystem goods, these ecosystem services provide the marine component of the life support systems of planet Earth. Both are being threatened as genetic diversity is diminished, populations are fragmented, species are lost and ecosystems disrupted. Loss of species, fewer individuals of critical species, changes in their spatial configuration, size or strength of interaction with other species can all contribute to changes in the functioning of the system.

The causes of these changes are multiple and complex. They include overfishing (including by-catches and waste), chemical pollution, eutrophication, habitat degradation or destruction (from trampling, trawling, dredging, drilling, dynamiting, building, dumping and noise) and the introduction of exotic species. Climate change and increases of UV-B radiation as a result of stratospheric ozone depletion pose additional hazards. Most waters are affected by many of these stresses, some by all of them.

There are clear signals from around the planet that these activities are resulting in serious problems. The demise of many of the world's fisheries has received widespread attention—but the declines of non-commercial species of seaweeds, shellfish and fishes gleaned from shores around the world for local use are equally serious. Unexpected, dramatic mass mortalities of many marine species have been reported—ranging from marine mammal die-offs and fish kills to mass mortalities of sea urchins, abalone, seagrasses and others. The incidence of the bleaching of coral reefs appears to be increasing. Water quality is seriously impaired in coastal regions: in many places this represents a critical hazard to human health. Increases in rubbish, especially plastics, are obvious to almost everyone who frequents the shore. There have been many reports of increases in the frequency, intensity and spatial extent of harmful algal blooms such as red tides; with consequences ranging from human health hazards such as paralytic shellfish poisoning to aquacultural die-offs and increased mortality of fishes and marine mammals. The symptoms vary from place to place. Some are well documented, others less so. The actual causal factors are often ambiguous. None the less, on the whole, the picture is one of marine ecosystems in trouble, especially in nearshore waters.

The vast majority of people on Earth live within 80 kilometres of the coast. Near shore habitats bear the brunt of both land-based and sea-based activities: tourism, recreation, fishing, mariculture, domestic and industrial waste disposal, military activities, and the transportation, mining and energy industries. As a result, bays, estuaries, enclosed seas and coral reefs provide ample evidence of a plethora of problems. Many of these systems, especially coral reefs, estuaries, kelp forests and rocky shores are among the most productive systems on Earth; coastal waters produce 75 per cent of the world's fish catch. A higher priority must be put on ensuring their sustainability.

The old adage “dilution is the solution to pollution” captures the historical attitudes toward oceans as vast, bountiful and infinitely resilient. The many problems occurring around the world suggest this is grossly misplaced. We are learning that the oceans, especially coastal areas, are under increasing and serious threat from multiple sources. We do not yet know the full extent of the problems, but marine scientists are in strong agreement that we are faced with a

crisis of unprecedented complexity, proportions and consequences. The magnitude, kind and rate of change are startling. Making predictions about the likely outcomes of different possible management or policy options is extremely difficult. This uncertainty, coupled with incomplete baseline information about many systems, presents enormous challenges. The future undoubtedly holds surprises.

Decisions by society about land-use practices which affect the oceans and about uses of marine biota and habitats will be at their most powerful if they are informed by the best possible scientific understanding. In some cases, we have sufficient information to manage our activities more wisely, i.e., with significantly less impact—but though known, this information is often not used or communicated. In other cases, information urgently needs to be obtained by research and adaptive management. New mechanisms are needed to disseminate scientific knowledge more efficiently and effectively and to utilize it more appropriately.

Humans depend upon the life-support systems provided by the oceans. A sustainable biosphere requires a living ocean. It is time for a substantially different approach to thinking about and managing both the land-based and sea-based activities that currently threaten our oceans. The seas can no longer be a marginal issue. (Source: *Our Planet*, Vol. 8, No. 3)

New ozone plant leads the way

One of the UK's largest ozonation operations recently went on line at Severn Trent's Mythe water treatment works near Tenkesbury in Gloucestershire.

The £6 million plant, designed and installed under a turnkey operation by Capital Controls, a Severn Trent company, treats 120 million litres of water a day drawn from the adjacent River Severn serving nearby Midlands cities. The project also provided the company with valuable new experience.

This plant, one of the biggest of its kind anywhere, is being very carefully monitored to assist future designs for other water treatment plants in the area and elsewhere. Standards for drinking water are obviously of prime importance and ozone's forceful and highly effective disinfection properties are a powerful weapon in eliminating potentially dangerous contaminants such as trihalomethanes.

Ozone for the plant is produced on site by five large generators, each with an output capacity of 17.5 kg/h of ozone under fully automatic conditions.

This is used for both preozonation combined with activated carbon and final ozonation in banks of large 6-metre-deep concrete tanks containing a series of fine bubble diffusers.

Safety is also a major factor of the plant, and after the ozone has contact with the water, the application of heat at temperatures up to 400° C destroys it. (Source: *Waste Minimization & Environment*, October 1996)

Floating wave generator

Golder Associates is introducing a unique Floating Wave Generator (FWG) to reduce ice formation and enhance water quality. Golder is working directly with Per Andersen, who holds the FWG patent to develop and market the technology worldwide.

The device, initially developed to prevent ice formation in harbours and marinas, operates by generating a mechanical wave train. Constant agitation of water via artificial waves and the mixing of lower, warmer water with colder surface water deters ice build-up. The artificial waves also serve as an effective mechanism for mixing and re-aerating stagnant

water. (Source: *Waste Minimization & Environment*, October 1996)

New drifting buoys aid in hurricane forecasting

As Hurricanes Edouard and Fran moved off the coast of Africa and began to intensify in the Atlantic's warm summer waters, they were monitored by a new array of floating buoys that transmitted critical data to the National Oceanic & Atmospheric Administration's National Weather Service forecasters.

For the first time ever in this part of the Atlantic, floating buoys operated by the National Data Buoy Center took a hurricane's vital statistics and transmitted them directly to forecasters who used the information to help predict its path.

Dropped into the ocean by C-130 hurricane reconnaissance aircraft flying out of Mississippi's Keesler Air Force Base, the series of 14 drifting buoys took Edouard's and Fran's pulses as the storms moved by them. The buoy array measured wind speed and direction, barometric pressure, and sea and air temperature—measurements that gave important clues about the storm's strength, speed, and direction of travel to forecasters at NOAA's National Hurricane Center in Miami. (Source: *Sea Technology*, November 1996)

UK's EA shifts blame

Human hormones, rather than industrial chemicals, may be "feminizing" fish in sewage-polluted rivers, says new research.

The UK Environment Agency last week published the results of a three-year study of oestrogenic chemicals in domestic sewage effluent, which have been blamed for hermaphrodite effects in fish. It has identified the culprits as the natural female hormones oestrone and 17 β -oestradiol. The hormones were found in all the effluent samples, at very low concentrations of less than 10 ng/litre. They were shown to produce "additive" effects greater than the sum of their individual effects.

While the hormones are excreted in an inactive form, researchers found the active forms in effluent samples, suggesting that the hormones had been somehow reactivated between excretion and discharge from the sewage treatment works.

The synthetic hormone ethinyl oestradiol, used in the contraceptive pill, was found in only a few of the samples.

The agency is continuing its research into possible industrial sources of oestrogenic chemicals, or endocrine disruptors. (Source: *European Chemical News*, 18-24 November 1996)

Cal Poly establishes new biotechnology institute

Headed by microbiology professor Raul Cano, the Environmental Biotechnology Institute at Cal Poly will explore approaches to land and water pollution problem-solving through the use of microorganisms and their products. The institute plans to promote research and education in the environmental biotechnology field.

Biotechnology has been used to measure the well-being of ecosystems, transform pollutants into benign substances, generate biodegradable materials from renewable resources, and develop environmentally safe manufacturing and disposal processes. Biotechnology used to include composting and waste-water treatment technologies.

The most recent technology of environmental bioremediation turns waste materials into harmless by-products such as water, carbon dioxide and various forms of salt. The

process itself is similar to composting lawn or garden clippings to be used later as a soil nutrient.

The institute will focus on research that could lead to the development of technologies to clean up areas contaminated by petroleum, metals, pesticides, radioactive elements and other toxic materials and wastes, according to Cano. Ultimately, research at the institute could lead to novel and useful medical and industrial applications. (Source: *Sea Technology*, December 1996)

UMC advocates way for control of marine fouling

David Jones, chairman of UMC International Plc. (Eastley, Hampshire, UK), recently presented a paper on "Controlling Hull Fouling Without Damaging the Environment" at the Shiprepair and Conversion Conference held in London.

Assuming that underwater cleaning is required at four-month intervals, then a vessel can be maintained afloat for two years for the same cost as applying two coats of a tin-free antifouling paint, and in some cases it is viable to provide a clean hull by means of hull cleaning alone. However, the way ahead lies with specialist coatings, such as the non-toxic silicon-based paint recently applied to the liner *Norway* in Southampton, in conjunction with the underwater cleaning.

In order to produce a product that the customer will buy, research into coatings and hull cleaning must be pursued together. Research and development into the new range of coatings will only be successful if it goes hand in hand with research into new improved methods of underwater hull cleaning.

The advantages of a successful "package" comprising a non-toxic coating combined with hull cleaning would be enormous. Not only would it solve the environmental problems, but it would provide the customer with an antifouling coating with an open-ended life, only limited by its mechanical condition. (Source: *Sea Technology*, January 1997)

Dolphins die from tin pollutants

For the first time, a US study has found concentrations of organotin compounds, including tributyl tin, in marine mammals in the USA. The researchers suggest that the chemicals, which are used in marine paints, may have contributed to the deaths of dolphins by suppressing their immune systems.

Since 1987, dolphins have died in large numbers along the Atlantic coast of the USA, in the Gulf of Mexico and the Mediterranean. These incidences have occurred mainly in industrialized areas. Scientists have suggested that organochlorine pollutants were to blame.

Shipbuilders and owners use paints containing tributyl tin to prevent barnacles, molluscs and slime attaching to boats' hulls. It is known to cause mussels and fish to develop sexual organs of the opposite sex, but scientists have not yet fully investigated the implications for marine mammals.

A group led by Skidaway Institute of Oceanography in Georgia measured the concentrations of butyl tin compounds in dead bottlenose dolphins found along the US Atlantic and Gulf coasts between 1989 and 1994. They report that the livers contained the highest concentrations of organotin compounds; the blubber, heart and brain were also contaminated.

The team also found that the average concentration of butyl tin compounds in the US dolphins was higher than those found in diseased animals from the Mediterranean and

Japanese coastal waters. These levels were also three to four times higher than in US off-shore animals. Bottlenose dolphin live primarily around coastal areas so are more likely to encounter pollutants, explain the researchers.

It is suggested that organotins, as well as organochlorines, may suppress dolphins' immune systems. Butyl tin compounds strongly inhibit energy production in cells, damage plasma membranes and disrupt metabolic equilibrium.

The USA is the major producer and consumer of organotin compounds, accounting for about 35 per cent of world consumption. In 1988, the Government passed a law banning the use of tributyl tin on boats less than 82 feet long. But it can still be used on longer vessels and aluminium-hulled boats. (Source: *Chemistry & Industry*, 20 January 1997)

Japan still battling one of largest oil spills

In Mikuni, Japan, the battle against one of Japan's worst oil spill disasters continued as massive new slicks pushed by heavy winds hit a stretch of coastline already affected by the spill previously. In the morning of 2 January 1997, the 13,157-ton tanker *Nakhodka* ran aground about 100 miles from the Hyogo Prefecture. The ship was carrying 133,000 barrels of heavy fuel oil. The authorities initially estimated that 26,000 barrels of oil leaked out but now say that the figure appeared too low.

RADARSAT International (RSI) (Richmond, BC, Canada) electronically delivered a RADARSAT image on 11 January to the Remote Sensing Technology Centre (RESTEC) of Japan. As RSI's distributor of RADARSAT data, RESTEC will be providing data to local agencies involved in assessing the oil spill.

A 190-mile stretch of coastline spanning four prefectures facing the Sea of Japan around Kyoto has been affected in the spill and was expected to grow wider, according to the Japanese Fisheries Agency.

Some of Japan's richest fishing areas have been affected as well as small ports and tourist resorts. Some fishing markets were either shut down or just had frozen or processed seafood for sale due to the oil spill. Shellfish-gathering operations were damaged and it is feared that the oil could damage offshore net and bottom fishing of shrimp and crabs. Wildlife authorities have had few reports of harm to wildlife except for several cases of seagulls and other birds covered by the oil. (Source: *Sea Technology*, February 1997)

New test disk for low chlorine levels developed

Tintometer Ltd. (Salisbury, UK) reports it has developed a new Lovibond® water test disk for determining very low concentrations (0.002 to 0.003 parts per million) of chlorine in water.

DPD reagent is used in the normal way, developing a pale sample colour that is indicative of the level of chlorine in the water. The concentration is determined by matching the sample against predetermined colour standards in the test disk.

This method, based on visual colorimetric analysis, allows considerably more sensitive chlorine testing than photometric which will typically give accurate measurements down to 0.02 ppm. Field trials have so far highlighted in monitoring seawater to establish the extent of influence of chlorine used to prevent biofouling in outlets and in tropical aquaria, where the new disk was successfully used to detect trace levels of chlorine which can prove to be highly toxic to fish. (Source: *Sea Technology*, February 1997)

Solids removal system

The Pond Piranha from Equipment Specialities Co. is a remotely controlled floating dredge pumping system designed to excavate hazardous waste, sand, gravel, crushed ore, fly ash, coal slurry, mine tailings, alum sludge and sewage sludge. The submersible agitator pump is capable of pumping slurries up to 70 per cent by weight. Eight models are available from 10 to 75 hp. Excavation rates range from 30 to 234 cubic yards per hour. (Source: *Power Engineering*, February 1997)

Bitor tests Orimulsion ocean spill containment

Bitor America Corp., the national supplier of Orimulsion, has released the results of a marine spill test showing effective containment and clean-up of Orimulsion. Orimulsion, composed of 30 per cent water and 70 per cent natural bitumen, is used as an alternative fuel in electricity generation. The open ocean spill test, conducted off the coast of Venezuela, showed that Orimulsion can be contained and picked up if spilled in the open ocean, as more than 80 per cent of the fuel was recovered.

The test involved the release of 86 gallons of Orimulsion, with several pieces of equipment deployed and tested to determine their effectiveness in containing and recovering the spilled fuel. Approximately 150 feet of Orimulsion boom (OriBoom) was deployed to surround the spilled fuel and ensure its containment. (Source: *Power Engineering*, February 1997)

Six options for Brent Spar

The world's biggest White Elephant may not be going to the seabed after all. Shell has picked a short list of eleven disposal operations for Brent Spar, the decommissioned oil storage buoy—and none of them involve deep-sea disposal. However, the company warns, a marine grave may still be the only cost-effective option.

The 11 proposals come from six contractors, and all will be subject to an in-depth evaluation. The options include on-shore scrapping; slicing the hull into sections to be used for artificial reefs, dock gates, a fish farm, or quay extensions; and removing the topside structures for refurbishment as a training centre. Rejected options included converting the Spar into a wave-and-wind power station, which would have seen the structure sprouting huge windmill turbines.

Shell has asked all the contractors to prepare detailed cost analyses of their proposals, which will be submitted at the end of April. The company expects to choose the winning bid before the end of the year, although the final solution to the Brent Spar problem could end up as a combination of several proposals. (Source: *Process Engineering*, February 1997)

Asian coral reefs

The Mentawai Islands along the southern coast of Sumatra in Indonesia are a picture of tropical paradise: countless remote atolls fringed by white sand beaches and coconut palms.

But below the surface of the crystal-clear azure waters, on the coral reefs that skirt the islands, it is another story.

Jeroen Deknatel, director of operations at Fantasea Divers based on Phuket Island in Thailand, was so impressed at the tourist and recreational diving potential of the Mentawais that he took his live-aboard dive ship down to the area 18 months ago and organized two cruises for divers.

Two years earlier, scientists from the Bung Hatta University in Padang, the main port in the region, had visited

the Mentawais and found pristine coral reefs teeming with fish.

Yet on its two cruises, covering more than 1,280 kilometers (800 miles) and 65 dive sites throughout the chain of islands, the Fantasea found that most of the reefs were completely destroyed.

Possible causes of the destruction included dynamite and cyanide fishing, infestation by the coral-eating crown of thorns starfish and sediment runoff due to logging on some islands.

But the prime suspect was the use of explosives and sodium cyanide poison to kill or stun reef fish so that they could be caught quickly in large quantities.

Application of liquid cyanide, mainly by divers using plastic squirt bottles, to stun large fish such as wrasse, groper and cod so that they can be pried from holes and crevices in reefs, is a more recent innovation.

Such fish, when shipped live to Chinese seafood restaurants—in Hong Kong, China, Taiwan, Singapore and other countries in an increasingly affluent region—command prices many times higher than the same fish chilled, frozen or even farmed.

Large fish destined for the restaurant trade are generally able to pass cyanide poison out of their systems when put in holding pens before shipment. The trouble is that while explosives damage sections of a reef, cyanide kills the smaller fish as well as the living coral, algae and invertebrates on which the fish population depends for survival.

A survey by the Indonesian Institute of Sciences has estimated that 58 per cent of Indonesia's coral reefs had been heavily damaged and 35 per cent partly damaged, largely because of human activity.

Because the reefs provide vital shelter and breeding grounds for fish, and many of the poorest communities among Indonesia's population of 200 million depend heavily on fish for protein, the economic and social consequences of wholesale reef destruction could be devastating. (Source: *International Herald Tribune*, 4 February 1997)

Ecological sea water purification system

In recent years, water pollution and eutrophication in enclosed seas have been the cause of many serious problems, such as red tide. The sea water purification system described below was designed to make use of the self-purification function which is found in nature.

A rubble mound is constructed to separate out part of a polluted sea area. As the tide ebbs and flows, the movement of the waves and so on causes the polluted sea water to pass through the mound. Various physico-chemical and biological processes then act on the water to purify it, and as a result, the enclosed body of calm and purified water can be used for a wide range of purposes: for recreation, as a beach, a tidal marsh, a fish or shellfish nursery, etc.

In order to verify the water purification efficiency of the rubble mound, an on-site model facility was constructed in a coastal area of Mikawa Bay, Japan where the water was between 2 to 4 m in depth. The mound was built of rocks with diameters of from 20 to 30 cm, and its surface was covered with larger rocks, the diameter of which was approximately 80 cm. The width of the crest was 5 m, its height was 5 m, its slopes were 1/1.3 and 1/1.5, and its length was 6 m. Sheet steel piles were driven into the sea floor at the shore-side of the mound. By this means, a body of sea water was enclosed by the mound and the steel sheet piles. Some 40 days after completion of the construction of the facility, the water purification functions of the structure gradually became

evident. The monthly average values of suspended solid concentrations of water enclosed by the facility were 1 to 4 mg/l, while those of the water outside were 2 to 9 mg/l. The concentrations of suspended solids and chlorophyll in the enclosed water were 40 to 50 per cent less than that of the water outside, and in addition, it was found to be much clearer.

Following on from this, an experiment was made to test a substitute rubble material. A huge quantity of waste concrete is being produced in the restoration and reconstruction of the buildings and public works that were damaged during the devastating earthquake which occurred in 1995 in Kobe. This waste concrete material is readily available for reuse as a substitute rubble material. When waste concrete is directly unloaded into the sea, however, its alkaline components leach into the sea water and raise the pH of the sea in that area. In order to solve this problem, a method of pre-treating waste concrete was tested in the laboratory. The result of this was the development of a method which decreased the amount of alkaline components leaching into the sea water by an amount greater than that obtained by two weeks stocking in normal conditions after rinsing out the attached powder elements.

It is clear that the system described above has admirable sea water purification properties and, in addition, it enables recycled waste concrete to be used as a substitute rubble material. (Source: *Science & Technology in Japan*, No. 61)

Water purification system using Bio-Polacon

It could be said that water pollution in closed coastal areas and lakes and swamps comes about partly due to the imbalance between self-purification by ecosystems and the inflow load due to a decrease in organisms and an increase in concrete structures such as revetments in waterfront areas. Today the concept of "mitigation" has been introduced, and attempts come to be made to create hydrophilic spaces in waterfront areas with due consideration for the habitation of organisms rather than carrying out development projects

which emphasize their convenience and disaster prevention functions.

If waterfront areas can regain a wide variety of organisms which have disappeared from these areas, they will become more hydrophilic and the water will be purified naturally because the suspended substances and dissolved organic matter in water will be captured by the organisms. In other words, the method of purifying water for large areas is to provide organisms with a comfortable environment and activate food chains. As one of such methods, hollow permeable porous concrete blocks with continuous voids and a large surface area (hereinafter referred to as Bio-Polacon) which provide organisms with a habitat can be considered for the construction of bases.

Bio-Polacon is able to attract organisms and has the resultant ability to purify water as well as the prospect of a biological water purification method.

The representative water purification method using organisms is an inter-gravel contact oxidization method. This method uses mainly gravel for a substratum to which organisms adhere and microbial film sticks to the surfaces of the gravel. On the other hand, the method using Bio-Polacon employs hollow porous concrete blocks for a substratum which attracts organisms, and the organic matter decomposition ability of a wide variety of organisms inhabiting the substrata is used. That is, conventional concrete blocks are materials where large and small aggregates are scattered in a cement paste. They have no voids and are watertight. In a Bio-Polacon water purifying system, aggregates which are nearly uniform in particle size are bonded together by cement paste. As a result, continuous voids are formed, making it permeable. This structure allows both aerobic and anaerobic bacteria to live not only on the surface but also in the hollows in the material. It provides organisms with a habitat which varies widely in size, including micro algae, protozoa and even crustacea, such as lobsters and crabs. Ecosystems formed around Bio-Polacon improve water quality. (Source: *Science & Technology in Japan*, No. 61)

F. COUNTRY NEWS

AFRICA

Congo

Production growing by leaps and bounds

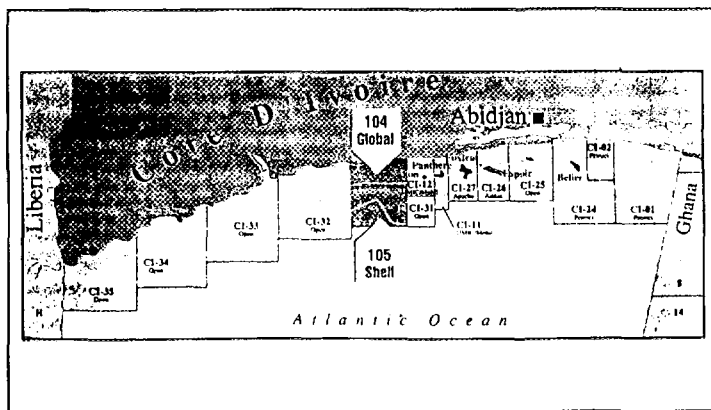
Things keep looking up for Congo. By the end of the year, the 400 million barrel N’Kossa Field offshore will be delivering 120,000 barrels per day. For a field that came on stream in June 1996, this is exceptionally speedy gush.

In 1995, the oil patch shook with news of the Moho Field located in 800 metres of water. With cumulative flow rates of 5,700 bbl/day in two sands, the Moho discovery helped, in part, to double Congo’s recoverable reserves to 1.5 billion bbl, from 800 million bbl in 1994. Its gas reserves increased to 4.3 thousand cubic feet from 2.7 thousand cubic feet. In August 1996, Moho Marine-2 tested 4,700 bbl/day in a location 5 km due north of Moho Marine-1. The field is still undergoing evaluation, and development programme will only come when more seismic data has been acquired and interpreted by operator Elf. Still, the economics look good, with production facilities a mere 15 km away at N’Kossa. (Source: *Offshore*, November 1996)

Côte d’Ivoire

Awards blocks CI-104 and CI-105

State-owned Petrocci has finally agreed on a production sharing contract with Global Natural Resources (GNR) for Block CI-104, covering 250,300 acres in shallower water portion (>200 metre water depth) of former Block CI-31, west of United Meridian’s Block CI-12. CI-104 lies immediately west of Block C-12 and C-11. Block C-11 is producing about 16,000 barrels of oil per day of oil and 5,500 million cubic feet/day of gas. GNR hopes that a partner will join them on the block before the drilling phase. The deepwater portion of CI-31 was redesignated Block CI-105, and has recently been awarded to Shell Exploration.



Exploratory tests are scheduled to be drilled on both CI-11 and CI-12 before the year end. The contract allows three exploratory periods of two years each, with a 25 year development period for any discovery.

The work programme requires GNR to reprocess 2,000 km of 2-D seismic, shoot 350 sq km of 3-D seismic and drill at least one exploratory well. (Source: *Offshore*, November 1996)

Equatorial Guinea

Mobil succeeds again

Even as the Zafiro Field has been put in production, Mobil continues its success streak in this small aquatory south-east of Nigeria. The company has just suspended Amatista 1, located south of the Zafiro Field, which penetrated down to a deeper sequence than the main Zafiro sands. The well was not drill stem tested. The TD was 11,378 ft (3,468 metres) and the water depth was 1,220 ft (372 metres). The deepest casing run was to 7,221 ft (2,353 metres). Amatista’s objectives were arguably a drape over a leading edge thrust feature. The drape is apparently the intra Qua Ibo sands, which is genetically related to the producing sequence in the main Zafiro Field. A comparable thrust feature was encountered in Delta-1, northwards in the same lease and Mfon-1, drilled by Conoco but these were dry. (Source: *Offshore*, November 1996)

Namibia

Losing streak continues with Chevron abandonment

When Chevron first forayed into offshore Namibia, 20 years ago, they found only gas in the virgin formations and hurried away disappointed. Now they are back, but there is no magic to halt the losing streak in the young south-west African country which is desperately in need of its own homegrown energy and all the resources it could harness for development.

Until recently, Namibia was one of the busiest sites of deepwater exploration. In 1993, the Norwegian company Norsk Hydro drilled a dry hole in 491 metres of water. In 1995, they suspended another, with minor oil shows. Ranger Oil plugged the 2313/6-1 well, located in 218 metre water depth in the Southern Walvis Bay Basin after drilling to 2,605 in rocks of Mesozoic age. In August this year, Chevron plugged and abandoned 2815/15-1 which is located in 180 metres water depth. (Source: *Offshore*, November 1996)

Nigeria

Exxon’s ultra deepwater prospect a disappointment

Disappointing results from Bosi-1, Exxon’s first deepwater well in Nigeria, may substantially douse optimism for investment in the six newly carved out leases in the outer deep offshore. At 1,400 metres water depth, Bosi-1 is the farthest adventure in the deepwater off the coast of West Africa.

The new leases, in water depths between 1,500 to 2,500 metres, were carved out by the State Department of Petroleum resources in the wake of Shell’s huge success with Bonga-1 (water depth = 1,100 metres) and Exxon’s decision to drill Bosi-1 in 1,400 metres water depth.

Exxon plugged and abandoned Bosi-1 with gas and very small oil shows at 14,206 ft after drilling for nearly 200 days with severe pressure conditions. The well was twice sidetracked, as the mud and claystones which made up most of the formation clung to the drill pipe, creating mechanical problems. The sands that were encountered were occasional streaks. (Source: *Offshore*, November 1996)

AMERICAS

United States of America

Adopting international code of conduct for marine fishing

The United States is taking steps to implement an international code of conduct that promotes the use of sound marine fisheries management measures in national and international waters, according to a National Oceanic and Atmospheric Administration spokesman. Negotiated since 1991 and adopted by the United Nations Food and Agriculture Organization in 1995, the code contains six themes that emphasize increased responsibility in fisheries management, fishing operations, aquaculture development, integration of fisheries into coastal area management, post-harvest practices, and trade and fisheries research. Although most of the code is voluntary and non-binding, it includes a binding compliance agreement that establishes a broad range of obligations for nations that have fishing vessels operating on the high seas, including the obligation to ensure that those vessels do not undermine international fishery conservation and management measures. Nations must also prohibit their vessels from fishing the high seas without specific authorization and must take enforcement measures against vessels that disregard those rules. (Source: *Sea Technology*, September 1996)

Boost to mahi-mahi breeding

Mahi-mahi (or dolphinfish) breeding has benefited from research conducted at the Oceanic Institute at Hawaii resulting in higher survival rates for the fish. More than 40,000 fish have been produced from 128,000 eggs in a recent breakthrough, achieving a 31 per cent survival rate compared to a mere 5 per cent previously.

A new technique for screening eggs before hatching has been developed at the Institute to enable farmers to predict with more certainty which spawns will produce the best larvae. Reasons for the variation in egg quality, however, remain a mystery. Commercial feasibility of *mahi-mahi* breeding can now be demonstrated but there is still room for improvement of grow-out procedures.

Production levels achieved at the Institute would be sufficient to supply a big *mahi-mahi* farm with a production target of 125 tons a year. This takes into account a 50 per cent loss of juveniles during weaning from live to pelleted food. (Source: *INFOFISH International*, May 1996)

ABS holds IBM audit fees but threatens large rises

The American Bureau of Shipping (ABS) has announced that it has withheld a planned increase in auditing fees in an attempt to encourage shipowners to begin the International Safety Management Code Certification process.

There will be a minimum 10 per cent increase followed by a very significant increase on 1 January 1998 effective through to the deadline [1 July 1998], which will penalize those owners who continue to procrastinate.

As ABS points out, "According to the latest figures issued by the International Association of Classification Societies [IACS], less than 5 per cent of the estimated

18,700 vessels required to comply with the Code have been certified by IACS members.

"Many owners appear reluctant to begin the process. Our experience is that it takes a minimum of 12 months, and often as long as 18 months, to fully implement the provisions of the Code.

"Regulatory authorities, the responsible flag States, IACS and the leading port States have all indicated that there will be no extension of the deadline. Yet the vast majority of shipowners have yet to embark on this voyage." (Source: *Fast Ferry International*, January-February 1997)

Shrimp Council formed

The National Fisheries Institute (NFI) has announced the formation of the Shrimp Council to promote environmentally sustainable and responsible shrimp harvesting.

To carry out its mission, the Shrimp Council will raise funds for research and promotion of responsible production methods, environmental protection and restoration projects, and consumer education programmes. Among the projects under consideration are research on by-catch reduction technologies, shrimp disease prevention, endangered turtle population status and shrimp farm-mangrove interactions.

Currently, more than 25 shrimp industry-related companies provide financial support to the Shrimp Council. (Source: *INFOFISH International*, May 1996)

ASIA/OCEANIA

Australia

Undersea farming machine. A team of West Australian engineers and marine scientists has developed the world's first submarine farming machine. Designed to revegetate the sea bottom, the *Ecosub* rolls along the seabed, harvesting large seagrass clumps for replanting in areas denuded by dredging or other human activity.

The vehicle runs on four balloon-shaped wheels and is equipped with hydraulic cutters, lifters and containers to hold the seagrass and its supporting sand intact for transport to replanting areas. The machine is operated by a diver, and winched along the seabed by a cable attached to a post.

The team hopes eventually to develop models which seed the grass directly, and even harvest the mature plant from underwater farms. (Source: *INFOFISH International*, May 1996)

New Zealand

FPSO in place. New Zealand's first floating production, storage and offtake system has come on stream on the Maui field, 40 kilometres offshore New Plymouth in the Tasman Sea. It is operated by the 50:50 Shell Todd Oil Services (STOS) joint venture.

The new oil field was discovered during exploration drilling in 1993 during the final stages of the Maui B project development, and its oil is produced from below the gas-bearing sands of the Maui field. It is estimated to have recoverable reserves of between 20 and 30 million barrels of crude with a field life of between five and seven years. The 135,000-ton FPSO is named Whakaaropai—Maori for Good Thoughts.

Group managing director, Steve Miller, commented: "In line with the experience of the refiners in Europe, this business has been delivering inadequate returns and the Group is now pursuing several initiatives to rectify the situation". (Source: *Shell World*, December 1996)

Malaysia and Thailand

Uses and markets for seaweed products

Seaweed is defined as a mass or growth of marine algae which is available from natural stock or maricultured. The algae are generally classified into four main groups, largely upon the basis of pigmentation: green algae (the *Chlorophyceae*), blue-green algae (*Cyanophyceae*), red algae (*Rhodophyceae*) and brown algae (*Phaeophyceae*). Red and brown algae are found almost entirely in marine environments and are most important commercially, while the green and blue algae are more commonly found in freshwater and land.

Total world production of seaweeds has been on the increase over the years. The total production of red, brown and green seaweeds totalled 5.5 million tons in 1992 compared to 4.6 million tons in 1991, an increase of 20 per cent. Production of brown seaweed increased dramatically by 1 million tons over 1991, while red and green seaweeds increased marginally.

Major producers of brown seaweed in 1992 were China (2.9 million tons), Korean Republic (407,000 tons), Japan (346,000 tons) and Norway (189,000 tons), while Japan (346,000 tons), Philippines (350,000 tons) and Indonesia (188,000 tons) were the leading producers of green seaweed. Asian countries located in the tropical and temperate belts produced almost 90 per cent of the world's total seaweed production.

While traditional uses of seaweed as food, animal feed and fertilizer remain important, it is now increasingly used as raw materials for certain chemical products. Various red and brown seaweeds are utilized in the manufacture of four seaweed colloids: agar, alginate, carrageenan and furcellaran.

Colloid is a non-crystalline substance which dissolves to give viscous and sticky solutions. Seaweed colloids are often referred to as phycocolloids. A phycocolloid is obtained from seaweed for its gelling, emulsifying and stabilizing properties. It is becoming increasingly important in industrial use. Seaweed colloids are used in many fields, particularly in the food processing sector and some non-food sectors.

Malaysia imports alginates from the USA, Europe and Japan via Singapore. Imports are mainly carried out by chemical companies for their own use as well as for distribution to other smaller companies.

A similar situation exists in Thailand. Companies dealing in chemical products and food activities trade in alginates. They are imported from the USA, Europe and Japan and comprise food grade and industrial grade. Bangkok is the main centre of import and it is from here that they are distributed to various parts of the country.

Companies dealing in chemicals and food additives are the main sources of suppliers of carrageenan in Malaysia. They are either imported through Singapore or from the producers direct.

The major importers in Thailand are also chemical companies that are based in Bangkok with their sales and distribution agents spread across the country. The big users of carrageenan purchase their supplies direct at a negotiated price as in the case of pet food industries.

The total utilization of carrageenan in Malaysia is about 150 tons valued at US\$ 1.5 million, while in Thailand it is about 1,100 tons valued at US\$ 10.3 million.

The total import value of seaweed and other algae into Malaysia dropped from US\$ 5.4 million in 1992 to US\$ 4.3 million in 1993, but subsequently increased to US\$ 4.4 million in 1994 (January-November). Imports into Thailand have increased rather significantly both in volume and value

over the recent years. The import volume increased 55 per cent, from 580 tons in 1992 to 899 tons in 1993, while the value picked up by 50 per cent from US\$ 12.2 million to US\$ 18.3 million during the same period.

Carrageenan and alginate will continue to be imported into Malaysia and Thailand. This is partly because attempts to grow *Eucheuma spp.* were unsuccessful in Sabah, Malaysia.

In Thailand, no carrageenan-producing seaweeds are available, including *Eucheuma*. Of the algin-producing seaweeds, only *Sargassum* is found certain areas. Availability of a constant supply of *Sargassum* appears to be a problem and it is only abundant during the cool season. However, Thailand has yet to explore the commercial viability of this source.

Consumption of alginate and carrageenan is expected to increase over the years in both Malaysia and Thailand. The high economic growth in both countries is expected to increase the number of food processors and other industries that are likely to use phycocolloids. While the increase in usage is expected to be marginal in Malaysia, in Thailand it is expected to be higher. The quality and low labour cost available in Thailand has resulted in Thai products using alginate and carrageenan to be competitive on the world market. At the same time, large-scale promotions of Thai products both domestically and abroad have resulted in steady production levels and world-wide acceptance of products made in Thailand.

In Malaysia the opportunity to exploit the pet food industry is open. At present, pet food is imported mainly from Thailand, and Malaysia will be able to cater for both domestic and as export markets by developing this sector. As in Thailand, carrageenan will be used in substantial quantities in the manufacture of this product by Malaysia.

The article is based on a survey report compiled by INFOFISH—1996. (Source: *INFOFISH International*, April 1996)

India

Shrimp disease survey

In 1995, the Shrimp Culture Research Centre of the CP Group of Thailand, in cooperation with the technical service of CP Aquaculture India Pvt. Ltd., investigated histopathological shrimp specimens from 76 disease outbreaks in growout farms in India. The farms were located along the eastern coast of India, including the States of West Bengal, Andhra Pradesh and Tamil Nadu. The shrimp specimens, ranging from PL-26 to juveniles and subadults, were mainly *Penaeus monodon* with a few *P. indicus* or mixed species.

The results of the survey revealed that white spot disease caused by systemic ectodermal and mesodermal baculovirus (SEMBV) was the most common disease problem as it was found to be the main pathogen in 47 per cent of the disease outbreaks. While SEMBV was considered to have been the primary pathogen generally causing a severe systemic infection in all these cases, it was found only sometimes as a single agent but usually (78 per cent of SEMBV cases) in a multiple pathogen complex with other secondary agents.

The second most common (20 per cent of all cases) disease problem was epibiont fouling on its own. MBV occupied number three position comprising 15 per cent of all cases; it was usually found together with epibiont fouling or occasionally with bacterial infection. A variety of bacterial infections was the main problem in 13 per cent of the cases; these included localized or systemic infection, bacteria-associated haemocytic enteritis (HE) and varying degrees of

hepatopancreatic necrosis and inflammation. Bacterial infection was found alone or with secondary MBV and/or epibiont fouling.

The survey also covered 10 separate cases of hatchery disease outbreaks. Shrimp stages PL-2 through PL-23 had a mild degree of external bacterial fouling which was usually associated with a variable degree of MBV infection. MBV was found to be more of a problem in the hatchery than in the grow-out pond. It was first diagnosed as a minor infection in hatchery-reared PL-5. In both hatchery-reared and wild PL-15 and PL-20 it was found to be of a slight to moderate degree. In other groups of PL-17, PL-18, PL-19 and PL-23, MBV ranged from a moderate to severe infection. A few cases of broodstock had mild subclinical MBV infections together with chronic localized bacterial infection; other broodstock had a degree of lymphoid organ pathology (LOP) as well as localized bacterial infection. (Source: *INFOFISH International*, April 1996)

AFI seeks World Bank aid

The Aquaculture Foundation of India (AFI) is planning to set up a School of Aquaculture and several Technology Development Centres at important aquaculture regions in the country. The aim is to help meet the skilled manpower requirements for aquaculture and to update the technology and manage the industry on a sustainable basis.

The AFI has looked into the possibility of obtaining a soft loan from the World Bank for the purpose. In this regard, the president of the organization met with officials of the World Bank in Washington, USA, in January 1995. This was followed by a meeting with Dr. Donald D. Zweig, aquaculturist, World Bank, in February 1995 at Hyderabad, India, in which the Commissioner of Fisheries of Andhra Pradesh and representatives of the aquaculture industry participated.

Prospects of obtaining World Bank assistance are said to be bright. However, the AFI has to build up and upgrade its technical competence. Towards this end, the AFI has decided to induct persons or institutes of eminence as honorary members of the organization so that their experience, knowledge and expertise would be available for the activities of the AFI. (Source: *INFOFISH International*, May 1996)

Tough time for seafood exports

The Indian seafood industry is in for tough times as the European Union (EU) decided not to accept all 257 exporters deemed qualified to export seafood by the Export Inspection Agency (EIA) of India. The EU feels that only 42 are able to meet its standards, and claims that the EIA has not evaluated the facilities of all the processing units sufficiently. The EU requires all pre-processing centres or peeling sheds to have the same standard as that of the processing units.

Though the EU has not declared a deadline for the exporters list, India will have to submit a revised list as soon as possible as several other countries have submitted theirs. Once the EU approves the revised list of exporters, they will be subjected to random checks by health inspectors. If any exporter is found not complying with the standards, the EU may impose a ban. The EIA, being made the competent authority to assess seafood, is expected to encounter several problems with the exporters in finalizing the revised list. (Source: *INFOFISH International*, May 1996)

Locally produced feed launched

After two years of research, the Central Marine Fisheries Research Institute (CMFRI) of India has come out with a

technology for commercial production of an indigenous shrimp feed. Called *Mahima*, the feed has been successfully tested on shrimp farms and is being introduced to shrimp farmers, starting with those in the State of Andhra Pradesh.

The CMFRI feed incorporates low cost, locally available ingredients, such as mantis shrimp, soybean and coconut oil cake and is half the price of imported feeds. The composition of the feed is 20 per cent soybean, 20 per cent rice bran, 10 per cent mantis shrimp meal, 15 per cent shrimp head meal, 12 per cent coconut oil cake, 20 per cent wheat flour, 1 per cent sardine oil, and 2 per cent vitamin and mineral premix.

The ingredients are mixed thoroughly and the pellets are made either by gelatinizing the starch and then mixing the other ingredients, or by steaming the mixture for ten minutes. The investment cost for setting up a plant for producing 100 kg of *Mahima* feed a day, incorporating a pulverizer, pelletizer, packing and weighing machines and dryer, is estimated to be Rs 76, 500.

In trials the feed was found to be attractive to shrimp and allowed for normal growth and moulting with minimal cannibalism. (Source: *INFOFISH International*, May 1996)

Shipping: P & O to develop Bombay port projects

P & O, the UK-based shipping to property conglomerate, is set to take up two port projects around Bombay worth about a combined \$ 500 m in what will be the largest foreign investment in the Indian port sector, according to Government officials.

The project in Maharashtra State will help to ease congestion in India's largely State-run port system, which has struggled to keep pace with growth in cargo volumes since economic liberalization started in the early 1990s. Indian ports have been handling more than 200 million tons of cargo a year, well above their rated capacity of 175 million tons.

A recent government-commissioned report on infrastructure estimated an additional capacity of 350 million tons a year would have to be added to the Indian port system by the year 2006, which would require investments of about Rs 250 billion (\$7.14 billion).

Maharashtra Government officials said company subsidiary P & O Australia Ports was close to finalizing a deal to develop an all-weather port at Vadhavan, about 120 km north of Bombay.

The first phase of the project—development of a seven-berth port with capacity to handle 25 million tons of cargo a year—was expected to require an investment of about \$ 300 m, of which about two thirds is expected to be funded through debt. However, over time, officials said P & O had estimated the level of investment could rise to about \$1 billion as the port is expanded to 29 berths with a capacity of 250 million tons a year.

Maharashtra officials said P & O was likely to form a consortium to fund the project which would be developed on a Build-Own-Operate-Transfer (BOOT) basis with a 30-year term. P & O would also have the option to expand the term by a further 20 years.

A P & O Ports Australia-led consortium has already been granted a letter of intent for its bid to construct a two-berth container terminal at Jawaharlal Nehru Port near Bombay.

The terminal will also be built on a BOOT basis with a 30-year term and government officials estimate construction costs at Rs 7 billion (\$200 m). P & O's consortium partners are DBC Port Management and Kornsoratorium Perkapanan Berhad. (Source: *Financial Times*, 7 February 1997)

Telecom hardware as fish lure!

Fishermen in Sabah, Malaysia, are said to be removing handsets from Telekom Malaysia's payphones and using them to lure fish. According to an officer of the national telecommunication service, the department learned this while investigating the mystery of so many missing handsets. One of the daily papers reported that the problem is rampant in the coastal fishing areas like Kota Kinabalu and Tawau. Apparently, handsets from nearly 5 per cent of the 3,500 payphones installed in the state had been used for this purpose. Fishermen apparently passed electricity through the handset to produce a sound which attracted fish in the sea.

In the neighbouring Philippines, inland fishermen have resorted to using electricity to catch fish. In the past they have often been shocked to death or near death by dipping oven wires into water and drawing electricity from power lines. According to a report that appeared in *Seafood International*, they have now learned to use lower voltages; a car battery or a pack of 12 flashlight batteries. The electricity generated stuns the fish and fishermen say they too feel a prickly sensation while dipping the wires attached to a short pole. Fishermen wade in the water to collect the stunned fish. "Power" fishing is a popular activity in the country during the summer months even though it is illegal. (Source: *INFOFISH International*, May 1996)

Singapore

High resolution survey completed

Oceonics Singapore recently completed a high resolution geophysical survey for the proposed new container port at Pasir Panjang. The project was requested by the Port of Singapore Authority (PSA) following an initial survey of nearly 600 kilometres by Oceonics back in 1994. That survey identified an area of Triassic limestone, which raises special engineering problems for the construction of the container port with the numerous cavities and cavern systems.

The most recent project involved the high density geophysical survey with boomer and sparker systems. Using only 5-metre line separations to gain additional information about the limestone, 250 kilometres of data were collected. The survey team wanted to map the limestone top and its contact with the surrounding rocks plus locate cavities with a diameter larger than 2 metres.

The data collected identified numerous anomalies that related to cavities on the borehole records. It is likely that this was the first time that high density boomer and sparker data have been successfully employed in a job of this nature. (Source: *Sea Technology*, September 1996)

EUROPE

EASTFISH for Europe

EASTFISH, the other regional fish marketing and information services network is established to serve 20 countries in Central and Eastern Europe. The United Nations Food and Agricultural Organization (FAO), having established INFOFISH (Asia and the Pacific), INFOPECHE (Africa), INFOPECSA (Latin America) and INFOSAMAK (Arab countries), has now set up EASTFISH for Central and Eastern Europe, to assist the fishery industries in transition and compete with the other developed and developing countries. EASTFISH, based in Copenhagen, is designed to provide essential services to the countries of the region to achieve market orientation and facilitate the structural adjustment of the fishery sectors. The project is funded by

the Danish Government. (Source: *INFOFISH International*, May 1996)

France

Does pollution induce marine animal mutations?

IFREMER has established a research programme on the marine environment in the Seine Estuary, to evaluate the genotoxicity of sediments and their link to mutations and cancer. Diverse surveillance strategies are being used to better understand the long-term parameters, including contamination levels of marine organisms. Researchers have in this regard established a correlation between the presence of mutagenic and carcinogenic pollutants and the induction of an enzyme marker. The second phase involves research on the mutation of gene markers which have been detected in human cancers. IFREMER researchers recently characterized these genes in marine fish, an important discovery in terms of cellular inter-species gene conservation affecting humans. (Source: *IFREMER*, November 1996)

Conclusion of a study on the cycle of nutritive elements offshore of Brest

The Brest offshore area, like many estuaries, contains high nutritive salt levels, due to urban and agricultural effluents. The fear is that the area will fall victim to the destructive power of eutrophication, i.e. the proliferation (mainly in summer) of oxygen-depriving phytoplanktons which cause higher mortality rates among the fauna. Recent IFREMER tests have shown that this is not the case and that these waters can be classified as "clear". This is due to two main factors: a strong twice-daily tide and the massive presence of benthic filtering invertebrates. There is, however, some proliferating in certain concentrated zones, monitored by the IFREMER REPHY surveillance network. These may in some cases be toxic to local species, including edible shellfish. The reduction of nitrogen content in these zones is therefore highly recommended. (Source: *IFREMER*, November 1996)

Germany

"Vegetarian" coral

Scientists in Germany have discovered an unusual vegetarian coral in the northern Red Sea. Most corals are sedentary and use organisms in the surrounding waters as food. They also harbour symbiotic algae which, in exchange for nutrients and a home, harness the sun's energy to produce sugar for the coral. The corals supplement this diet by catching tiny animals. However, the species of coral known as *Dendronephthya hemprichi*, is a soft coral which does not photosynthesize but lives on algae and primitive plant forms as food. (Source: *INFOFISH International*, May 1996)

Ireland

Atlantic survey

An environmental status report is being prepared for an extensive area of the Atlantic from west of the United Kingdom mainland to the edge of the Continental Shelf. The area includes the entire Irish marine territory and four scientists are working from the Forbairt Laboratory in Shannon, Co. Clare, on a two-year project coordinated by the Marine Institute.

The team, who are reviewing all available published reports, would welcome any additional information.

Denis Moloney from the team can be contacted at the Forbairt Laboratory, Shannon Town Centre, Co. Clare.

Tel.: 061 361499; fax: 061 360863. E-mail: qsr@marine.i
(Source: *Technology Ireland*, February 1997)

Sweden

ISO 9002 certificate for Port of Göteborg AB

The Port of Göteborg AB has received an ISO 9002 quality certificate for its entire organization. Over a period of three years, the port company has won ISO 9002 certification for parts of its organization step by step. The company's goal has been Total Quality Management, and this was achieved in December, when a representative of Det norske Veritas, the classification society, handed over the final, over-all certificate. (Source: *Ports and Harbors*, March 1997)

United Kingdom

Best possible standards for waste management

Associated British Ports (ABP), the United Kingdom's largest ports group, has taken a strong lead in the portside management of ship-generated waste, which includes oil, garbage and sewage.

Every one of ABP's 22 ports recently submitted and is now implementing a plan outlining the waste-reception facilities available at each port to the Maritime Safety Agency (MSA) in compliance with the Department of Transport's Merchant Shipping Notice, M1659. ABP's move proactively supports the United Kingdom's Government's aim to discourage the dumping of waste at sea through improving the provision, awareness and use of waste-reception facilities. (Source: *Ports and Harbors*, March 1997)

Flood barriers "built too low"

Coastal areas could be in danger of flooding because sea walls may have been built too low, according to a report being studied by Government scientists.

The report by mathematicians at Lancaster University for the Ministry of Agriculture, Fisheries and Food shows a flaw in the calculations used to design Britain's 500 miles of sea defences. Sea walls and flood defences, including the Thames Barrier, were built to prevent a repeat of the 1953 storm surge flood that killed 300 people on the East coast, where surges and freak weather can raise sea levels unexpectedly.

However, according to the *New Scientist*, which had seen the report, parts of the Bristol Channel near Ilfracombe may need defences six feet higher. To work out the height of walls needed to cut the chance of flooding to under 1 in 100 per century, a mathematical technique called extreme value theory was used to convert past records from tide gauges into predictions of maximum likely storm surge.

Extreme value theory assumes that any non-random effects, which crucially include tides, are removed from past records before calculations are made. However, tide gauge records include the effects of regular tides and freak weather. According to the *New Scientist* report, the mathematicians warned the Ministry that the effect of using the uncorrected gauge measurements could lead to substantial underestimates of the highest storm surges—possibly up to six feet. (Source: *Electronic Telegraph*, 10 November 1996)

Immingham enjoys steel export boost

An upsurge continues in the volume of steel exports passing through Associated British Ports' (ABP) Port of Immingham, on the Humber Estuary in North-East England, which recently handled its largest-ever single shipment of steel.

The order was shipped in one of largest vessels ever to enter the enclosed dock, the 3,590 dwt vessel, *Steel Flower*. She sailed for the Great Lakes on 27 September with a record 32,000 tons of British Steel's products, bringing the total of British Steel cargo loaded at Immingham for export to the Great Lakes and the Far East in the first nine months of 1996 to 380,000 tons—almost double the figure achieved during the whole of 1995. (Source: *Steel Times*, January 1997)

New weatherproof store for Whitby

The future of commercial shipping at the Port of Whitby, on the north east coast of the United Kingdom, has been secured by the opening of a new 1,400 m² transit shed provided by Associated British Ports (ABP). ABP operates a stevedoring and ship's agency business at the port through its wholly owned subsidiary, Whitby Port Services Ltd.

The new facility at Endeavour Wharf is equipped with a 25 ton gantry crane and is fully insulated and ventilated, making it ideal for the storage of high-grade steel and other non-weatherproof cargoes such as paper and board materials. For steel, the port's main customer is Hoogovens who have expressed themselves well-satisfied with the new facilities. (Source: *Steel Times*, January 1997)

Across the United Kingdom

Canal transport could make a comeback with a proposal to link the Irish Sea to the North Sea via a 274 metre wide waterway across the Pennines. The proposal is being considered by a consortium headed by AMEC Civil Engineering. According to AMEC, a 112.6 km canal could link the Solway Firth on the north-west to Newcastle-upon-Tyne in the north-east accommodating barges carrying 15,000 tons of cargo. (Source: *Technology Ireland*, February 1997)

Scallop shells to strengthen egg shells

Scallop shells from the Shetland Islands are being put to a new use—crushed as grit for the diet of laying hens. Once the scallops have been removed, shell disposal can be a problem. With tiny pieces of meat sticking to the shell, they soon start to smell and become a hazard to the environment, while dumping into the sea is expensive.

A Shetland dairy farmer had the idea of crushing the shells to produce a supplement to the layers' diet, adding the extra calcium needs for strong egg shells. But first a way of removing the meat had to be found since this was clogging the crushers.

An engineering company in the United Kingdom developed a machine to remove the meat. This is now in operation in the Shetland Islands and the shells are supplied to a major chicken feed manufacturer. The machine devised by the company consists of a perforated stainless steel barrel washer with a vibratory drier. As the shells rub against each other under water, the meat is removed. The shells are elevated out, receive a final rinse with powerful water jets and are then dried to remove surplus moisture. (Source: *INFOFISH International*, May 1996)

GENERAL

Aquaculture growing in importance

Aquaculture has been one of the fastest growing food production systems in the world over the past decade with production increasing at an average rate of 9.4 per cent per year. Food and Agriculture Organization (FAO) statistics show that, between 1984 and 1994, total world aquaculture production more than doubled by weight from 10.4 to

25.5 million tons and tripled by value from US\$ 13.1 billion to US\$ 39.8 billion.

Aquaculture is currently outpacing livestock meat production in terms of growth by two to four times. Farmed finfish and shellfish food production increased at an average rate of 10.7 per cent per year since 1984 compared with only 2.6 per cent per year for total livestock meat production (191.7 million tons of slaughtered meat was produced in 1994). Furthermore, in contrast to livestock meat production where the bulk (52 per cent of the total) is still produced within developed countries, over 86.4 per cent of total aquaculture production is produced within developing countries.

Asia currently produces 89.9 per cent of the total world aquaculture production by weight and 82.4 per cent by value. China alone accounts for a staggering 60.4 per cent of total world aquaculture production (15.4 million tons), followed by India (6.3 per cent, 1.16 million tons), Japan (5.6 per cent, 1.43 million tons), the Republic of Korea (4.3 per cent, 1.09 million tons), and the Philippines (3.1 per cent, 0.78 million tons); these five countries produced 79.7 per cent of the total world production in 1994. The next largest aquaculture producer by region was Europe (5.3 per cent, 1.3 million tons), followed by North America (2.2 per cent, 0.57 million tons), South America (1.4 per cent, 0.35 million tons), the former USSR (0.6 per cent, 0.14 million tons), Africa (0.32 per cent, 0.08 tons) and Oceania (0.29 per cent, 0.07 million tons).

Of particular note is the fact that aquaculture production is generally growing at a much faster rate within developing countries and regions than within developed ones. For example, total aquaculture production has increased by only 24.6 per cent by weight since 1984 within developed countries (with an average growth rate of 2.2 per cent per year) whereas within developing countries production has increased by 188.7 per cent by weight during the same period (with an average growth rate of 11.2 per cent per year). It

follows from the above that the developing countries' share of total aquaculture production has been steadily increasing over the past decade, rising from 73.3 per cent in 1984 to 86.4 per cent in 1994. Another point of interest is that approximately 75.1 per cent of total world aquaculture production by weight was produced in 1994 within Low-Income Food Deficit Countries (i.e. food deficit countries whose per capita income was less than US\$ 1,345 in 1993). (Source: *INFOFISH International*, April 1996)

Boom expected in global fish trade

Global fish production (wild caught and aquaculture) in 1994 reached 109.6 million tons, increasing by 87.3 million tons. China was the top producer with 20.7 million tons, followed by Peru (11.6 million tons), Chile (7.8 million tons), Japan (7.4 million tons) and USA (5.9 million tons). Anchoveta was the top species landed at 11.9 million tons, followed far behind by Alaska pollack, Chilean jack mackerel, silver carp and Atlantic herring in order of rank.

Despite growing concern about over-fishing, the world fish trade is forecast by world fishery experts to be dynamic as new markets open up and competition intensifies. According to FAO, it is likely that diversification of products and new species for human consumption and other uses will gain importance. The total supplies of fish for human consumption amount to 71 million tons (average 1991-1993) and could vary from 73 million tons to 108 million tons in the year 2010. It is currently estimated that 38 per cent of global fish supplies for direct human consumption flow through international trade channels. According to FAO, world exports of fishery products in 1994 were 43 million tons, an increase of 5 per cent over the previous year, and imports at 51 million tons, an increase of 14 per cent. It also pointed out that, with the creation of the World Trade Organization (WTO) many countries previously closed to fish imports will have to open their markets and relax regulations. (Source: *INFOFISH International*, April 1996)

G. INTERNATIONAL NEWS

IMO seminars

A series of seminars is being held under the auspices of the International Maritime Organization (IMO) to help Governments implement the amendments adopted in 1995 to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978.

The amendments entered into force on 1 February 1997. Although they provided for a transitional period during which Administrations may continue to issue certificates in accordance with previous practices, this period must not exceed five years. The amendments also require Governments to submit to IMO by 1 August 1998 information to establish that they have the administrative, training and certification resources required to implement the Convention. The ships flying the flags of States which have not ratified the Convention will also be required to meet STCW requirements when they visit the ports of States which have. It is vital, therefore, that Governments take action as quickly as possible to ensure that they meet the Convention's requirements.

To help them to do so, IMO has begun a series of nine training seminars and workshops, the first of which were held in Manila, Philippines and in Dalian, China. Other seminars will be held in Bombay, India; Gdynia, Poland; Tampico, Mexico; Rio de Janeiro, Brazil; Alexandria, Egypt; Accra, Ghana and Abidjan, Côte d'Ivoire. A tenth session, to be held in South Africa, is being considered. Financial assistance has been provided by the Governments of Canada, the Netherlands, Norway and the United Kingdom, by the Commission of the European Communities and by the International Transport Workers' Federation.

The seminars are intended to assist Governments, in particular Parties to the 1978 STCW Convention, maritime training institutions and shipping companies to implement the Convention uniformly. Particular attention is paid to assisting Governments to establish administrative and technical resources and a legal framework necessary for the effective implementation of the revised Convention. The meetings also provide guidance on how STCW Parties should prepare and communicate to IMO information on their implementation of the Convention, as required by new regulation I/7, including information on the outcome of the periodic quality audits required by new regulation I/8.

Participants are provided with information to enable them to identify the technical assistance needs of their countries regarding:

- Staff training to meet the new requirements for trainers and assessors;
- The establishment of quality assurance systems;
- The adaptation of training provisions to ensure competence outcomes and the assessment of competence; and
- The establishment of procedures for investigating reported incompetence (regulation I/5), prosecution for infractions of the Convention and withdrawal of certificates.

The seminars are intended for maritime Administration staff who are directly responsible for implementing the STCW Convention, staff of maritime training institutes who train seafarers for certification at the support, operational and management levels under the Convention, and industry

representatives with a direct interest in maritime training matters. The selection of participants is limited to persons who hold relevant senior positions and are directly involved in training and certification activities. Participation is free of charge but is limited to two participants from each developing country in the region. (Source: *IMO News*, No. 3, 1996)

IMO Secretary-General calls for action on ship number scheme

The Secretary-General of the IMO has appealed to Governments and shipowners to implement the IMO ship identification number scheme as quickly as possible. The scheme is intended to promote maritime safety and prevent criminal activities such as fraud. It became mandatory on 1 January 1996 when amendments to the International Convention for the Safety of Life at Sea (SOLAS), 1974 entered into force.

The IMO ship identification number scheme is extremely simple, involves no cost for the industry and yet promises to be extremely effective in improving safety and combating crime at sea. It should already be in place, but calls to IMO have made it clear that many of the world's ships have not yet been assigned a number and that the scheme is not fully understood.

The aim of the ship identification number scheme is to assign to every merchant ship in the world a number that will always remain the same no matter how many times the ship is sold or changes flag or name. The number will enable the ship to be easily identified and should help to reduce fraud. It will also help improve safety and could be of use in pollution prevention.

The scheme was first introduced as a recommendation in 1987. The IMO number consists simply of adding the initials IMO to the seven-digit number assigned to each ship in Lloyd's Register of Shipping (LRS) when its keel is laid. The number remains in the ship's certificate throughout its life and thus serves the same function as a fingerprint: it is unique and enables the ship to be identified instantly.

Requests for the IMO number for new ships and queries concerning the numbers of existing ships should be addressed to the LR Service or to IMO. These requests will be answered as quickly as possible. However, the increasing number of requests and the related verification work may result in relatively short delays that should be taken into account by the flag Administration when issuing certificates.

Requests, as mentioned above, should be addressed (preferably by fax) to the Maritime Information Publishing Group (LRS) and should include the information concerning the ship given in IMO Circular Letter Number 1886. Copies can be obtained from Flag State Administrations; the Maritime Information Publishing Group (Fax +44 (0)171 423 2190 or telephone +44 (0)171 423 2797); or the IMO Maritime Safety Division (TCI and PM Section) (Fax +44 (0)171 587 3210). (Source: *IMO News*, No. 3, 1996)

UK marine safety agency reports on IMO Code

In response to concerns expressed within the fast ferry industry about the International Maritime Organization's Code of Safety for High Speed Craft, the IMO's Maritime

Safety Committee agreed at its 66th Session as a priority to work towards revising the Code by 1999.

As the United Kingdom's Maritime Safety Agency (MSA) puts it application of the Code has shown that some parts are open to interpretation and that a consistent application of its detailed requirements is necessary both nationally and internationally.

The MSA reports, "The HSCAG is made up of representatives of the classification societies, the Chamber of Shipping, builders and designers of high speed craft, the hovercraft industry, the seafarers' union, the Royal Institution of Naval Architects, the Consumers Association and the MSA". (Source: *Fast Ferry International*, December 1996)

APELL for port areas

It has long been recognized that port areas represent a complex interface, between land and sea, between human activities and the natural environment and between different transport modes. They have unique safety and environmental protection problems and need well-integrated emergency plans. The International Maritime Organization (IMO) and the United Nations Environment Programme Industry and Environment centre (UNEP IE) have now joined together to help all those with responsibility for port safety to improve prevention of technological accidents and to improve awareness and preparedness to respond to them should they none the less occur.

UNEP IE launched its Awareness and Preparedness for Emergencies at Local Level (APELL) programme in 1988. APELL's goals are to prevent technological accidents and, failing this, to minimize their impacts. This is achieved by assisting decision makers and technical personnel to increase community awareness of hazardous installations and to prepare coordinated emergency response plans involving industry, government and the local community, in case unexpected events at these installations should endanger life, property or the environment. The APELL Handbook sets out a ten-step process for doing this.

APELL was originally developed for land-based fixed installations. However, many APELL users have requested specific guidance in relation to port areas. Many of IMO's conventions, agreements, regulations, manuals and other guidance documents have great relevance to shipping operations in port areas, including comprehensive technical information on contingency planning for emergencies. IMO has been able to gather the views and advice of government and industry experts in the development of this guidance for use in port areas, recognizing that the community surrounding the port may well be affected by accidents within the port area and that emergency plans within and outside the port therefore need to be coordinated and the community informed and prepared.

APELL for Port Areas is now available in a consultation version in English, French and Spanish. The process it outlines will be tried out through several pilot projects. IMO and UNEP hope that all those tackling the problems of emergency preparedness planning in port areas will find the guidance helpful. (Source: *Ports and Harbors*, September 1996)

Global programme of action for the protection of the marine environment

Over half of the world's nearly six billion people live within 60 kilometres of the shoreline. This concentration of populations is largely the result of the tremendous productivity of coastal ecosystems, the health of which is vital to sustaining not only coastal communities but human society

as a whole. These natural systems are under unprecedented stress from land-based activities. In fact, municipal, industrial and agricultural wastes and run-off account for some 70 to 80 per cent of all marine pollution. Pollution of the marine environment from land-based sources poses a major global environmental challenge for the 21st century.

This pollution is a global problem, though the severity and type of pollution vary from country to country and region to region. In the developing world, the construction of basic sewage treatment facilities and the enforcement of rules on industrial and commercial effluent can often not keep pace with the tremendous economic and population growth being experienced in many coastal cities. Industrialized nations, too, still have major issues to resolve in controlling all the various forms of land-based activities that degrade marine systems.

It was not until the 1982 United Nations Convention on the Law of the Sea (UNCLOS) that nations tried to look at this issue from a global perspective. UNCLOS obligates Parties to protect and preserve the marine environment by cooperating regionally and globally, and to adopt laws and regulations to deal with land-based sources of marine pollution. The Oceans Chapter of Agenda 21 (approved at the United Nations Conference on Environment and Development) called on UNEP to sponsor an intergovernmental meeting on the subject in an effort to see that these obligations and those contained in regional conventions and other environmental initiatives are implemented. This was held in November 1995 in Washington, DC and resulted in the adoption of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities by 109 Governments.

This Global Programme of Action:

- Identifies practical steps to implement the legal obligations set forth in UNCLOS to prevent, reduce and control land-based marine pollution;
- Serves as a practical source of guidance for action at the national and regional levels;
- Initiates a long-term effort to identify and make available knowledge and experience about "what works" in dealing with land-based marine pollution;
- Encourages international financial institutions and other donors to accord priority to dealing with land-based marine pollution in projects relating to coastal areas;
- Emphasizes the need for commitment by recipients at the national level to apply the full range of management tools and financing options available domestically.

The Global Programme of Action provides a solid framework with which to reverse the trend of continuing marine degradation from land-based activities. Making it work, however, will require sustained attention at every level—globally, regionally, nationally and locally.

Globally, UNEP must ensure the rapid establishment of a clearing-house to provide needed information about "what works" in dealing with land-based marine pollution. We should make sure that such information exists in an accessible format for countries around the world. Several ideas about how to develop such a mechanism are currently circulating, and the UNEP Governing Council meeting affords an excellent opportunity to better define this important role.

Another critical step towards implementing the Global Programme of Action is the development of a legally-binding instrument to phase out and eliminate persistent organic pollutants (POPs). Such an agreement, which must be negotiated multilaterally, would address a major source of the land-based marine pollution problem. 1997 should see the formal beginning of negotiations toward this end.

Regionally, we must find new and better ways of developing cross-border cooperation in solving these problems. Severally institutions offer an avenue to pursue in this regard. The Asia Pacific Economic Council (APEC) is a good example. APEC, which includes all the Pacific nations, recently launched several new initiatives—on Clean Oceans and Seas, Sustainable Cities and Clean Production. All three of these initiatives provide useful, though different, mechanisms for implementing the Global Programme of Action on a regional basis.

Another example is the newly created Arctic Council, which includes all eight Arctic nations and is designed to address concerns and challenges unique to this region. One major issue is pollution from POPs, radioactive elements and other sources which migrate thousands of miles on ocean currents and ultimately end up in the Arctic food chain. Dealing with this threat will almost certainly be a top priority for the Council as it evolves.

Nationally, many countries have developed laws and regulations addressing the most serious aspects of land-based marine pollution, but much more attention needs to be paid to implementation. Again, what makes this so difficult is the diversity of land-based activities contributing to the problem. An effective regime must cover the industrial, agricultural and municipal sectors. There is also no getting around the fact that taking meaningful action can impose significant short-term economic costs. The challenge for Governments is to muster the political will to make hard decisions today in order to avoid a much costlier situation tomorrow. In the United States alone, coastal areas provide 28 million jobs—many of which will cease to exist if fisheries are contaminated, tourist destinations fouled or public health problems exacerbated.

The challenge for all nations in implementing the Global Programme of Action is to recognize that confronting the problem of land-based sources of marine pollution means being active from the court system to the multilateral convention, from the local library to the national legislature. Only through this kind of thorough approach can we hope to attain the goal of clean oceans and seas for this and future generations. (Source: *Our Planet*, Vol. 8, No. 5)

Inmarsat expansion

The Inmarsat Council has agreed to open regional offices to represent Latin America, South and East Asia and Africa.

The offices representing South and East Asia and Latin America will be established later this year, followed by Africa in early 1997. Inmarsat member countries in each of the regions have submitted proposals offering sites for the new bureaux.

Inmarsat opened its first regional office in Beijing, China in January 1994. Its success in contributing to the development of the Chinese market for satellite communications has pointed to the need for, and benefits of, expanding Inmarsat's presence regionally, particularly in rural and remote regions.

As a next step, Inmarsat will open offices in the Arab World and Central and Western Asia later in 1997. Final proposals for these ventures will be submitted to the Council next year.

The Council also agreed to make available excess capacity on its satellite system for leases ranging from six months to three years.

In another initiative, Inmarsat approved the inclusion of its Inmarsat-A system under the Inmarsat service provider (ISP) programme.

Inmarsat service providers will be permitted from 1 September 1996, providing customers with the possibility of a single point of contact for mobile equipment, billing,

customer care and after-sales support. Currently, customers contact Inmarsat terminal dealers, accounting authorities and call-routing organizations separately. The ISP approach, which originated at the Council's meeting in November 1995 and initially covered the Inmarsat-B, C and M systems, mirrors that used in the cellular and paging industries.

The ISP programme now applies to Inmarsat-A customers, providing their satellite phones are not used for distress and safety communications. (Source: *Ocean Voice*, October, 1996)

The WWC develops its strategy

Ways in which the World Water Council (WWC) will meet its objectives in promoting awareness of global water issues and facilitating conservation, protection, development, planning and management of world water resources, were debated by the interim Board of Governors during a two-day meeting in Granada in July. Some specific suggestions were also put forward concerning the Technical programme for 1996/1997. This meeting followed the official formation of the WWC in June.

In his opening address to the meeting, the Chairman outlined the background to the formation of the Council, observing that it was only in the past 20 years that comprehensive water resources management had been acknowledged as the key to global problems. Today there was a general consensus concerning the link between quality of life, water supply and sanitation, food security, energy and environmental issues. He drew attention to problems of pressures on natural resources which were exacerbated by a continuing major population increase, and noted that 1.5 billion people lived at a "barely life-sustaining" level of poverty. Added to this were problems of devastating floods and droughts in many parts of the world, and chronic water shortages, which would be more and more deeply felt with time, and would represent a serious impediment to economic development. It was likely that competition for the world's limited water resources could lead to instability and eventually even conflict between countries with shared waterways on their boundaries, unless a major effort was pursued now in improving the management of water resources.

He further noted that resolving global water issues required a broad range of skills and expertise. The aim of the WWC Interim Board, he said, was to design a technical programme to address these issues, and to reach agreement to implement appropriate actions.

The seven principal objectives of the WWC, as set out in the Draft Constitution (which will remain in draft form until the first General Assembly) are as follows:

(a) To identify critical water issues of local, regional and global importance on the basis of ongoing assessments of the state of water in all its dimensions.

(b) To promote suitable mechanisms to raise awareness about critical water issues at all levels of decision-making, including the general public in different parts of the world.

(c) To facilitate arrangements for providing advice and relevant information to institutions and decision makers concerning actions which are required to ensure the sustainability of global, regional and national water resources.

(d) To sponsor programmes and actions to promote policies and strategies for conservation of water as well as comprehensive and integrated water resources planning and management, and to contribute to the resolution of issues related to transboundary waters, including river and lake basins, aquifers and wetlands.

(e) To assist in ensuring availability and accessibility of water of suitable quality for the poor and disadvantaged population and ensuring social and gender equity in respect of water use.

(f) To promote the implementation of effective policies and strategies for integrated management of water demand, and encourage appropriate actions by concerned organizations.

(g) To provide a forum to arrive at a common strategic vision and platform to launch actions required for sustainable management of water resources worldwide. (Source: *Hydropower & Dams*, Issue Four, 1996)

OECD shipbuilding agreement

Application of the Agreement Respecting Normal Competitive Conditions in the Commercial Shipbuilding and Repair Industry is the only effective way to ensure fair competition, the OECD Council Working Party on Shipbuilding said at the close of a meeting at which the United States reported on its prospects for ratification of the Shipbuilding Agreement.

The Agreement cannot come into force until it has been ratified by all signatories: the European Union, Norway, Japan, the Republic of Korea and the United States. The United States is the last of the signatories that has yet to ratify it.

The meeting took stock of current production and forecasts for the shipbuilding industry:

- Production in world shipbuilding increased in the early 1990s with a world total of 24.2 million gt delivered in 1996, of which OECD countries accounted for 88 per cent;
- Shipbuilding activities in OECD countries and non-member economies will peak shortly after the year 2000 and then slow down;
- World shipbuilding capacity is estimated to increase by 16 to 24 per cent between 1994 and 2000 as a result of such factors as construction of new docks and facilities, productivity increases and conversion of military facilities;
- Downward pressure is expected to continue on ship prices and thus reduce profitability of shipbuilding activities. Due to depressed world market prices, a number of shipbuilding companies in the OECD area

faced severe financial difficulties in 1996 which, in some cases, jeopardized their very existence.

The Chairman of the Council Working Party pointed to the severe and long-lasting political and economic consequences should the Shipbuilding Agreement not come into force: it is unlikely that subsidies would be eliminated or reduced, despite budgetary constraints, but rather could increase and be perpetuated; and there would be a high risk of a price war, cut-throat competition and dumping which countries would have no effective means of preventing in the absence of the Injurious Pricing Code of the Shipbuilding Agreement.

The Working Party of the Council reiterated the crucial importance of the Agreement as a means to create a level playing field for the future of OECD Member countries' shipbuilding industries. (Source: *OECD News release*, 13 March 1997)

DSB coordinating European Union project

DSB Rederi is acting as coordinator for a European Union project that has been established with the long-term objective of implementing an open European, and ultimately worldwide, standard for integrated ship control systems that addresses automation hardware, software and human elements in maritime transport.

Known as DISC, an acronym for Demonstration of Integrated Ship Control Systems, this is the first R&D project under the Second Call of the EU's 4th Framework Programme, Waterborne Transport.

According to DSB Rederi, directed by DG VII, DISC is part of the European effort to enhance marine safety, efficiency and competitiveness, and is hence part of the implementing instruments of the EU's Common Transport Policy.

One of the more immediate aims of the project is to establish the skeleton for a future European/International ISC Standard that includes identification of the availability of suitable technologies and future operational, safety and efficiency improving functions to be adopted by the Standard.

Another is the establishment of the minimum requirements for demonstration of the feasibility and validation of the core technologies involved in the suggested standard, and their integration into one coherent system. (Source: *Fast Ferry International*, January-February 1997)

H. SOFTWARE

Inmarsat epirb trials successful

The German hydrographic agency, BSH, has completed a successful sea trial of the Inmarsat-E emergency positioning indicating radio beacon (epirb) system.

An Inmarsat-E epirb, manufactured by OHB System of Bremen, Germany, was launched from the survey vessel *Atair* and left to float unattended for 48 hours. During that period the epirb made 15 transmissions in accordance with the schedule defined in the Inmarsat-E system definition manual. The trial, conducted on Inmarsat's behalf, took place in the North Sea to the north-west of Heligoland in the overlap of the Atlantic-east, west and Indian Ocean regions. Consequently it was possible to receive the transmissions at all three Inmarsat-E equipped Land-Earth Stations (Raisting, Perth and Niles Canyon). Out of 60 reception opportunities, only one was missed, giving a success rate of better than 98 per cent. Inmarsat-E epirbs carry built-in GPS receivers that continually update their transmissions with new position information, allowing the drift of the epirb (and any survivors) to be plotted to an accuracy of better than 200 m. (Source: *Ocean Voice*, October 1996)

Bimcom PC for Windows

Bimcom PC for Windows, which is fully compatible with Microsoft Windows 3.1X and Windows 95, provides an easy way to interface to the Bimcom world-wide messaging system. Users of Bimcom PC for Windows can send faxes and receive e-mail (including X-400 messages and binary files) and telexes anywhere in the world.

Developing an easy-to-use system was a high priority for Bimcom PC for Windows. For example, managing incoming messages is simplified with Bimcom PC for Windows with its capacity to filter messages into user-definable folders. The system also provides an easy-to-use address book.

Another key feature of Bimcom PC for Windows is "message reconciliation" which allows users to see the status of all messages sent. This is especially important for broadcasts to a large number of recipients.

Connections to the Bimcom network can be scheduled on a regular basis, the connection process being run in the background allowing other Windows applications to be run concurrently. Local Bimcom access telephone numbers are contained in a pull-down list, making it easy to select the most convenient and nearest connection. (Source: *Ocean Voice*, October 1996)

MMS's Fleetlink system

Fleetlink now provides data communications via Inmarsat-A, B, C and M. MMS say it is an ideal choice for shipowners and operators who need flexible ship/shore communications options.

MMS was approached to develop a solution that interfaced MMS Fleetlink with Inmarsat-M. Fleetlink's new Inmarsat-M option allows the transmission of files directly from a computer to the satellite without the use of a modem. (Source: *Ocean Voice*, October 1996)

Solas Lifeline GMDSS

A recent installation aboard six ships operated by London Ship Managers proved the system's value with each installation being carried out at sea while the ships continued their normal operations.

London Ship Managers chose to install the pedestal version of Solas Lifeline using Inmarsat-C duplication for area A3 operation on six of their ships. But whilst the system has its own pedestal mounting to meet ISO 8468 bridge layout guidelines, it is also designed for mounting on the bulkhead or to be positioned on existing cabinets or desks. Support equipment, such as power supplies and battery chargers are housed in a separate cabinet which can be situated up to 30 m away from the console. An umbilical cable connects the two units.

MTI say the unit's size and unique design make it flexible enough to fit into virtually any bridge situation. Solas Lifeline is purpose-built and self contained, and supplied as the least number of separate elements. The more bits and pieces there are to deal with, say MTI, the greater the likelihood of something going wrong. The Solas Lifeline concept is to make installing and operating GMDSS easier and far more straightforward. (Source: *Ocean Voice*, October 1996)

Seasat 2 Inmarsat-C satellite

It provides private and secure communication links, with access to public data networks and bulletin services from virtually any point on the globe.

The Seasat 2 communicates through the Inmarsat-C satellite data network. It is easily mounted and requires a DOS-based PC and printer to complete the system. Seasat 2 provides access to electronic mail services and lets you send or receive any document in a PC file format.

The Seasat 2 is available with an optional built-in GPS receiver that can automatically relay your vessel's position, speed and course. The antenna which comes as standard supply can transmit up to 10 k/bits of data per message. However, an optional heavy-duty antenna can be purchased that will allow for transmission of up to 32 k/bits of data.

The Seasat 2 complies with all the latest GMDSS regulations, including a two-stage alarm distress button. It is approved for all four sea areas and is part of Sea's complete GMDSS system—the Sea 400 A3. (Source: *Ocean Voice*, October 1996)

Capsat-M Satellite Phones

The new enhancements of the M terminals permit the user to connect a secure telephone unit (STU-IIB) in both 2400 and 4800 bps modes. Using the Perth or Laurentides LESSs, the user will have access to the secure service on a world-wide basis.

The STU-IIB telephone is connected to the TT-3030 through the auxiliary telephone interface of the unit, where a change in the voice codec enables transmission of the specific STU-IIB signals. The change is implemented as a software upgrade of the equipment.

Along with the STU-IIB option, the user gets the possibility to send data at the enhanced rate of 4800 bits/sec using the STU-IIB telephone's RS 232 interface. The data rate is hereby doubled compared to the speed of the standard Inmarsat-M data channel.

In live tests performed via the Laurentides LES, the actual throughput of the 4800 bits/sec channel was measured to be 3800 bits/sec using the Zmodem protocol. (Source: *Ocean Voice*, October 1996)

New guide to Marine Computer Software includes CD-ROM

Fairplay Publications Ltd. (Coulson, Surrey, UK) has recently announced the release of the 1997 edition of the *Marine Computing Guide*. In its ninth edition, the annual contains a comprehensive international classified directory of computer software, systems, and services for the maritime industry. For the first time, the information in the guide is formatted on CD-ROM as well as in printed form. The CD-ROM comes with the printed directory at no additional charge. The CD-ROM contains demos of some of the products listed in the directory, allowing the user to examine the programs more closely.

The guide gives complete details for each software package, including application areas, hardware requirements,

operating systems, most recent version date, price, and narrative description plus information on the software developers/vendors. The 1997 edition also provides Web site addresses with the company listing. An article included in the guide, "Navigating the Internet", provides a brief summary of the Internet and a reference to maritime-industry web sites.

This 1997 edition lists 320 companies and more than 1,050 software packages. This includes 82 new company listings and more than 280 new products. (Source: *Sea Technology*, January 1997)

Global Sea Level Observing System (GLOSS)

A new version of the GLOSS Station Handbook is now available from BODC. It contains information on the GLOSS Network, details and maps of more than 300 sea level stations, the two volumes of IOC Manuals and Guides No. 14 on sea level measurement and interpretation, and data sets from the Permanent Service for Mean Sea Level. For further information please contact: Information Officer, Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside, L43 7RA, UK. Tel.: 0151-653 8633; Fax: 0151-653 6269, e-mail ljr@pol.ac.uk, Web site: <http://www.pol.ac.uk/>

I. CALENDAR

Thirteenth Fast Ferry International Conference
Singapore International Convention & Exhibition Centre
25-27 February 1997

Offshore Egypt '97
Middle East Conference & Exhibition
Cairo Nile Hilton
8-10 April 1997

China Fast Ferry & Commercial Craft Show
Shanghai
13-16 April 1997

The Asian International Seafood Show 97
and Conference
Hong Kong Convention and Exhibition Centre
6-9 May 1997
Worldwide agents
Overseas Exhibition Services Ltd.
11 Manchester Square
London W1M 5AB, UK
Tel.: +44 171 486 1951
E-mail: wood@montnet.com
Web: http://www.montnet.com

International Association of Ports and Harbors
(IAPH)
20th World Ports Conference
31 May - 6 June 1997
The Port of London Authority
IAPH Head Office:
Kono Building,
1-23-9, Nishi-Shimbashi, Minato-ku
Tokyo 105, Japan
Tel.: +81-3-3591-4261
Fax: +81-3-3580-0364
Telex: 2222516 IAPH J
E-mail: iaph@msn.com

Second Asia-Pacific Marine Biotechnology
Conference and
Third Asia-Pacific Conference
on algal Biotechnology
Arcadia Hotel and Resort
Phuket, Thailand
7-10 May 1997
Information:
APMBC '97 & APCaB '97
Biotec, NSTDA Building
73/1 Rama VI Road
Ratchathevee, PO Box 23
Sanam Pao, Bangkok, Thailand
Tel.: (662)6448102
Fax: (662)6448109

International Tasmanian Aquaculture Exchange Conference
Wrest Point Convention Centre
Hobart, Tasmania
25-28 July 1997
Information:
6th International Tasmanian Aquaculture Exchange
Mures Convention Management
Victoria Dock, Hobart, Tasmania 700
Tel.: (03) 62341424
Fax: (03)62344464

The Summit of the Sea— a series of conferences
St. John's, Newfoundland
1-19 September 1997
Information:
Summit of the Sea
John Cabot 500th Anniversary Celebrations
Box 1997, Station C
St. John's, Newfoundland A1C 5R4 Canada
Tel.: (709)5791997
Fax: (709)5792067

Stock Enhancement and Sea Ranching
First International Symposium
Bergen, Norway
8-11 September 1997
Information:
PUSH, Bontelabo 2
N-5003 Bergen, Norway
Fax: (47-55)317395

World Fishing Exhibition-Vigo '97
Spain
17-21 September 1997
Information:
Nexus Media Ltd.,
Top Floor, 84 Kew Road
Richmond, Surrey TW9 2PQ, UK
Fax: (44-181)3329335

IX Deep Offshore Technology (DOT)
Conference & Exhibition
3-5 November 1997
The Hague, Netherlands
Information:
In the Americas and Asia-Pacific:
Leonard LeBlanc (Attending, Papers)
Glen Bliss (Exhibiting)
3050 Post Oak Blvd., Suite 200
Houston, TX 77065 USA
Tel.: (01) 713 963-6219
Fax: (01) 713-963-6285
E-mail: leonardl@pennwell.com

J. PUBLICATIONS AND WEB RESOURCES

Publications

Atlas of the Ocean: Wind & Wave Climate

By Ian Young and Greg Holland
246 pages. Hardcover. Elsevier Science Inc.

This full-colour atlas includes global and regional estimates of wind and wave conditions based on information from the GEOSAT satellite mission. The approach of using remotely sensed data has many advantages: the data are high spatial density and accuracy and have a full global coverage, unlike measurements collected from ships and buoys. (Source: *Sea Technology*, July 1996)

Ship Production: Second Edition

By Richard L. Storch, Colin P. Hammon, Howard M. Bunch and Richard C. Moore
456 pages. Hardcover. Cornell Maritime Press

This book presents a unified system from which understanding of the total shipbuilding process can be obtained. It is suitable for teaching, both for undergraduate and graduate courses. It can also serve as a valuable resource for practising shipbuilding professionals.

Updated and revised to reflect current information and practice in the shipbuilding industry, this book is organized in three sections. The first introduces ship production and shipbuilding terms, economic and production management theories, and the general concept of group technology. The second examines the practice of shipbuilding. In conclusion, the work focuses on the status of the US shipbuilding industry and the application of group technology to ship conversion, overhaul and repair. (Source: *Sea Technology*, July 1996)

Port Privatization—process, players and progress

Cargo Systems has published *Port Privatization—process, players and progress*—a wide-ranging report which encapsulates the various models for private participation in the ports industry, the process and financing of privatization, and the protagonists. The report includes a special foreword by Rexford B. Sherman, Director of Research and Information Services of the American Association of Port Authorities.

As well as collaborating with the acknowledged academic experts in the field, the report contains contributions from leading organizations and supra-governmental agencies involved in the process, including the World Bank, the Overseas Coastal Development Institute and the Commonwealth Development Corporation (CDC), from associated financiers, accountants and lawyers, and from the major private sector players involved, such as P&O Port Management, International Container Services Inc. and Stevedoring Services of America.

The whole complex procedure of privatization, ranging from preparations for sale to carrying out meaningful and acceptable valuations, is explored, with clear guidance given concerning the funding options available, the relevant agencies and how to obtain finance, and the legal ramifications of the process. Available from: IIR Publications, 8th Floor, 29 Bressenden Place, London SW1E 5DR, UK. Fax: +44 171 931 0516. (Source: *Ports and Harbors*, November 1996)

Precautionary approach to fisheries

FAO Fisheries Technical paper No. 350, Part 1.
Published by the Food and Agriculture Organization of the United Nations, 1995

The document proposes a definition of the precautionary approach to fisheries as well as an elaboration on the burden of proof. It also contains detailed guidelines on how to conduct fishery management and research and how to develop and transfer fishery technology in a context of uncertainty and responsible fisheries.

Available from Publications Division, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy. (Source: *INFOFISH International*, April 1996)

Fisheries management in crisis

Edited by Kevin Crean and David Symes

The present crisis in fisheries management has resulted not only from the uncertainty surrounding biological stock assessment but also from a collapse in confidence in the centralized regulatory systems.

The established role of the biological sciences in formulating fisheries policies and strategies for challenged, and alternative systems are now firmly on the scientific and political agenda.

This new work assembles expert contributions from Europe's leading social scientists, sociologists, social anthropologists, political scientists and geographers who have been actively involved in fisheries management research. Together they provide contemporary and critical analysis of existing strategies whilst examining opportunities for alternative systems based on principles of subsidiarity, regionalization, and co-management.

Available from Fishing News Books, Osney Mead, Oxford OX2 0EL, UK. Fax: (44-0)1865 206026. E-mail: rosamund.snow@blacksci.co.uk. (Source: *INFOFISH International*, April 1996)

Review of maritime transport 1995

Published By the UNCTAD Secretariat (New York and Geneva: United Nations, 1996) 147 pages.

Introduction. Tables. Boxes. Graphs. Annexes.

Order from: Sales and Marketing Section, United Nations, Palais des Nations, avenue de la Paix, 1211 Geneva 10, Switzerland.

Fax: 41-22-917-0027.

Tel.: 41-22-917-2613

E-mail: unpubli@unog.ch.

This annual publication by the UNCTAD Secretariat reviews major developments in world transport and provides an abundance of statistical data on many facets of international shipping and port activity.

Chapter topics focus on seaborne trade; development of the world merchant fleet; ship productivity, supply and demand; shipbuilding and demolition; port development; multi-modal transport and technological developments.

The final chapters update the status of various maritime conventions and UNCTAD initiatives in the area of human resource development, and review in depth maritime transport developments in Sub-Saharan Africa. (Source: *Ports and Harbors*, March 1997)

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